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HIGH SCHOOL BIOLOGY TEACHERS AND BIOETHICS:
AWARENESS, ATTITUDES AND TEACHING PRACTICES

A MASTER'S THESIS

BY

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To my beloved ones: Ayşe, Rasim and Burak

HIGH SCHOOL BIOLOGY TEACHERS AND BIOETHICS: AWARENESS,
ATTITUDES, AND TEACHING PRACTICES

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High School Biology Teachers and Bioethics: Awareness, Attitudes and Teaching

Practices

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December 2020

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Curriculum and Instruction.

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ABSTRACT

HIGH SCHOOL BIOLOGY TEACHERS AND BIOETHICS: AWARENESS, ATTITUDES AND TEACHING PRACTICES

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M.A. in Curriculum and Instruction

Supervisor: Asst. Prof. Dr. Jennie Farber Lane

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Nowadays, with the advancement of technology, biotechnology and genetic engineering applications have gained momentum, especially in the field of medicine, very important developments have been made. However, the risks and ethical aspects of these practices cause conflict among scientists. These applications within the scope of bioethics are taught within the high school MoNE curriculum and the IBDP curriculum. Disagreements between scientists are likely to manifest themselves in biology classes. This study investigates the bioethics awareness of high school biology teachers, their attitudes towards bioethics and teaching these subjects, and their instructional strategies. Thus, the research aims to contribute to bioethics education. In this study, the mixed method in which qualitative and quantitative research approaches are applied together was used. The data of the study were analysed by descriptive statistics and content analysis methods. Analysis results determined that teachers have bioethical awareness, have a positive attitude towards bioethics, and make use of various teaching strategies that they think are effective for teaching.

Keywords: bioethics, biotechnology, genetic engineering, awareness, attitude, instructional strategy

ÖZET

LİSE BİYOLOJİ ÖĞRETMENLERİ VE BİYOETİK: FARKINDALIK, TUTUM VE ÖĞRETİM UYGULAMALARI

Özge Deniz

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Günümüzde teknolojinin ilerlemesi ile birlikte biyoteknoloji ve genetik mühendisliği uygulamaları hız kazanmış, özellikle tıp alanında çok önemli gelişmeler kaydedilmiştir. Ancak bu uygulamaların taşıdığı riskler ve etik boyutu bilim insanları arasında anlaşmazlığa sebep olmaktadır. Biyoetik kapsamında olan bu uygulamalar lise MoNE müfredatı ve IBDP müfredatı dahilinde öğretilmektedir. Bilim insanları arasındaki anlaşmazlıkların biyoloji sınıflarında da kendini göstermesi muhtemeldir. Bu çalışma lise biyoloji öğretmenlerinin biyoetik farkındalıklarını, biyoetik konularına ve bu konuları öğretmeye karşı tutumlarını ve bu konuları öğretim stratejilerini araştırmaktadır. Böylelikle araştırma biyoetik öğretime katkıda bulunmayı hedeflemektedir. Bu çalışmada nitel ve nicel araştırma yaklaşımlarının birlikte uygulandığı karma yöntem kullanılmıştır. Çalışmanın verileri betimsel istatistik ve içerik analizi yöntemleri ile analiz edilmiştir. Analiz sonuçları, öğretmenlerin biyoetik farkındalığına sahip olduklarını, biyoetiğe karşı tutumlarının pozitif yönde olduğunu ve öğretimi gerçekleştirmek için etkili olduğunu düşündükleri çeşitli öğretim stratejilerinden yararlandıklarını saptamıştır.

Anahtar kelimeler: biyoetik, biyoteknoloji, genetik mühendisliği, farkındalık, tutum, öğretim stratejisi

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CHAPTER 1: INTRODUCTION

Introduction

In modern times, there have been many new studies, discoveries and inventions in the field of biology and medicine. Some of these innovations are beneficial, while some are more controversial. For instance, using gene therapy to map our genes to prevent birth defects, compared to the concern about creating a super race through genetic engineering. Therefore, ethics – a set of moral issues or aspects (such as rightness; “Ethics,” n. d.) – has become integral to biology. For biology, bioethics means the study of what is right and wrong in new discoveries and techniques in biology, such as genetic engineering and the transplantation of organs (Bioethics, n. d.). For biology education, this means teachers need to help their students understand ethical issues surrounding biotechnology. This study aims to explore teachers’ awareness, attitudes and teaching practices associated bioethics.

Background

The research, discoveries and inventions associated with innovations in technology have resulted in ethical arguments in the field of biology. Scientists have been discussing the moral values related these bioethical issues for many years. However, the conflicts remain unresolved. Some scientists support the idea that the applications of genetic engineering, gene therapy and biotechnology are beneficial for human. In contrast, others think they are too risky. This conflict in the field of science affects education.

In Turkey, there is a national curriculum and some schools also implement the International Baccalaureate Diploma Programme (IBDP), an international education program. Bioethical issues are covered in both MoNE curriculum and in IBDP biology syllabus guide. By reviewing the curriculum for these programs, it is possible to learn what bioethical issues each of these programs indicated should be taught to high school students in biology. The general concepts of bioethics are taught in both curriculums. Furthermore, there are specific parts directly regarding bioethics. In MoNE biology curriculum, genetic code and protein synthesis unit is a particular unit including bioethical issues and its applications (MoNE, 2018). Similarly, there is a particular subtopic called genetic modification and biotechnology, also there is a specific topic called bioethics and bioinformatics in IBDP biology syllabus guide. (IB Biology Guide, 2016). The researcher of the current study has examined both curriculum and found that, based on the number of objectives listed in each, that the IBDP curriculum has more content related to bioethical issues and its applications.

More information is needed about what biology teachers actually do in the classroom for bioethics education. Similar to scientists, some teachers are eager to share bioethical issues with students while others avoid the topic. This may be due to the fact that bioethics are controversial issues as well as teachers' level of knowledge, culture and community pressure, teachers' personal and religious beliefs, and the limitations of the curriculum. El Arbid and Tairab (2020) note that socio-scientific issues such as genetically modified organisms and human cloning may cause science educators to be concerned about these issues. If biology teachers do not have sufficient content knowledge with regard to bioethical issues, they can feel insecure

to cover bioethics in their lessons. In their study, Borgerding, Sadler and Koroly (2013) indicate that some teachers have feelings of insufficiency and anxiety to integrate biotechnology content into their classes. Moreover, they report that teacher's culture may affect their willingness to teach controversial issues.

It may be possible that Turkish culture affects the quality and quantity of bioethics education. Perhaps this is one reason why the national curriculum has fewer objectives related to the topic. There is little research in Turkey about bioethics education in high schools. In contrast, the research has broadly given a place in some other countries. For instance, the research by Asada, Tsuzuki, Akiyama, Macer, Macer (1996) in the New Zealand, Australia and Japan focuses on high school teaching of bioethics. The results indicate that most teachers are aware of and support to teach bioethics as well as teach the bioethical issues in their classes. In another study, Kidman (2009) found that teachers are less inclined to teach bioethics even though students want to explore bioethical issues. These studies are examples of how other countries have explored teachers' attitudes and practices regarding bioethics education.

Problem

Both the national curriculum and IBDP include bioethics in their program guides. Given the concerns about the controversy surrounding bioethical issues, there is a chance some teachers may not discuss these topics in their classroom. Others may not include bioethics simply because they are unaware of the issues. Some teachers may discuss the topics but lack the resources to provide a through overview. Perhaps,

a broad of instructional strategies are not used in lessons. The lessons are limited with few instructional strategies.

Different attributes of teachers may affect if and how teach bioethics, including culture, beliefs and training. To ensure that bioethics is included in biology classes and is taught effectively, it is important to learn how teachers currently think and teach about bioethics.

Purpose

The purpose of this study is to gain insights into high school biology teachers' awareness of and attitudes toward bioethical issues. In addition to these, the research aims to explore instructional strategies used by biology teachers for teaching bioethical issues. Furthermore, teachers' recommendations to support bioethics education are investigated. The outcomes of this study could help identify effective ways for teachers to confidently and effectively incorporate bioethics in their lessons. For this purpose, the researcher used mixed method research design to gain insights into perceptions and practices of biology teachers who graduated from a nonprofit teacher education program in Turkey. A quantitative questionnaire was administered to alumni of this program. Next, interviews were conducted with selected participants to follow up on the results of the questionnaire.

Research questions

1. To what extent do biology teachers report they are aware of bioethics?
2. What are biology teachers' attitudes towards bioethical issues?
3. What are biology teachers' attitudes toward teaching bioethical issues?

4. According to biology teachers,
 - a. What might influence teachers to avoid teaching about bioethics?
 - b. What might encourage teachers to include bioethics in their practice?
5. What instructional strategies do high school biology teachers use for teaching about bioethical issues?
6. What recommendations do high school biology teachers have to support bioethics education?

Significance

The study will help teachers reflect about their awareness of, attitudes toward and instructional strategies they use when teaching bioethics. It will shed light on the quantity and quality of bioethics teaching in Turkey. The results can help identify ways to improve the content and integrity of exploring ethical issues in science, such as attending seminars and conferences related to bioethical issues and bioethics education. As teachers improve their confidence, skills, and experience in incorporating bioethics in their classes, their students will become more knowledgeable about the role of science in their everyday lives. Following are several reasons why it is important for students to receive education related to bioethics:

- Encourage students to become conscious and sensitive citizens who examine the source of developments particularly in the field of medicine, together with its ethical dimension,
- Improve students' critical reasoning skills,

- Encourage to become individuals who are empathetic and respectful of diverse views,
- Improve science understanding as it motivates students to think deeply.

Definition of key terms

Attitudes: An *attitude* is a comprehensive and usually longlasting opinion of something. Attitudes are judgemental as they portray how positive or negative an individual feels toward something (Lavrakas, 2008).

Bioethics: The study of what is right and wrong in new discoveries and techniques in biology, such as genetic engineering and the transplantation of organs (Bioethics, n.d.).

Dispositions: Teachers' internal filters that affect the way they tend to think about and act on the information and situations related to their teaching practice (Stooksberry, Schussler & Bercaw, 2009).

CHAPTER 2: REVIEW OF RELATED LITERATURE

Introduction

In Turkey, bioethics is included in both the national biology curriculum and international curriculum such as the International Baccalaureate. The current study explores high school biology teachers' awareness of, attitudes toward and instructional strategies for bioethical issues particularly biotechnology, human gene therapy, human genome project and genetic engineering. This chapter consists of a review of the related literature, including studies about teachers' awareness of bioethical issues, attitudes toward bioethical issues and bioethics education. As scientific argumentation is important to bioethics, information about this teaching practice related to this skill is discussed. Lastly, the conceptual framework guiding the present research is provided.

Awareness of and attitudes toward bioethical issues, and bioethics education

In this section of the literature, the relevant studies regarding teachers' awareness of and attitudes toward bioethical issues and bioethics education are presented. The findings of these studies provide insights into how other researchers have investigated teaching dispositions toward bioethics education.

Asada, Tsuzuki, Akiyama, Macer, and Macer (1996) conducted a study in New Zealand, Australia and Japan related to high school teaching of bioethics. In their study, the researchers focused on knowledge and teaching of 15 bioethical issues such as in vitro fertilization, biotechnology, genetic engineering, nuclear power and prenatal diagnosis. For conducting their study, the researchers benefited from an

online survey that collected data in these three countries. The survey was applied to national random samples of high schools in those countries and the samples consisted of biology and social study teachers. The response rate for all three countries is as follows: in New Zealand 206 biology teachers completed the survey with 55 %, 96 social science teachers with 26%; in Australia 251 biology teachers with 48 %, 114 social science teachers with 22 %; and in Japan 560 biology teachers with 40 % and 383 social science teachers with 27%. The participation results show that more biology teachers responded to the survey when the results are compared with social science teachers. According to Akiyama et al. (1996), biology teachers were more aware of bioethics than social science teachers, even though the topic is relevant to the curriculum of both disciplines.

Booth and Garrett (2004) also used a survey to learn whether ethical issues were taught and if taught, how and how much time was devoted to the topic. The instrument also assessed instructors' opinions and attitudes toward teaching ethics. Participants were instructors from selected American liberal art colleges and universities. About 500 questionnaires were sent to instructors in the schools via mail and 151 responses were received with 30 % response rate. Data results indicated that most instructors supported ethics education in genetic classroom and 93 percent of them gave a place to teach ethical issues in genetic classroom. However, time devoted for ethical issues by most instructors was less than five percent. Several reasons such as lack of time, lack of sources, comfort level and other reasons were given with the purpose of explaining this situation by the researchers. Furthermore, the data results indicated that various methods were used to teach ethics in genetic

classroom. The methods covered informal discussion, casual vocalization, formal lecture, assigned papers, case studies, additional readings, role playing and others.

In contrast to the previous studies mentioned above, the study by Kidman (2009) showed that teachers' attitudes toward discussing bioethics in science lessons were negative, whereas students were willing to explore the issues. She used a mixture of quantitative and qualitative research approaches and benefited from a series of questionnaires that their participants were consisted of 508 15- 16 year old students of senior biological science and their 35 teachers from eight secondary schools scattered throughout Queensland, Australia.

Finally, in a different study, Dawson and Taylor (1999) argued whether teaching bioethics in science makes a difference in terms of students' ability to solve bioethical dilemmas. The researchers described a research study that focused on a Year 10 biotechnology course taught by Camel at an independent girls school in Perth, Western Australia. The authors said that "The course was designed to explicitly introduce students to bioethics education. The learning activities that students participated in provided them with opportunities to develop, reflect on, and justify their bioethical values" (p. 3). These learning activities included whole class and small group discussion of case studies, role plays, design and administration of a questionnaire to determine the views of friends and relatives toward transplantation, and preparation of a library portfolio about a topic that raises bioethical issues. A questionnaire with four bioethical dilemmas was developed and given to 23 students who had studied in biotechnology and to 38 students who had not. The study found

that both groups expressed ability to resolve bioethical dilemmas, but the students who studied biotechnology were more able to identify and evaluate bioethical issues.

While limited, there have been some educators in Turkey who have researched bioethics education. Keskin-Samancı, Özer-Keskin and Arslan (2014) developed a bioethical values inventory to explore ninth grade students' ethical values. The authors found that the use of scenarios helps students explore related scientific facts, discern the ethical dilemmas in the scenarios and the conflicting views.

The relevant studies the researcher mentioned above are compatible with each other in terms of topics they focused on. However, the results they illustrated are not same. In their studies, Akiyama et.al (1996) and Booth and Garrett (2004) explain that most biology teachers' attitudes to bioethics are positive and they try to give a place to teach bioethical issues in biology classes via different instructional methods. However, barriers such as time, resources availability and comfort level affect willingness to incorporate bioethics education in their practice (Kidman, 2009). Clearly, given these mixed results, further exploration of bioethics education in schools is needed.

Teachers' views on socio-scientific issues and argumentation

This section of the literature review provides research related to assessment of teacher's views about socio-scientific issues and about the inclusion of the issues in the curriculum. A key strategy teachers use to explore controversial issues, argumentation, is also explored in the literature.

Wan and Bi (2020) stated that science and technology have a crucial role in our society. The advocate that education encourage students to think about and to take sensible decisions on major social topics regarding science. Socio-scientific topics such as environmental issues, safety and health, resources and energy, ecological system, and biotechnology will affect the lives of students. Therefore, these topics need to be covered in science curriculum.

Macalalag, Joseph and Lai (2020) suggest that analyzing socio-scientific issues play a key role in developing students' scientific literacy. However, students' knowledge of socio- scientific issues is restricted. Furthermore, the teachers are not confident and supportive to teach these issues (Kinskey & Zeidler, 2020).

Some studies, such as the one by El Arbid and Tairab (2020), find that science teachers have positive attitudes toward inclusion of socio- scientific issues in the science curriculum. Teachers in their study report that discussing these issues helps students develop evaluation skills regarding socio-scientific issues such as biotechnology and its applications. The researchers emphasized that teacher background and experience affect their ability to and interest in teaching about controversial issues. Teachers' need guidance in developing students' argumentation skills and decision-making skills.

Rundgren, Erikson and Rundgren (2016) developed a six-step socio-scientific issues instructional module and implemented it with upper secondary school students. The purpose of the module was to enhance students' evaluation skills related to socio-scientific argumentation. The first step of the module included socio-scientific issues

to be discussed, the scientific context of the issue and required instructions. In the second step, as groups, students searched additional information, began to discuss various perspectives of the issue and formulated their arguments accordingly. In the third step, students categorized their arguments into particular groups. In fourth step, students have group discussion related to the issue. In fifth step, students decided upon the issue individually after group discussion. Lastly, in the sixth step, feedback on students' argumentation was given and the exercise was summarized by the teacher. The findings of the research indicated that all student participants developed evaluation skills. They were able to consider both sides of an issue to develop their arguments to support their claims.

Conceptual framework

The present study is designed to gain insights into high school biology teachers' awareness of and attitudes toward bioethical issues. Furthermore, the research aims to explore instructional strategies used by biology teachers for biotechnology teaching. To guide this study, a conceptual framework was used based on the research by Stooksberry, Schussler and Bercaw (2009). Their paper explores intellectual, cultural and moral aspects of teaching dispositions and they developed a model that could be used as a tool for teacher educators and teacher candidates to investigate ways of thinking that implicitly and explicitly influence the inclinations and action of teaching. Further information about this model is provided below.

The researchers explain that dispositions are teachers' internal filters that affect the way they tend to think about and act on the information and situations related to their teaching practice. Based on their literature review, they conclude that filters are

developed by teachers' prior experiences, beliefs, culture, values and cognitive abilities. They emphasize that it is important for teachers to be aware of their own dispositions. For the purpose of addressing teacher candidates' awareness of and development of dispositions, the researchers provided a heuristic model that is composed of three domains: Intellectual, cultural and moral.

Stooksberry et al. (2009) stated that *intellectual dispositions* are comprised of both knowledge and skills and may affect teachers' decisions related to content and pedagogy. The decisions involve learning expectations, what is taught and how is taught. Prospective teachers' prior learning experiences as a student influence how they perceive information and experiences with regard to content and pedagogy. Stooksberry et al. (2009) discuss how *cultural dispositions* represent the teachers' perceptions of self, of others and of the community. Cultural dispositions stem from teachers' own cultural identity but are also influenced by the teaching community and school setting.

While the previous two dispositional domains provide conceptual guidance for the study, it is the third domain, *moral dispositions*, that has the most relevance. The moral domain involves the capacity of a person to care for others; to understand them and address their needs. Furthermore, decisions made by teachers are the reflection of their values in action. Teachers make decisions throughout their practice when planning lessons and reacting to students' needs. Stooksberry et al. (2009) point out that, ironically, this domain is often overlooked in teacher preparation programs, maybe it is challenging to address conflicts and controversies over varying beliefs

and attitudes. However, teaching is overtly a moral activity according to the researchers.

Dispositions in general, and moral dispositions in particular, are important to include in teacher education programs. However, because they reflect the personal ways of thinking of an individual, they are difficult to observe and recognize. To help understand teachers' dispositions, Altan, Dottin, and Lane (2019) reviewed the work of Dewey (1933) and Costa and Kallick (2000) and recommended that teacher educators can look for "intelligent behaviors" that reflect habits of mind. Habits of mind are how individuals confront and react to problems and challenges in their lives. The conceptual framework of Altan et al.(2019) can complement the work of Stooksberry et al. (2009) to provide insights to understanding dispositions. Altan et al. (2019) organized intelligent behaviors according to selected learning theories to help educators recognize and understand teaching dispositions. The current study used this framework to gain better insights into intellectual, cultural, and moral dispositions of the teachers' insights and comments regarding teaching about biotechnology and associated bioethics.

CHAPTER 3 : METHOD

Introduction

The purpose of this study is to gain insights into high school biology teachers' awareness of, attitudes toward and instructional strategies used for bioethical issues. Furthermore, the current study aims to gain insights about teachers' recommendations for bioethics education. This chapter gives information about what research design and research method are used to address the research questions for the study. Also, this chapter provides information about the context, participants, instrumentation and, how data is collected and analyzed.

Research design

This study incorporated a mixed method of quantitative and qualitative approaches with an embedded design. Johnson, Onwuegbuzie, and Turner (2007) suggested that mixed methods research pieces elements of qualitative and quantitative research approaches together for the purpose of enhancing breadth and depth of understanding and corroboration. The aim of the embedded design is to gather quantitative and qualitative data simultaneously or sequentially, the two sources of data support each other (Creswell, 2012).

In the current study, the quantitative data was collected first, and then was supported with qualitative data. The former was collected via a questionnaire and the later through semi-structured interviews. The reason for using the mixed method is that the questionnaire was to give a broad picture of perceptions and practices, while the

interview helped gain deeper insights into reasons including barriers, needs and facilitators.

Context

The general context of this study is high school biology classes in Turkey. The schools implement either IBDP curriculum or MoNE curriculum or both. A few of the schools also implement IGCSE curriculum. Therefore, another context for this study is the high school biology curriculum and its inclusion of topics related to bioethics. In the MoNE biology curriculum, topics such as technology related to genetic code and protein synthesis are covered at the twelfth grade level (MoNE, 2018). The IB biology DP guide includes topics such as genetic modification and biotechnology, it also has specific topic called bioethics and bioinformatics (IB Biology Guide, 2016).

Participants

The participants were alumni biology teachers who have earned an MA in Curriculum and Instruction with Teaching Certificate and are working in different schools in Turkey. This population was purposefully selected because as they were all alumni of the same pre-service teacher education program and were included in an email list retained by the program. In purposeful sampling, participants and sites are intentionally selected by researchers on the purpose of learning or understanding the central phenomenon (Creswell, 2012). In this case, a phenomenon was how bioethics education is being taught in Turkish high schools.

Participants were also individuals who were voluntarily responded to the questionnaire and agreed to be interviewed, therefore, the second sampling strategy used for the research was convenience sampling. Participants in convenience sampling are selected by the researcher since they are volunteer and available to be studied. In that case, the researcher that does not have confidence to say that the individuals represent population. Nevertheless, useful information can be gained by the sample for answering questions and hypotheses (Creswell, 2012).

There were 22 teachers who responded to the questionnaire, however one did not give consent to participate so that individual's data was excluded. Most of the participants were female (n=18). More than 72% participants were above the age of 29. About half of the respondents have one to five years of teaching experience, the rest over five years.

The interviews were conducted with five biology teachers who work in different private high schools in Ankara. Their teaching experience ranged from four years to ten years. Three teacher participants were implementing the MoNE curriculum, IBDP curriculum and the IGCSE curriculum, one teacher participant was teaching IGCSE and IBDP curricula and one was teaching IBDP and MoNE curricula.

The Bilkent University Ethics Committee granted permission to conduct this study. The participants were asked to indicate that they had read about the study and agreed to give consent. They were assured their responses would be kept confidential. Before recording their interviews, they were asked for permission.

Instrumentation

In this study, two instruments were used for data collection. Both tools were used to explore high school biology teachers' awareness of, attitudes toward and instructional strategies used for selected bioethical issues. An overview of the items in the instruments and their relevance to the study's research questions is provided in Table 1.

Table 1
Research questions and data sources for the study

Research question	Instrument 1 (See Appendix A)	Instrument 2 Questions(See Appendix B)
Q-1 Awareness	Part 2: Q-1, Q-2 and Q-3	-
Q-2 Attitudes toward bioethical issues	Part 3a- Likert Scale	-
Q-3 Attitudes toward teaching bioethical issues	Part 3b- Likert Scale	-
Q-4 Avoiding and encouraging bioethics teaching	-	Q-1 and Q2
Q-5 Instructional strategies	Part 4: Q-1, Q-2, Q-3, Q-4, Q-5, Q-6 and Q-7	Q-3
Q-6 Recommendations	Part 4: Q-5.1	Q-4

The first instrument was a questionnaire (Appendix A). The items mainly came from existing validated and reliable instruments. The questionnaire had 20 questions, 11 of which came from existing instruments used with permission (Asada et al.,1996; Bal, Samancı & Bozkurt, 2007; Booth & Garrett, 2004), The remaining nine (along with two sub-questions) were developed by the researcher. The first part of the questionnaire involved five demographic questions. Participants were asked for the year they received their teaching certificate, the highest degree they earned, duration

of teaching experiences, gender, age, whether they are currently teaching high school biology and biology or science courses they were currently teaching. The second part of questionnaire was composed of three questions revealing teacher participants' awareness of bioethical issues. The third part of the questionnaire involved two questions investigating teachers' attitudes toward bioethical issues and teaching these issues. The last part of the questionnaire was composed of eight questions exploring bioethics education and instructional strategies used for teaching bioethical issues. The items of questionnaire developed by the researcher were validated by cross-checking their meaning with a colleague who is one of the teacher participants of this study. Each item in the questionnaire was discussed in terms of its accuracy and intelligibility to prevent misunderstanding and biases. Reliability of different sections of the instrument were calculated by Cronbach's alpha and are provided in the next chapter. In addition, individual responses of participants were checked in terms of their stability and consistency with a teacher participant after questionnaire was conducted.

The second instrument was an interview (Appendix B). The interview was a type of semi-structured interview. In the instrument, there were four open-ended questions developed by the researcher to gain deeper insights into high school biology teachers' attitudes toward and instructional strategies used for bioethical issues as well as teacher recommendations for effective bioethics education. The first question of interview investigated why some biology teachers avoid teaching bioethical issues. The second question of the interview explored the ways to encourage teachers for bioethics education. The third question of the interview investigated instructional strategies used by biology teachers during bioethics education. The fourth question

of the interview explored recommendations of teacher participants to teach bioethical issues. These items were validated by cross-checking their meaning with a colleague who is one of the teacher participants of this study. Each item in the interview was discussed in terms of its accuracy and intelligibility to prevent misunderstanding and biases. Reliability of the instrument was tested by a teacher educator. After data transcriptions were analyzed and themes were formulated by the researcher, a teacher educator reviewed the transcriptions and checked the compatibility of the themes with the transcriptions.

Method of data collection

In the summer of 2018, the instrument was sent electronically to alumni of the teacher education program via the program's Facebook page. As sufficient data could not be collected, in fall 2018 the questionnaire was emailed to 71 teachers in the program's database.

All five of the biology teachers who participated in the interviews lived and worked in private schools in Ankara. A meeting was set up during a time and place convenient for the interviewee. The one-on-one interviews were conducted in the schools which teachers work in March 2019, in May 2019 and July 2019. The interviews lasted around 40 minutes each and as noted, were recorded with permission.

Method of data analysis

The questionnaire data was analyzed with the help of descriptive statistical approaches. The main purpose was to look for frequencies and means. Given the

research questions and the low number of participants, inferential statistics were neither needed nor feasible. The outcome of the data analysis was used to design the interview questions. Items that provided unexpected or mixed responses were explored during the interviews.

During the analysis of interviews, semi-structured face-face interviews were recorded. Then, the audiotape recordings were listened several times, key responses were transcribed and translated from Turkish to English. Repeated listening and transcribing key responses instead of the whole interview is a strategy that the researcher saves time and energy (Flick, 2002; Strauss, 1987). The key responses were reviewed repeatedly to become familiar with the data and to identify themes and to understand the broader meaning of the interviews. In this way, “familiarization” approach was used in the qualitative data analysis (Ritchie, Spencer & O’Conner 2003, p. 221). Themes which shed light on interviewee’ responses were formulated by guidance of the conceptual framework that was used based on the research by Stooksberry, Schussler and Bercaw (2009). The researchers’ heuristic model presented intellectual, cultural and moral dispositions that are teachers’ internal filters affecting the way they tend to think about and act on the information and situations related to their teaching practice. The internal filters themselves and related thinking ways and actions that are revealed by the particular dispositions shaped the relevant themes of the current study.

CHAPTER 4: RESULTS

Introduction

The purpose of this study is to gain insights into high school biology teachers' awareness of, attitudes toward and instructional strategies used for bioethical issues. The following research questions were developed to guide the investigation into this study:

Research questions

1. To what extent do biology teachers report they are aware of bioethics?
2. What are biology teachers' attitudes towards bioethical issues?
3. What are biology teachers' attitudes toward teaching bioethical issues?
4. According to biology teachers,
 - a. What might influence teachers to avoid teaching about bioethics?
 - b. What might encourage teachers to include bioethics in their practice?
5. What instructional strategies do high school biology teachers use for teaching about bioethical issues?
6. What recommendations do high school biology teachers have to support bioethics education?

The study had two sources of data: A questionnaire and an interview. This chapter presents the results of the quantitative and qualitative data analysis. A desired outcome of this study is to contribute to the improvement of bioethics teaching in Turkey.

Demographic information

As discussed in the methods chapter, the participants were alumni of a biology teacher education program of a graduate school in Ankara, Turkey. The data with regard to demographic information presented the following results:

- Participants received their teaching certificates in different years ranging from 2004 to 2018.
- More than 80% of teacher participants had master's degree.
- More than half of the teachers had one to five years' experience, the other half over five years teaching experience
- More than 90% of participants were female.
- They were teaching a variety of biology and science courses such as IGCSE biology, IBDP biology (standard and high levels), Environmental systems and societies, MoNE biology and A level biology.

During the interviews, participants were asked several questions about their background and teaching experience. They provided the following information:

- Four teacher participants had master's degree; one of them had doctorate degree.
- The duration of the teaching experience ranged from five years to ten years.
- They were implementing IGCSE, IB and MoNE curriculums.

Awareness of bioethical issues

In one section of the questionnaire, the participants were asked several questions to learn their opinions about bioethical issues. Some of the questions were open-ended questions and others were Likert scale questions. Regarding the open-ended questions, the main item in this section asked teachers to describe what they think

bioethics is. All of the participants ($N=21$) responded to this question, and following are a few of their definitions:

- Ethical concerns related with life sciences. It can be simply ethical issues related with an experiment in biology teaching or practices in biotechnology, genetic engineering
- I think it should study the moral issues raised in the use of new technological and scientific developments such as GMO, cloning etc.
- Consistency between the facts of the nature and implications in line with the values of humans
- Consider the rights of every living thing when doing science.

For one of the Likert scale questions, participants were asked to rate their awareness of bioethical issues. Of the respondents, 80.95% ($n=17$) said they were aware or very aware. Furthermore, four participants ($n=4$) that is 19.05% of the respondents stated they had little awareness.

In the last question, participants were asked how much they have heard of some subjects related to bioethics. Table 2 lists the subjects about which they were asked. The Cronbach's alpha value of the items listed in the table 2 was 0.91 ($\alpha=.91$). That means scores from the Likert scale items were stable and consistent. In general, it appears they are knowledgeable about all the subjects listed, with slightly less knowing about human gene therapy.

Table 2
Descriptive statistics for hearing some subjects related to bioethics

Subject (Likert response)	Frequency			M
	NH (1)	HNK (2)	HAK (3)	
Biotechnology	0	3	18	2.86
Human gene therapy	0	7	14	2.67

Table 2 (cont'd)

Descriptive statistics for hearing some subjects related to bioethics

Subject (Likert response)	Frequency			M
	NH (1)	HNK (2)	HAK (3)	
Human genome project	0	4	17	2.81
Genetic engineering	0	3	18	2.86

Note. NH=Never heard of it; HNK=Heard of it, but I do not have very much knowledge; HAK=Heard of it and I am very knowledgeable

As Table 2 shows, most teacher participants were knowledgeable about biotechnology, human gene therapy, human genome project and genetic engineering. Interestingly, agreement with human gene therapy tended to decline. Like being in other new biomedical technologies, gene therapy has not been yet improved for extensive usage. Therefore, it is hard to have clear ideas about gene therapy (Wellcome Trust, 2005).

Attitudes toward bioethics

The data providing information about biology teachers' attitudes toward bioethical issues was collected from two Likert scale questions in the questionnaire. The Likert scales were five- point Likert scales: Strongly disagree (1), disagree (2), do not know (3), agree (4) and strongly agree (5). In the interviews, teachers were asked follow-up questions to gain deeper insights about these responses regarding attitudes and instructional strategies. Below, teachers' responses to the questionnaire are shared followed by a section discussing the interview results.

Attitudes toward bioethical issues

Findings from the quantitative data

In one question, participants were asked to specify to what extent they agree with certain statements about bioethics. Table 3 provides the frequency and mean

responses to each of these statements. The Cronbach's alpha value of the items listed in the Table 3 was .98. That means scores from the Likert scale items were stable and consistent.

Table 3
Descriptive statistics for attitudes toward bioethical issues

Item	Frequency					M
	SD	D	DK	A	SA	
a. Genetic engineering makes life easier for humans	2	0	0	15	4	3.90
b. Biotechnology makes life easier for humans	2	0	0	12	7	4.05
c. Genetic engineering can provide opportunities for new discoveries	2	0	0	8	11	4.24
d. Biotechnology can provide opportunities for new discoveries	2	0	0	7	12	4.29
e. Transgenic organisms contain risks for nature.	2	0	2	14	3	3.76
f. Releasing genetically modified organisms in the environment contains risks	2	0	3	10	6	3.86
g. Genetic engineering studies with animals and plants are beneficial to people	2	2	2	14	1	3.48
h. Human gene therapy studies are beneficial to people	2	0	1	14	4	3.86

When the results of Table 3 are examined as a whole, it seems that although participants acknowledge that bioethical issues are risky, they have a positive attitude towards biotechnology and genetics. It is interesting to note that more teachers agreed than strongly agreed with most of the statements, which could indicate they

have some hesitancy in providing full support. Nonetheless, their responses indicate that, they believe the popular bioethics applications such as genetic engineering and biotechnology makes human life easier. Furthermore, the participants evaluated these applications as opportunities for new discoveries. However, they did acknowledge there were some risks. Of the 20 participants who answered this question, 17 agreed that transgenic organisms contain risks for nature. Similarly, 16 teachers agreed that releasing genetically modified organisms in the environment contains risks.

Attitudes toward teaching bioethical issues

Findings from the quantitative data

In the following question, participants were asked to remark to what extent they agree with some statements attributed to teach bioethics. Table 4 provides the frequency and mean responses to each of these statements. The Cronbach's alpha value of the items listed in Table 4 was .93. That means scores from the Likert scale items were stable and consistent.

Table 4
Descriptive statistics for attitudes toward teaching bioethical issues

Item	Frequency					M
	SD	D	DK	A	SA	
a. I do not have any concerns about teaching bioethical issues.	2	0	1	7	11	4.19
b. I feel confident teaching about bioethical issues	2	1	1	12	6	4
c. I feel comfortable when I talk about bioethical issues	2	0	2	11	6	3.90
d. Bioethics is sensitive issue to teach about	3	9	1	6	2	2.76

Table 4 (cont'd)
Descriptive statistics for attitudes toward teaching bioethical issues

Item	Frequency					M
	SD	D	DK	A	SA	
e. Bioethics is sensitive but it can be taught via correct teaching strategies	2	0	1	9	9	4.10
f. I personally believe that genetic engineering and its applications should be covered in the biology syllabus	2	0	1	5	15	4.25
g. I personally believe that the biology syllabus should include discussion of the issues involved in science and technology	2	0	0	5	14	4.38

As Table 4 suggests, most biology teachers agreed with all statements, except they disagree that bioethics is too sensitive to teach about (item d). This agreement indicates that biology teachers do not have any concern to teach bioethics and feel comfortable when they teach about these issues. Furthermore, they believe that bioethics and its applications should be in the school syllabus. Item d is only one out of the seven items involving negative judgments towards bioethics teaching and the lowest mean belongs to this item ($M= 2.76$). The mean value indicates that participants were hesitant about whether bioethics are too sensitive to teach or not. Overall results show that despite their indecision, teachers show a positive attitude towards teaching bioethics and believe that even though bioethical issues are sensitive to teach, they could be taught with correct teaching strategies.

Findings from the qualitative data regarding teaching about bioethical issues

During interviews, teachers were asked to discuss attitudes towards teaching bioethics. The discussions focused around reasons why some biology teachers avoid teaching bioethics. Teachers provided a variety of reasons, data analysis revealed five main themes. These themes were reviewed in light of the conceptual framework. These are being knowledgeable, beliefs, curriculum, exam-oriented education and discussion management. Information about each of these themes is provided below along with some quotes from the participants, who are identified as T1, T2, T3, T4, and T5. Being knowledgeable means having a good level of knowledge about a subject. Some exemplary quotes regarding this theme are provided in Table 5.

Table 5
Key responses pertaining to the theme being knowledgeable

Teacher participant	Key responses
T2	The teacher doesn't feel confident. Maybe he has no intention of finding out. You talk more about what you know well. That is why the person can avoid teaching bioethics.
T3	The teacher avoids teaching these subjects when subject knowledge is not sufficient. You're always nervous when you don't have subject knowledge. That's why it needs to be completed. These are very up-to-date issues, and because technology is involved, it doesn't feel easy to complete.
T5	When teachers don't have a clear concept of bioethics; they feel insecure. There's a perception I don't know what to say about it.

Belief means internalizing something which is accepted as truth even if there is no proof for this. Table 6 highlights some relevant comments teachers made related to this theme.

Table 6
Key responses pertaining to the theme beliefs

Teacher participant	Key responses
T1	It could be because the person is a conservative. So it might be about his infrastructure, his culture and his beliefs. It could be about the institution the teacher works for.
T3	The cultural past, religious past and religious beliefs that teachers have can affect them. I've never met anyone like that. But that's a possibility, and the school administration's approach is also important. For example, working here and studying in religious schools is very different.
T2	If there are students with very strong faith and the topic is sensitive, the teacher doesn't want to be involved. The teacher's own faith prevents him from talking.
T5	The lack of support of society on these issues, the personality, character, background and culture of the students and culture of teachers reflects itself in bioethics.

Curriculum means what academic contexts regarding a lesson is covered in a school program. In Table 7, several quotes related to this theme are provided.

Table 7
Key responses pertaining to the theme curriculum

Teacher participant	Key responses
T1	It could be about which curriculum is followed. In order to complete the IB curriculum, the student needs to have those discussions. But what's the situation with the MoNE? I don't know if it's giving teachers more chances to avoid it.
T5	If the curriculums that are taught do not force bioethics teaching, if bioethics are a single objective in these curriculums, if it is not expanded and integrated into the general, teaching may be avoided

Exam-oriented education is education which takes importance of exams instead of objectives students need to gain. For example, one teacher (T2), explains this them as follows:

The teacher may be working at an exam-oriented school. There's a pressure that every student will pass with a good grade. He doesn't ask about ethics in that exam. That's why he's ignoring ethics.

The theme of discussion management means about the topic of bioethics is organized and controlled in a discussion. A quote by participant T4 showcases this as follows:

It is hard to manage discussion. Everyone on the subject may have an idea from the past. The debate environment may not be a free environment. Some students in the classroom can try to top others. Discussion management requires prior preparation and equipment. Teachers might not want to do extra work on the subject.

Teacher participants gave several reasons for avoiding bioethics teaching. They did mention being knowledgeable, beliefs, curriculum, exam- oriented education and discussion management. The majority of the participants (three participants) stated that if a teacher has not adequate knowledge about bioethics, the teacher could avoid bioethics instruction. Furthermore, as it can be seen in Table 6, teacher participants suggested that the teacher's beliefs, culture, religion or community's beliefs that teachers are in, may lead to avoiding bioethics teaching if there is a conservative approach. All participants believed the impact of beliefs on teachers who tend to avoid teaching bioethical issues. Two teachers stated that what a curriculum expects is limited, it gives teachers a chance to avoid teaching bioethics. In addition, exam-oriented education could result in a teacher's ignorance of bioethics during teaching. Lastly, a teacher suggested that difficulty of managing discussion and its requirements may cause the teacher to avoid teaching bioethics.

Findings from the qualitative data regarding encouraging teachers to include bioethics in their practice

The data provides information about how biology teachers who avoid teaching bioethics could be encouraged to teach these issues. Ideas of teacher participants were investigated with a related interview question. Teachers provided a variety of reasons, data analysis revealed three main themes. These are in service training, encouraging value judgments to form, placement in the curriculum. In service training is a professional training covering a variety of activities for staff development. Encouraging value judgments to form means helping someone to create his own value judgments. Placement in the curriculum is about how much a subject or an objective is included in the curriculum.

Table 8
Key responses pertaining to the theme in service training

Teacher participant	Key responses
T1	Workshops can be held, Booklets and presentations with case studies that teachers can use as examples can be prepared in this field. An environment where teachers can discuss themselves can be created, transferring experiences and discussion management can be taught.
T2	The school administration can provide teachers with regular training for bioethics teaching. In regular teacher observations at school, teachers can be encouraged. Again, the administration can request the teacher for a study.
T3	Teachers who avoid bioethics can be encouraged by in-service training. For example, we make videos, take them to trips or build a lab so that students understand better. Trips should be organized, specialists should be organized for presentation, etc.
T5	Teachers who refrain from teaching bioethics can be encouraged by education. First, a starter activity can be done to measure teachers' knowledge of this topic. Then awareness is created by providing in-service training

As Table 8 indicates, the majority of teacher participants (four teachers) stated that in-service training including a variety of applications and activities could be a way to encourage biology teachers who did not teach bioethics.

One of the teachers, T4 did mention if a teacher encourages students to form their own value judgments, being a guide during this process, the teacher does not have to say something. She explained that,

Teachers make students be able to create their own value judgments under the guidance of the teacher. To achieve this, teachers need to give good examples, create an environment where asking questions is free, to prepare materials that students will question in order to have bioethics discussions, and they discuss them with students. In this way, without the teacher having to say anything, the student creates his own values.

Finally, T5 stated objectives related to bioethics should be included more in the curriculum since the teachers are exposed to apply bioethics and hence, internalizes it. She explained her opinion as follows:

Bioethics is a single objective in the 4-year curriculum. If the curriculum is shaped within the framework of bioethics, as in IB, it won't be the only objective. It spreads to something holistic and we evaluate the bioethics elements here in each unit. Or the unit can be put to questions at the end. As done in the nature of science, a small story can be shared to raise awareness for children. Since the teacher also has to apply the curriculum, he internalizes the curriculum regarding bioethics and so bioethics teaching. If it was just in-service training, the teacher says we've learned. However, it is not the correct statement. That's why bioethics objectives should be in the curriculum. Teachers must be exposed to bioethics to teach.

The instructional strategies used for bioethics teaching

The data providing information about instructional strategies biology teachers use for bioethics teaching was collected from the related part of the questionnaire followed by some relevant interview questions. In addition, themes created by considering the

content of participants' responses to interview questions exhibit qualitative data results for this concept.

Findings from the quantitative data

In the questionnaire, participants were asked whether they teach about bioethical issues in their classes. Twenty participants (95.24%) stated that they teach bioethics in their classes. Only one participant noted he does not teach about bioethics in his classes. There were 65% of biology teachers reported that the bioethics components of the class count towards students' grades and these grades are mostly based on exams, papers and participation in discussion. When participants were asked how they teach bioethics in their classes, they provided the following responses (see Table 9)

Table 9
Descriptive statistics for teaching strategy

Item	f
Open informal discussion	18
Case study analysis	12
Casual vocalization of thoughts on the subject	9
Formal lecture	7
Assigned papers	6
Included in assigned readings but not discussed	2
Included in optional reading but not discussed	2
Role playing	2

As Table 9 suggests, a variety of instructional strategies are incorporated into the lessons by teacher participants when they teach about bioethics. The highest frequency belongs to open informal discussion (n=18). That means biology teachers

mostly benefit from open informal discussions as an instructional strategy to teach bioethics. Furthermore, Item d, e and f have the lowest frequency (n=2). Only two teacher participants include bioethics in assigned readings and optional readings. However, they do not discuss these issues. Also, only two teachers integrate role playing into their lesson when they teach about bioethics. In addition, the table indicates that at least one of these instructional strategies is used by teacher participants.

Participants were asked which the instructional strategy they use the most to teach bioethics in their classes. Teachers' responses indicated that the most used instructional strategy is open informal discussion (n=8). The instructional strategy is followed by formal lecture (n=4) and casual vocalization of thoughts on the object (n=3). It is clearly seen that the results are compatible with Table 9. That means while the teaching strategies used by many teachers are open informal discussion, formal lecture and causal vocalization of thoughts on the subject, these are the most commonly used strategies. The only exception is case study analysis (n=3) since low preference rates were indicated by teachers who benefit from this teaching strategy in their classes.

Regarding issues to be included in lessons during bioethics instruction, teachers had mixed responses. Teachers were given a variety of issues as part of bioethics education, however, the Cronbach's alpha value of the items (see Table 10) was low ($\alpha = .57$). A low Cronbach's alpha value may be revealed by small number of questions or poor interrelatedness among items (Adeniran, 2019). It is possible that teachers did not understand the meaning or intentions of these questions.

Furthermore, the reason why they were not extremely supportive could be their concerns about controversy regarding bioethics. Nevertheless, some interpretations can be made based on their responses. It seems the biology teachers think it is important to incorporate certain issues like a variety of prominent ethical principles, general consequences of research on the individual or society, consideration for diversity of values and beliefs, awareness of foundations for personal opinions (biases), defending one's personal stance on issues into their classes during bioethics instruction. Furthermore, the mean values indicating teachers' agreement with these issues were very close to each other except for the issue regarding defending one's personal stance on issues. ($M= 3.75$) The reason behind the decline with this issue could be teachers' concerns about imposing their beliefs unintentionally when they cover this issue in their classes.

Table 10
Descriptive statistics for issues that are important to be included in lessons

Item	Frequency					M
	SD	D	DK	A	SA	
a. A variety of prominent ethical principles	0	0	2	12	6	4.2
b. General consequences of research on the individuals and society	0	0	2	9	9	4.35
c. Consideration for diversity of values and beliefs	0	1	0	9	10	4.4
d. Awareness of foundations personal opinions (biases)	0	1	0	10	9	4.35
e. Defending one's personal stance on issues	2	1	2	1	2	3.75

Findings from the qualitative data

The instructional strategies used for bioethics teaching were investigated with a relevant interview question and with a related sub-question. Teachers were asked was about what effective instructional strategies they use on bioethics teaching. Then, teacher participants were asked for why these strategies are effective. Teachers provided a variety of reasons, data analysis revealed two main themes. Unlike the themes in other sections, the themes associated with these questions were created based on the content of the questions. These themes are instructional strategies and the effect of instructional strategies. Instructional strategy means techniques which teachers benefit from to make students learn. The effect of instructional strategy means how successful these strategies are for student learning. Table 11 lists five teachers' responses regarding instructional strategies.

Table 11
Key responses pertaining to the theme Instructional Strategies

Teacher participant	Key responses
T1	Debate is effective. Except for debate, I have not experienced other strategies. However, if students search about a topic and write an essay about it or create a question and searching about the question could be other effective strategies
T2	I start with high order critical thinking questions. I give a case study and promote students to talk about the case. We could debate. Finally, students talk in small groups and share what they talk about afterwards.
T3	I make students watch videos. I use online simulations and virtual labs. I have a debate if they want. If they do not want, I talk about different perspectives on the issue.
T4	To give the student a topic and create thesis and antithesis, and to debate are effective strategies for teaching bioethics.
T5	Naturally occurring, spontaneous events are the best. Questioning, debates and case studies are effective teaching strategies.

As Table 11 suggests, all teachers stated that debate is an effective instructional strategy to teach bioethics. However, teachers also expressed several instructional strategies they thought as effective strategies to teach bioethics. Looking at the table as a whole, it can be said that teachers use different and various instructional strategies that they believe are effective for bioethics teaching. It was interesting that instructional strategies presented by five teachers were totally different from each other. Only common strategy used by teachers was debate. The finding indicates that the teacher participants are unique in their teaching.

In addition, when quantitative and qualitative data analyses are evaluated together, it is seen that open informal discussion and debate are the most preferred instructional strategies for bioethics teaching. Table 12 lists five teachers' key responses with regard to the effect of instructional strategies.

Table 12
Key responses pertaining to the theme the effect of the instructional strategies

Teacher participant	Key responses
T1	Debate is an effective way for the student to do deeper research and have an opinion for both perspectives.
T2	The teaching strategies I talk about are effective because it pushes students to think, they have to look for evidence and because they hear other ideas when they have communication with their peers.
T3	Videos and virtual labs are important for visualization. It's just when you try to explain it, it's abstract. We can use them to embody the subject. Hands on activities allow students to understand the issue much better by experiencing them, especially where videos are inadequate. The debate creates excitement. The students study well because they're going to discuss each other, and they learn a lot from each other.

Table 12 (cont'd)

Key responses pertaining to the theme the effect of the instructional strategies

Teacher participant	Key responses
T4	The most effective strategy is to give the student the subject and ask him to create thesis and antithesis. Because the student can combine the thesis and antithesis. And he's making his own opinion. Debate is effective in understanding and empathy for each other's ideas.
T5	Naturally occurring events are effective because we're not talking about something that doesn't happen to us, we're talking about something that happens. The student doesn't forget it because he's involved. Other teaching strategies are effective because students can talk, argue, and they can find a free environment to express themselves.

As Table 12 states, five teachers indicated their unique views to explain why these strategies are effective on bioethics teaching. The variety reasons presented by teachers attribute different skills gained by students. For instance, making a research develops students' research skills. Creating thesis and antithesis and considering ideas from different perspectives develops their thinking skills. Communication with peers and working cooperatively develop their communication and social skills. Planning and organizing their work develops students' self-management skills. As a whole, all these skills reflect requirements for meaningful learning.

Recommendations by biology teachers to support bioethics education

Qualitative data analysis

In the questionnaire and during interview, teachers were asked two open- ended questions regarding ways bioethics education could be improved. Their responses regarding issues to consider during bioethics education were grouped based on the similarity of the content of the issues to give a main idea. First, they were asked

about issues to consider when teaching bioethics. These responses are highlighted in Table 13.

Table 13

Teachers' responses regarding issues to consider during bioethics teaching

The main idea	The related issues
Sensitivity	To be sensitive to the diversity of values and beliefs Students' personal experiences especially health related issues such as genetic diseases Family approach, nurture, religious issues, racism between students To be objective and sensitive while sharing the ethical issues with the students
Education	Possible concerns of all of the experiments conducting at school Recent scientific findings about the consequences of the current issue being discussed in the class To avoid misconceptions
Professional development	To arrange a certificate program on bioethical issues given by an educator from medicine

Next, teachers provided recommendations for improving bioethics education during the interview. Their responses were grouped based on similarity of their content to give a main idea (see Table 14).

Table 14

Teachers' recommendations to support bioethics education

The main idea	The related recommendations
Behavior	To not leading the student To be open-minded and make students open-minded and respectful of opposing views individuals To be brave To make students think versatile To internalize bioethical issues

Table 14 (cont'd)

Teachers' recommendations to support bioethics education

The main idea	The related recommendations
Teacher preparation	To master the subject, To follow current issues and talk about these issues To search To make preparation To create a good classroom environment for discussion To share information with colleagues

Teachers' recommendations were diversified. They expressed the needs of bioethics teaching by emphasizing different aspects. These aspects shaped around five main ideas: sensitivity, education, professional development, behavior and teacher preparation. Teacher participants stated that teachers must be sensitive to different beliefs, values and students' experiences. They should not lead students. Teachers reported that they should be open-minded and encourage students to be as well. Also, teachers need to be prepared for the lesson and during the education they should discuss about recent scientific findings they currently followed. Furthermore, teachers need to avoid misconceptions when they teach bioethical issues. In addition, teachers can be encouraged with a certificate program on bioethical issues given by an educator from medicine. The integration of all these combinations into biology classes may have a great impact on improvement of bioethics education.

Resources for effective bioethics instruction

When teachers were asked about the biology textbooks, 12 out of 20 teachers stated that bioethical issues are integrated throughout the book. Of the 20 respondents, four teachers expressed that there are specific sections in the book devoted to bioethical issues. Other teachers (n=4) suggested that the textbook does not include bioethical issues.

In the following question, teachers were asked if they incorporate extra materials into their lessons besides the textbook when they discuss bioethical issues and were asked to describe these materials if they incorporate. There were 12 teachers (60%) who stated they incorporate extra materials into their lessons when discussing bioethical issues. Eight teachers (40%) expressed that they do not include extra materials.

Following are several extra materials used by high school biology teachers:

- From recent study papers, websites, university resources
- IB websites
- Cases on newspaper or scientific papers
- News, protocols signed by the some countries
- Readings, and investigations of students
- Case studies and scientific articles showing different perspectives in action, governmental policies etc.
- From IB guides

In another questionnaire question, teachers were asked for approximately what percentage of the class they devote to bioethics. The results of the current study also suggested that 19 biology teachers out of 20 devote less than 21% of their lessons to bioethics. Just one teacher puts more than 20% of one's lesson into bioethics. The curriculum content of bioethics education and some of the challenges to bioethics education discussed above may be the reasons for this response rate.

CHAPTER 5: DISCUSSION

Introduction

This chapter provides further discussion of the results and findings presented in the previous chapter. After an overview of the study, the study's research questions are discussed based on what was learned from the data analysis. Next, implications of the findings for the practice and further research are presented. Finally, some limitations of the study are provided.

Overview of the study

The purpose of this study was to gain insights into high school biology teachers' awareness of, attitudes toward and instructional strategies used for bioethical issues. Furthermore, teachers' recommendations for teaching bioethical issues were explored. Participants of the research were conveniently selected teachers who were alumni of a biology teacher education program of a graduate school in Ankara, Turkey. Teachers shared their perceptions through a questionnaire. To provide deeper insights into the responses, selected teachers were interviewed. The quantitative data from the questionnaire were analyzed using descriptive statistics. Content analysis helped to interpret the qualitative data. The researcher related the qualitative data to the quantitative data to address the research questions of the study.

Major findings and conclusion

In general, teachers report they are aware of bioethical issues

Teachers in this study felt they understood what bioethics is and were aware of current issues related to bioethics. Other studies found that in general teachers

appreciate the issue around bioethics (Rasool, Javed, Nadeem & Hakim, 2013). Furthermore, most of the teacher participants in the current study indicated they knew about particular issues related to biotechnology, such the human genome project, human gene therapy and genetic engineering. In a similar study, Asada, Tsuzuki, Akiyama, Macer and Macer (1996) surveyed biology and social studies teachers to ascertain their knowledge of topics such as pesticides, eugenics, biotechnology, human gene therapy and genetic engineering. Their study found that biology teachers were more knowledgeable about these issues than social study teachers. Like the current study, however, participants were more familiar with some topics than others.

Biology teachers support biotechnology, with reservations

The results indicated that most biology teachers agreed with the statements regarding benefits of biotechnology, genetic engineering and human gene therapy. They indicated that genetic engineering and biotechnology makes human life easier. In addition, the participants accepted these bioethics applications as opportunities for new discoveries. In conclusion, they had positive attitudes toward bioethical issues. There was evidence that participants had mixed views on some uses of biotechnology. The reason for this situation could be related to risks of bioethics. During the questionnaire, the teachers explained that applications of certain biotechnologies such as transgenic organisms and releasing genetically modified organisms contain unnecessary risks.

In the literature, several studies present similar findings with the current study. Therefore, the support for biotechnology seemed to be conditional. The results of

Chen and So's study (2017) revealed that most biology teachers have positive attitudes toward the applications of genetic modification, gene therapy, and assisted reproductive technology. The study suggested that biology teachers' attitudes toward modification, gene therapy, and assisted reproductive technology were context-dependent. The teachers felt less positive toward use of genetic modification for agriculture or food than using it for ecology. Furthermore, the participants' support was strong for gene therapy for treatments, but they were less supportive of therapy for gene enhancement. Lastly, the study indicated that there was a high ratio of acceptance about traditional assisted reproductive technology. The findings from this study indicate that while teachers may have positive attitudes towards biotechnology in some situations, in others they have reservations.

In another study, Cebesoy and Öztekin (2018) investigated middle school teachers' attitudes toward a variety of ethical issues related to biology, including genetic coding, abortion, pre-implementation genetic diagnosis, gene therapy and gene therapy applications. Teachers expressed reservations about many of the applications. For example, 30% of teacher participants were not sure about altering the genes of plants, humans, and other animals. Despite these reservations, it seemed 96% of participants believed in the benefits of modern science. Therefore, it seems attitudes toward biotechnology was mixed.

Another study conducted in Portugal by Fonseca, Costa, Lencastre and Tavares (2012) had similar results with Cebesoy and Öztekin (2018). The researchers stated that biology teachers expressed positive attitudes toward biotechnology. Fonseca et al. (2012) also suggested that teachers' approval of biotechnology applications was

dependent on their purposes and their usefulness. For instance, despite disapproval of cloning humans, they recognized that body parts could be cloned for organ transplants.

One criteria that seems to sway teachers' opinions in these studies, including the current one, is if the biotechnology is being used for extreme cases, such as life and death situations. For example, if there is a pressing need to cure a disease or to prevent malnutrition, they might support biotechnology. On the other hand, they disapproved of manipulating nature for cosmetics or enhancements. Clearly, attitudes about bioethical issues are influenced by societal norms and mores. Cultural dispositions representing a teacher's perception of self, others and society based upon her or his experiences and background relative to culture guide the way the teacher responds situations (Stooksberry, Schussler & Bercaw, 2009).

Teachers support including bioethics in the curriculum

Teachers in this study recognized that bioethics is a sensitive topic, nonetheless they did not express concerns about teaching bioethics and were confident to include bioethical issues in their teaching. They indicated that support materials and effective teaching strategies were needed to ensure they were properly taught. The reasons for the confidence may be about biology teachers' satisfying knowledge level of bioethics and their experiences in teaching. The participants supported the inclusion of bioethics in the curriculum.

The teachers in the current study noted that their textbooks, for the most part, included sections on bioethical issues. The textbook seemed to be their main resource

for teaching bioethics. Still, over half the respondents reported that they incorporated other support materials such as scientific articles, news media sources, case studies, and professionals in the field. Furthermore, a similar number of teachers shared that they do have class assignments, such as exam and essays, related to bioethics that count towards students' grades. Including bioethics components in grades can help the students to perceive the importance given to bioethics and promote them thinking and learning about these issues more. Teachers report they devote less than 20% of their class time to teaching bioethics, however. This may be acceptable and reflective of how the topic is covered in the curriculum and textbooks. It may be possible, however, to incorporate and discuss bioethical issues in many biology subject areas. This could help relate biology concepts to real life and to current events.

Other researchers too found that teachers generally support including bioethics in biology lessons (Fonseca et al., 2012; Rasool et al. 2013). Unlike the current study, however, Borgerding, Sadler and Coroly (2013) found that some teachers had feelings of insufficiency and anxiety when covering issues related to biotechnology into their teaching. They felt insecure when presenting information about a new biotechnology and worried about providing misinformation. Therefore, their study concluded teachers need professional development to ensure they are knowledgeable and competent to introduce bioethical issues to their students.

Knowledge, discussion management, beliefs, curriculum, exam-oriented education influence bioethics education

To encourage students to form their own value judgments indicated by the current study is one of the main necessities for bioethics education. A teacher participant

suggested that teachers need to give constructive examples, create an environment where asking questions is encouraged, prepare materials that students will question in order to have bioethics discussions, and discuss them for this purpose. Hence, both students would form their value judgements and the teachers would not have to say something. This approach is meaningful to make students inquirers and reflective learners. There are challenges to having discussions related in the classroom, however. Teachers need to prepare themselves, both in content knowledge and teaching strategies. Therefore, despite the perceived importance of and need for bioethics education, some teachers may opt not to include the topic in their lessons.

Several teachers mentioned that that lack of knowledge and dealing with classroom conflicts might prevent teachers from discussing bioethics in their lessons. They noted that as teachers become more knowledgeable, they become more competent at integrating bioethics into class discussions.

Other studies support these findings. Lazarowitz and Bloch (2005) reported that more experienced teachers had feelings of confidence more than novice teachers. Moreover, they found that more experienced teachers were willing to tackle controversial topics in the classroom lessons. The researchers believed that the experienced teachers had presumably come through the survival period and the non-confidence of knowing adequate about science and pedagogy. In the light of these findings, it could be said that knowledge level is directly proportional with experience in teaching bioethics.

Furthermore, willingness that experienced teachers may be influenced by their classroom management skills and managing the potential rise of heated debates.

Besides knowledge and experience, teachers in the current study said that beliefs, culture, religion or community's beliefs might have an impact on avoiding bioethics instruction. They said that some teachers may have more conservative views and therefore will not support discussing bioethical issues such as stem cell research.

Furthermore, they pointed out that the curriculum may influence if and how teachers include bioethics in their lessons. While both the national and the international IB curriculum have content related to bioethics, teachers noted that the IB curriculum's coverage is more extensive.

Exam-oriented education is another factor that may prevent teachers from conducting bioethics-related lessons. Teachers feel pressured to prepare students for exams and ignore bioethical issues to overview and discuss. The reason behind not covering bioethical issues is probably time constraints. Time was an obstacle for bioethics instruction. (Borgerding et.al, 2013; Booth and Garrett, 2004)

In the current study, it is interesting to point out that although teachers generally support reasons for including bioethics in biology lessons, they had mixed viewpoints regarding teachers' expressing their own views about bioethics. It could be said that biology teachers are sensitive to their students and the importance of being objective or neutral regarding the topic. During interviews, they stressed the importance of not biasing or influencing students regarding their opinions.

Teachers identified several skills and dispositions needed for effective bioethics education. These include content knowledge, having an open mind, courage, classroom management, lifelong learning, and collaboration. They also discussed the value of learning from professionals and online media sources.

Debates can help students explore and understand bioethical issues

Teachers listed the following strategies they used when teaching bioethics: open informal discussions, case study analysis, casual vocalization of thoughts on the subject, formal lecture and debate. Among these, teachers indicated they use case studies the least. The reason why case study analysis is less preferred may be that teachers consider case study analysis less effective than other teaching strategies for meaningful learning in bioethics. Another reason may be that case study analysis takes more time as it requires more preparation before teaching. Using debates was the most popular strategy. During interviews teachers explained that debates encourage students to conduct research, think critically, and communicate persuasively. They also acknowledged that students enjoy debates. It is clear from these responses, that teachers are interested in developing students learning skills in addition to teaching them about a bioethical issue.

These instructional strategies are supported by other studies (Booth & Garrett, 2004; Sadler, Amirshokoohi, Kazenpur & Allspaw, 2006). They identified additional strategies such as role playing activities, persuasive writing assignments, service learning projects, and independent research activities. In some cases (e.g., Booth & Garrett, 2004), unlike the current study, debates were not favored by teachers.

Teachers indicated that they were less effective at covering content and it was too easy for misconceptions to form.

Professional development can support bioethics education

As noted above, teachers reported that inclusion of bioethics in the curriculum is important. They also stressed the need for professional development experiences, these may be professional development workshops, in class observations, reflections and feedback, preparation of booklets, presentations and videos, build lab activities, sharing experiences, field trips. In their study, Bodgerding et al. (2013), recommended several differentiated professional development strategies for biotechnology instruction. In addition to providing background knowledge, they advocated for providing teaching resources and training to use the resources.

Implications for practice

As noted in the discussion of the findings, teachers identified that professional development could improve incorporation of bioethics in biology classes. This preparation can take place both before teachers start their practice and through in-service workshops and seminars. Given the many controversial issues in the subject area of biology, teachers need preparation on how to deal with students' varying attitudes and opinions. By helping students understand the Nature of Science and the history of science, they can understand how many biological concepts have been debated and contested. It is important that teachers can help students back their opinions and claims with scientific evidence. It is important that the skills of scientific argumentation be included in biology teacher preparation (Cinici, 2016; Driver, Newton, & Osborne, 2000; Ogan-Bekiroglu & Eskin, 2012; Sampson

&Blanchard, 2012). Science teachers suggest that argumentation makes students realize opposing views by examining and testing evidence and so make a decision on accuracy of scientific theories. They perceive arguments as '*a road to the correct view*' and incorporate other instructional strategies such as debates, counterarguments, open class discussion and role play into their classes less since they believe if students develop a scientific argument good enough, there is no obligation for other studies like counterarguments. (Erduran, Guilfoyle, & Park, 2020). Their findings indicate controversy regarding scientific issues such as biotechnology and its applications may be solved with the use of scientific argumentation during bioethics education. Therefore, it will be more effective to give priority to use argumentation during bioethics education and support this strategy with other instructional strategies like debates and open informal discussions.

Furthermore, the findings of the current study indicated teachers need more support on how to monitor and assess student learning during lessons on bioethics. One strategy may be to provide students with pre- and post-tests, that can be administered before and after activities such as debates. Teachers can also use a rubric during the debate that provides students criteria for expectations. Many of the resources related to argumentation referenced above include assessment strategies for teachers.

Another important aspect of bioethical education is teachers' dispositions. As noted in the findings, teachers expressed reservations about expressing their own views during discussions and debates related to bioethics. As part of their education, they can learn how best to or not to share their viewpoints. Is it realistic, for example, for

a teacher to remain totally neutral about a controversial issue? Professional teacher educators may need to monitor and screen teachers' viewpoints and ways of thinking to help them be aware of and open to conflicts of interests. The concept framework for habits of mind developed by Altan, Lane, and Dottin (2019) explains how intelligent behaviors can be monitored to identify underpinning educational theories. For example, professional developers can monitor teachers' questioning strategies and help them to develop techniques to promote student inquiry and reasoning skills.

To assist teachers and teacher educators in developing workshops and trainings, it is important that curriculum developers strategically include bioethics in their materials. To enhance students' awareness of bioethics and internalize it, teachers should incorporate biotechnology into their classes both as a separate topic and as integrated into other biology topics. In addition to content, the curriculum can provide teaching tips and ideas. Furthermore, organizations that develop teaching resources can create kits and online materials to facilitate the inclusion of bioethics in classroom lessons. Related to the earlier recommendation, seminars and workshops can help teachers learn how to implement the materials and monitor student learning.

Finally, it is important to have access to timely and current news related to bioethics. Online platforms where teachers can talk to each other and to professionals in various biotechnologies could be used to gain access to current innovations and controversies.

Implications for further research

The purpose of this study was to gain insights into high school biology teachers' awareness of, attitudes toward and instructional strategies used for bioethical issues. This research investigated alumni of a biology teacher education program awareness of, attitudes toward and instructional strategies used for bioethical issues. Other researchers can include high school biology teachers who graduated from other teacher education programs, academicians and middle school teachers. In addition to teachers' awareness of and attitudes toward bioethics, other researchers can investigate students' awareness of and attitudes toward bioethics.

This study investigated teachers' attitudes toward bioethics and instructional strategies used for bioethical issues. Further research can explore factors affecting teachers' attitudes toward bioethics and teaching way in bioethical issues. These factors can be age, culture and beliefs, teaching experience, curriculum and teacher preparation programs.

An evaluative study on how bioethics is included both the national and international curriculum would support effective bioethics education. The study can also compare and contrast textbooks used within Turkey and abroad.

Given that this study found professional development is important for bioethics education, researchers could develop and evaluate teacher education programs. They could develop programs that provide teachers with background about selected controversial topics in biology, introduce and model teaching resources, and monitor

how teachers implement the materials in the classroom. This study could also include measurements of student learning and development of argumentation skills.

Limitations

In this research, convenience sampling was used. The participants were alumni of a biology teacher education program of a graduate school in Ankara, Turkey. That is why the findings of the study and discussion may not be generalised for all high school biology teachers in Turkey, or indeed other countries.

The study was limited to the questions listed in the questionnaire and in the interviews. There may be other influential factors that influence whether and how teachers incorporate bioethical education in their teaching. Furthermore, some technical issues related to the online version of the questionnaire prevented teachers from being able to provide supplemental information about their responses.

The study was limited to teacher perceptions. The researcher was unable to conduct classroom observations and to view teachers' actual practice. There is a chance teacher misrepresented themselves intentionally or unconsciously.

In this study, the extreme responses of few teachers in the questionnaire could not be explored further as the teachers were promised anonymity. Regarding this instrument, a more extensive reliability check would further strengthen the study.

Another limitation of the study is the analysis of the qualitative data. Although the study had a conceptual framework, open coding was used to find the key themes. Furthermore, a reliability check of the thematic analysis was not conducted. Despite

this limitation, the framework was later reviewed to highlight some features noted in the themes and provided some confirmation of the findings.



REFERENCES

- Altan, S., Lane, J. F., & Dottin, E. (2019). Using habits of mind, intelligent behaviors, and educational theories to create a conceptual framework for developing effective teaching dispositions. *Journal of Teacher Education*, 70(2), 169-183.
- Adeniran, A. O. (2019). Application of Likert scale's type and Cronbach's alpha analysis in an airport perception study. *Scholar Journal of Applied Sciences and Research*, 2, 01-05.
- Asada, Y., Tsuzuki, M., Akiyama, S., Macer, N. Y., & Macer, D. R. J. (1996). High school teaching of bioethics in New Zealand, Australia and Japan. *Journal of Moral Education*, 25(4), 401-420.
- Bal, Ş., Samancı, N. K., & Bozkurt, O. (2007). University students' knowledge and attitude about genetic engineering. *Eurasia Journal of Mathematics, Science and Technology Education*, 3(2), 119-126. doi: 10.12973/ejmste/75383
- Bioethics. (n.d.). In *Cambridge Dictionary*. Retrieved from <https://dictionary.cambridge.org/dictionary/english/bioethics>
- Booth, J. M., & Garrett, J. M. (2004). Instructors' practices in and attitudes toward teaching ethics in the genetics classroom. *Genetics*, 168(3), 1111–1117. doi: 10.1534/genetics.103.023077
- Borgerding, L.A., Sadler, T.D., & Koroly, M.J. (2013). Teachers concerns about biotechnology education, *Journal of Science Education and Technology*, 22(2), 133-147. doi:10.1007/s10956-012-9382-z
- Cebesoy, U. B., & Öztekin, C. (2018). Genetics literacy: Insights from science teachers' knowledge, attitude, and teaching perceptions. *International Journal of Science and Mathematics Education*, 16, 1247-1268.

- Chen, Y., & So, W.W.M. (2017). An investigation of mainland china high school biology teachers' attitudes toward and ethical reasoning of three controversial bioethics issues. *Asia-Pacific Science Education*, 3(1), 1-16. doi: 10.1186/s41029-016-0012-6
- Cinici, A. (2016). Balancing the pros and cons of GMOs: Socio-scientific argumentation in pre-service teacher education. *International Journal of Science Education*, 38(11), 1841-1866.
- Costa, A. L., & Kallick, B. (2000). *Habits of mind*. Alexandria, VA: Association for Supervision and Curriculum Development.
- Creswell, J.W. (2012). *Educational research: Planning, conducting and evaluating quantitative and qualitative research*. Lincoln, LN: Pearson
- Dawson, V. M., & Taylor, P. C. (1999). Teaching bioethics in science: Does it make a difference? *Australian Science Teachers Journal*, 45(1), 59-64.
- Dewey, J. (1933). *How we think: A restatement of the relation of reflective thinking to the educative process*. Chicago, IL: Henry Regnery.
- Driver, R., Newton, P., & Osborne, J. (2000). Establishing the norms of scientific argumentation in classrooms. *Science Education*, 84(3), 287-312.
- El Arbid, S. S., & H. Tairab, H. (2020). Science teachers' views about inclusion of socio-scientific issues in UAE science curriculum and teaching. *International Journal of Instruction*, 13(2), 733–748. doi:10.29333/iji.2020.13250a
- Erduran, S., Guilfoyle, L., & Park, W. (2020). Science and religious education teachers' views of argumentation and its teaching. *Research in Science Education*. doi:10.1007/s11165-020-09966-2

- Ethics (n. d.). In *Merriam-Webster Dictionary*. Retrieved from <https://www.merriam-webster.com/dictionary/ethics>
- Flick, U. (2002). Qualitative research-state of the art. *Social science information, 41*(1), 5-24.
- Fonseca, M. J., Costa, P., Lencastre, L., & Tavares, F. (2012). Disclosing biology teachers' beliefs about biotechnology and biotechnology education. *Teaching and Teacher Education, 28*, 368-381.
- International Baccalaureate Organization (IBO). (2016). *ibo.org : Biology guide*. Retrieved from https://resources.ibo.org/dp/subject-group/Biology/resource/11162-occ-file-d_4_biolo_gui_1402_1_e?lang=en
- Johnson, R. B., Onwuegbuzie, A. J., & Turner, L. A. (2007). Toward a definition of mixed methods research. *Journal of Mixed Methods Research, 1*(2), 112-133.
- Keskin-Samanci, N., Özer-Keskin, M., & Arslan, O. (2014). Development of 'bioethical values inventory' for pupils in secondary education within the scope of bioethical education. *Eurasia Journal of Mathematics, Science and Technology Education, 10*(2), 69-76. doi:10.12973/eurasia.2014.1029a
- Kidman, G. (2009). Attitudes and interests towards biotechnology: the mismatch between students and teachers. *Eurasia Journal of Mathematics, Science and Technology, 5*(2), 135-143.
- Kinskey, M., & Zeidler, D. (2020). Elementary preservice teachers' challenges in designing and implementing socioscientific issues-based lessons. *Journal of Science Teacher Education, 1*-23.
- Lavrakas, P. J. (2008). *Encyclopedia of survey research methods* (Vols. 1-0). Thousand Oaks, CA: Sage Publications, Inc. doi: 10.4135/9781412963947

- Lazarowitz, R., & Bloch, I. (2005). Awareness of societal issues among high school biology teachers teaching genetics. *Journal of Science Education and Technology*, 14(5-6), 437-457.
- Macalalag, A. Z., Johnson, J., & Lai, M. (2020). How do we do this: Learning how to teach socio-scientific issues. *Cultural Studies of Science Education*, 15(2), 389–413. doi:10.1007/s11422-019-09944-9.
- Ogan-Bekiroglu, F., & Eskin, H. (2012). Examination of the relationship between engagement in scientific argumentation and conceptual knowledge. *International Journal of Science and Mathematics Education*, 10(6), 1415-1443.
- Rasool , S., Javed, S., Nadeem, S. G., & Hakim, S.T. (2013). Bioethics education, awareness of ethics and dissemination of knowledge among teachers and students. *RADS Journal of Biological Research and Applied Science*, 4(2), 20-32.
- Ritchie J., Spencer L., & O’Conner W. (2003). Carrying out qualitative analysis. *Qualitative research practice: A guide for social science students and researchers*, 219-262
- Rundgren, C. J., Eriksson, M., & Rundgren, S. N. C. (2016). Investigating the intertwinement of knowledge, value, and experience of upper secondary students’ argumentation concerning socio-scientific issues. *Science & Education*, 25(9-10), 1049-1071.
- Sadler, T. D., Amirshokoohi, A., Kazempour, M., & Allspaw, K. M.(2006). Socioscience and ethics in science classrooms: Teacher perspectives and strategies. *Journal of Research in Science Teaching*, 43(4), 353–376. doi:10.1002/tea.20142

- Sampson, V., & Blanchard, M. R. (2012). Science teachers and scientific argumentation: Trends in views and practice. *Journal of Research in Science Teaching*, 49(9), 1122-1148.
- Stooksberry, L. M., Schussler, D. L., & Bercaw, L. A. (2009). Conceptualizing dispositions: Intellectual, cultural, and moral domains of teaching. *Teachers and Teaching*, 15(6), 719–736. doi:10.1080/13540600903357041
- Straus, A. 1987. *Qualitative analysis for social scientists*. Cambridge: Cambridge University Press.
- T.C. Millî Eğitim Bakanlığı Talim Terbiye Kurulu Başkanlığı. (2018). Öğretim programlarını izleme ve değerlendirme sistemi: Biyoloji. Retrieved from <https://mufredat.meb.gov.tr/ProgramDetay.aspx?PID=361>
- Wan, Y., & Bi, H. (2020). What Major “Socio-Scientific Topics” should the science curriculum focused on? A Delphi study of the expert community in China. *International Journal of Science and Mathematics Education*, 18(1), 61–77. doi:10.1007/s10763-018-09947-y
- Wellcome Trust. (2005, August). What do people think about gene therapy?. Retrieved from <https://wellcome.org/search?search=what+do+people+think+about+gene+therapy%3F>

APPENDICES

Appendix A: Questionnaire

High School Biology Teachers' Awareness of, Attitudes toward, and Instructional Strategies used for Selected Bioethical Issues

Thank you for taking the time to complete this questionnaire. By answering the questions, we hope to gain insights into high school biology teachers' awareness of, attitudes toward, and instructional strategies used for selected bioethical issues. We appreciate your participation and contributions.

I have read and I understand the consent form included in the email. I consent to participate in this survey.

☐ Yes

☐ No

Part 1: Demographic Information

1- What year did you receive your teaching certificate?

Your answer

2- What is the highest degree you earned?

☐ College

☐ Master's

☐ Doctorate

3- How many years have you been teaching?

- ☐ 1-5
- ☐ 6-10
- ☐ 11-15
- ☐ 14-20
- ☐ More than 20 years

4- What is your gender?

- ☐ Female
- ☐ Male

5- What is your age?

- ☐ 22- 25
- ☐ 26-29
- ☐ 30-33
- ☐ Over 33 years old

Part 2: Teachers' Awareness of Bioethical Issues

1-Please describe what you think bioethics is?

Your answer

2- How would you rate your awareness of bioethical issues?

- ☐ Very aware
- ☐ Somewhat aware
- ☐ A little aware
- ☐ Not aware

3- Please indicate how much you have heard of each of these subjects?

	Never heard of it	Heard of it, but I do not have very much knowledge	Heard of it and I am very knowledgeable
Biotechnology	☐	☐	☐
Human gene therapy	☐	☐	☐
Human genome project	☐	☐	☐
Genetic engineering	☐	☐	☐

Part 3: Teachers' Attitudes toward Bioethical Issues

a- Attitudes toward Bioethical Issues

To what extent do you agree with each of the following statements

	Strongly disagree	Disagree	Don't know	Agree	Strongly agree
Genetic engineering make life easier for humans	☐	☐	☐	☐	☐
Biotechnology make life easier for humans	☐	☐	☐	☐	☐
Genetic engineering can provide opportunities for new discoveries	☐	☐	☐	☐	☐
Biotechnology can provide opportunities for new discoveries	☐	☐	☐	☐	☐
Transgenic organisms (Genes of one species that can be modified, or genes can be transplanted from one species to another) contains risks for nature	☐	☐	☐	☐	☐
Releasing GM (genetically modified) organisms in the environment contains risks	☐	☐	☐	☐	☐
Genetic engineering studies with animals and plants are beneficial to people	☐	☐	☐	☐	☐
Human gene therapy studies are beneficial to people	☐	☐	☐	☐	☐

b- Attitudes toward teaching bioethical issues

To what extent do you agree with each of the following statements:

	Strongly disagree	Disagree	Don't know	Agree	Strongly agree
I do not have any concerns about teaching bioethical issues (genetic engineering and biotechnology) in my classes	☐	☐	☐	☐	☐
I feel confident teaching about bioethical issues.	☐	☐	☐	☐	☐
I feel comfortable when I talk about bioethical issues.	☐	☐	☐	☐	☐
Bioethics is too sensitive issue to teach about	☐	☐	☐	☐	☐
Bioethics is sensitive but it can be taught via correct teaching strategies	☐	☐	☐	☐	☐
I personally believe that genetic engineering and its applications should be covered in the school biology syllabus.	☐	☐	☐	☐	☐
I personally believe that the school biology syllabus should include discussion of the issues involved in science and technology.	☐	☐	☐	☐	☐

Part 4: Instructional Strategies for Bioethical Issues

1- Do you teach about bioethical issues in your biology classes?

- ☐ Yes
- ☐ No

If you responded no, you do not need to complete the rest of the survey. Thank you for your contribution. For those who do teach about bioethical issues, please continue.



2-a- How do you teach about bioethics in your biology classes?
(Check all that apply)

- ☐ a- Formal lecture
- ☐ b- Open informal discussion
- ☐ c- Casual vocalization of thoughts on the subject
- ☐ d- Included in assigned readings but not discussed
- ☐ e- Included in optional reading but not discussed
- ☐ f- Role playing

- ☐ g- Case study analysis
- ☐ h- Assigned papers
- ☐ i- Other(Please specify)
- ☐ j- I don't at all

2-b- Of the strategies listed above, which one do you use the most?

Your answer

3-Does the textbook you mainly use for your class include bioethical issues?

- ☐ Not at all
- ☐ Yes, bioethical issues are integrated throughout the book
- ☐ Yes, there is a special chapter on bioethical issues
- ☐ Yes, there are specific sections in the book devoted to bioethical issues
- ☐ Other:

4. When discussing bioethical issues, do you incorporate extra materials into your lessons besides what is in the textbook?

- ☐ Yes
- ☐ No

4.1 If yes, please describe those materials.

Your answer

5- For each of the following items, please indicate the extent to which you agree it is important to be included in your lessons when teaching about bioethical issues.

	Strongly agree	Agree	Don't know	Disagree	Strongly disagree	Your own personal beliefs
A variety of prominent ethical principals	☐	☐	☐	☐	☐	☐
General consequences of research on the individual or society	☐	☐	☐	☐	☐	☐
Consideration for diversity of values and beliefs	☐	☐	☐	☐	☐	☐
Awareness of foundations for personal opinions (biases)	☐	☐	☐	☐	☐	☐
Defending one's personal stance on issues	☐	☐	☐	☐	☐	☐

5.1 What else should a teacher take into consideration when teaching bioethical issues?

Your answer

6- In a typical semester biology course, approximately what percentage of the class is devoted to bioethics?

- ☐ None
- ☐ 1-5%
- ☐ 4-10%
- ☐ 11-20%
- ☐ 21% or more
- ☐ Other:

7- Do the bioethics components of the class count towards students' grades?

☐ Yes

☐ No

7y- If yes, what is that grade based on? (Circle all that apply)

☐ Papers

☐ Exams

☐ Participation in discussion

☐ Other (please specify):

8- If there is anything else you would like to share about teaching bioethics in biology classes, please use the space below:

Your answer

Thank you for completing this questionnaire. Your responses will be of value to bioethics education in Turkey. If you have any questions, feel free to contact me. I may be contacting some of you for a follow up interview.

Appendix B: Interview Questions

Demographic questions

Q-1: What is your education degree?

Q-2: How many years have you been teaching?

Q-3: What are the curriculums you teach?

The main interview questions

Q-1: Why are some teachers eager to teach bioethical issues while others avoid them?

Q-2: How can teachers who avoid teaching bioethical issues be encouraged for teaching?

Q-3: What are the instructional strategies that you think are effective for teaching bioethics? Can you tell some strategies considering your lessons?

Sub-question: Why are these instructional strategies effective?

Q-4: What would you recommend to other teachers teaching bioethics?

Appendix C: Informed Consent Form for Questionnaire

Dear biology teacher:

You are receiving this message because you are a graduate of Bilkent University's Graduate School of Education and currently teaching biology in a Turkish school. I am currently a graduate student in this program and am conducting a study that would benefit from your insights. The purpose of this study is to gain insights into high school biology teachers' awareness of, attitudes toward and which instructional strategies they use in their classes for selected bioethical issues. We have secured permission from the Bilkent University ethics committee to conduct this study. The results of the study may be used in presentations or maybe published.

If you decide to participate, I will ask you to review this form and indicate in the first item of the questionnaire that you consent to participate. If there are any issues in the form you do not understand or are not clear for you, you can contact me and I will take time to explain it to you.

The research will involve your participation in an online questionnaire that will take about 15 minutes. In addition, I may contact you in a separate email to invite to share your insights in person during an interview if you are interested.

Participation to the questionnaire and the interview choice is voluntary. You will decide whether you participate or not. If you find any questions that are too personal, you do not have to answer them. Your relation with Bilkent University will not be affected if you do not participate or if you withdraw.

When you submit the survey, your responses will be anonymous and the data will be compiled with the rest of the responses. I will not share individual responses with anyone outside of the research team. The information that we collect from this research project will be kept confidential. Instead of using your name a number will be assigned to you, and any reference made will be made to the number.

If you have any questions, you can ask me whenever you want. If you wish to ask questions later, you may contact Özge DENİZ, ozge.deniz@bilkent.edu.tr

Appendix D: Informed Consent Form for Interview

Dear biology teacher:

You have been asked to participate in this interview because you are an alumni of Bilkent University's Graduate School of Education and currently teaching biology in a Turkish school. I am currently a graduate student in this program and am conducting a study that would benefit from insights.

The research will involve your participation in interview that will take around an hour. The purpose of this study is to gain insights into high school biology teachers' awareness of, attitudes toward and which instructional strategy they use in their classes for selected bioethical issues. We have secured permission from the Bilkent university ethics committee to conduct this study.

If you decide to participate, I will ask you review this form and sign the form indicating that you consent to participate. If there any issues in the form you do not understand or not clear for you, you can contact me and I will take time to explain it to you.

Participation to the interview choice is voluntary. If you find any questions that are too personal, you do not have to answer them.

When you complete the interview, our responses will be anonymous and the data will be compiled with the rest of the responses. I will not share individual responses with anyone outside of the research team. The information that we collect from this research project will kept confidential. Instead of using your name a pseudonym will be assigned to you.

If you have any questions, you can ask me whenever you want. If you wish to ask questions later, you may contact Özge DENİZ, ozge.deniz@bilkent.edu.tr

Teacher Name- Surname:

Signature:

Date:

Appendix E: Permission from Authors

Nilay Keskin Samanci <nilaykeskin@gmail.com>

Fri, 13 Apr 2018, 13:13



to me ▾

Dear Özge,

You can use the inventory. You may feel comfortable communicating with me about your research design, incorporating the ethical dilemmas in to your thesis and assessment strategies when you need it.

Best regards

Assoc. Prof. Dr. Nilay Keskin SAMANCI

Jinnie Garrett <jgarrett@hamilton.edu>

Sun, 25 Mar 2018, 14:41



to me ▾

Dear **özge deniz**,

Yes, certainly you may use parts of my survey in your study. I would be delighted if you would share the results you get once you are finished. Good luck with your graduate studies!

sincerely

Jinnie Garrett

darryl macer darryl@eubios.info via yahoo.com

Mon, 26 Mar 2018, 00:12



to me ▾

Dear Ozge,

Thank you for your email, and asking. Yes you have my permission to use the survey form, and I look forward to seeing the results.

with best wishes

Darryl

Darryl Macer, Ph.D. (Cantab), Hon.D., M.P.H.

President, American University of Sovereign Nations,

P.O. Box 1701, Sacaton, Arizona 85147, USA