

Article

Teachers' Sensitivity towards Technology and Environmental Ethics

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Received: 18 July 2018; Accepted: 12 August 2018; Published: 15 August 2018



Abstract: The purpose of the current study was to determine the science and classroom teachers' ethical sensitivities towards the issues of technology and the environment. Thus, the current study was conducted on 239 science and classroom teachers. The study employed the mixed method, in which qualitative and quantitative methods are used together. The quantitative dimension of the study is comprised of a survey, which was developed by the researchers. The qualitative dimension of the study comprised of three scenarios created by the researchers. Two of these scenarios are related to the environment and the other one is related to biotechnology. As a result of the study, the teachers' ethical sensitivities towards technology and environmental issues were found to be high. For some items in the questionnaire significant differences in gender-based, branch-based, and professional experience were found. The results obtained from the scenarios revealed that while science teachers adapt more realistic approaches to the events, the classroom teachers make decisions for the future. It would be useful to organize in-service training and ethical awareness training for teachers who are in the beginning of their professional lives.

Keywords: ethical sensitivity; teachers; technology and environmental ethics

1. Introduction

Children begin to develop moral consciousness during the period known as the second childhood stage and become respectful to others' moral conceptions [1]. This is a time for them to model the behaviors of their parents, teachers, and the people around them and to determine individuals who can be role models for them. At this stage, as well as those of the family, ethical sensitivities and moral behaviors of teachers are of such importance that they can affect their whole lives. Teachers should be good role models for their students by abiding to the ethical codes of their profession. With their ethical consciousness and sensitivities, teachers are polite in their interactions with their students, recognize their individual learning needs and behave in a tolerant and responsible manner. Teachers who have this ethical consciousness create a pedagogical environment which makes students feel safer, contributes to their developing a better personality, makes them understand the importance of conscience and prepares them to be sociable. In this sense, as ethical consciousness includes caring about others. It is important in the structuring of ethical behaviors [2]. Education is also defined as the process of self-recognition of individuals as it initiates a period of inquiry with ethical decisions of individuals [3] (pp. 43–44). The ethical dimension of education in an individual sense is defined as the activity of questioning one's own behaviors during the process of education [4]. Establishing a society with a high ethical sensitivity primarily relies on the creation of ethically sensitive individuals. In this regard, the importance of teachers in individual's education lives should be strongly emphasized. Teachers have the power for directing the society; thus, they need to consider ethical

values while exhibiting their behaviors. Given the tendencies of elementary school students to take their teachers as their role models, the importance of teachers' commitment to ethical values becomes clear [4].

When curricula are examined in terms of ethics, it is seen that there are some related objectives that aim to make students adopt inquiry-based approaches towards technological developments, as well as environmental and life-related issues in the society. When the 2018 science curricula in the Turkish education system are examined, it is seen that the number of objectives related to ethics in elementary and middle school levels is high ($n = 28$) [5]. When these objectives are examined for each course and unit, it is seen there are many objectives related to ethics in the science curricula of 3rd, 4th, 5th, 6th, 7th and 9th grades. In their interactions with their students, teachers should abide by the ethical codes of their profession. It is known that there are some attempts to develop suggestions and programs for the ethical training of science teachers abroad [6–9]. In addition, there is some research focusing on the strategies to be followed in teaching of the ethical dimensions of socio-scientific issues within science courses [10–12], a reflection of technology on values and its teaching [13], determination of the role of classroom teachers on values education [14], qualifications to be possessed by ideal educators [15], the effect of content competences of science teachers on the quality of their socio-scientific argumentations [16] and the reflection of teachers' religious beliefs on ethics education [17].

The great advances in technology in the 20th century and the negative effects of these developments on the environment are being addressed with objectives incorporated especially into the science courses. It is crucial that teachers should act as individuals with high ethical sensitivity towards ethical dilemmas that emerge in these areas, towards environmental issues such as effective use of water resources or biotechnology and should encourage their students to behave in this way. Teachers who are expected to educate their students, as highly qualified and ethically sensitive individuals in technology and environmental issues that have emerged in recent years should themselves be sensitive to these issues. The ability of teachers to recognize ethical problems, to solve them and to escape from dilemma is worth investigating as a sensitivity issue [18]. In the literature, teachers' and students' ethical sensitivity awareness were identified in different countries. Usually sensitivities were found at a high level. In a study carried out by [19] on university students, it was found that the participants' ethical sensitivities about environmental issues are considerably high. In the study conducted by [20] on middle school students, the participants' attitudes towards the environment were found to be high. Ottekin-Demirbolat and Aslan [18] reported that the elementary and middle school students' general ethical sensitivities are high. Kuusisto, Tirri and Rissanen [21] stated that Finnish teachers and pre-service teachers' general ethical sensitivities are high. In a study conducted in our country to determine the ethical sensitivities of people living in the city of Adana, it was found that 58.4% of the participants showed sensitivity towards environmental problems. In the same study, younger people were found to be more sensitive than older ones [22]. In another study, conducted in Sweden and France on 1109 teachers and pre-service teachers to investigate the attitudes towards and perceptions of the nature and environmentally friendly choices within the context of eco-feminism [23]. Around the world in the light of the literature above, teachers and students have high sensitivities about the environment or technological innovations. That is why are we face lots of problems such as global warming, depletions of resources, etc. Why are we forced to prevent these problems? Our success in this subject is by creating positive attitudes and behaviors in society's individuals. Thus, the current study aims to determine the ethical sensitivities of the teachers towards the environmental and technologic issues and to determine whether their sensitivities vary significantly depending on their branch, gender, and professional seniority. Then the study aims to determine the reasons behind the decisions with scenarios.

In addition, the current study assumes that in the face of a dilemma, ethical decisions to be made by teachers rely on their ethical sensitivities, which is another focus of the current study.

The measurement tools administered to the participants of the current study are believed to have increased their sensitivity, which is seen to be a contribution to the literature.

Environment, Technology and Ethics

There are reciprocal interactions between people, non-human creatures and inanimate entities that make up the global ecosystem. Throughout history, the desire of the people to dominate nature, the environmental policies of the governments and their attitudes towards nature have become factors that are effective in the degradation of the ecological balance [24]. Today, it is known that more than 100 species become extinct in the world every day, and this figure is expected to rise by two or three times in the coming years [25]. Many of today's environmental problems are the result of the wrong decisions made by older generations. It is not possible to make sure that we will not have unwanted consequences from decisions we make today [25]. In the face of these negative developments, people have started to feel frustrated and they have felt the need for leaving a better world for future generations; as a result, they make serious attempts to be more conscious and to raise others' consciousness [26,27]. In this connection, in 1972, the United Nations organized a World Environmental Challenges Conference in Stockholm, drawing attention to environmental education to be given about environmental problems in all countries. In addition, it was aimed to set up non-governmental organizations especially in Western European countries to raise the environmental sensitivity of the public [28]. While environmental awareness has developed in this way in the world, one of the most important steps to protect the environment in our country was taken in 1978 with the establishment of an undersecretary affiliated to the Prime Minister. This was followed by the establishment of the Ministry of Environment in 1991. In addition to all these, departments of environmental engineering have been opened in the universities and steps have been taken to protect the environment and increase environmental awareness in our country [28]. Scientists from all walks of life have tried to make people understand that they are part of the environment rather than the owner [29].

In addition to these environmental problems, today's rapidly developing technology in many fields such as industry, medicine, communication, transportation, architecture, etc., creates controversial situations. People sometimes feel obliged to evaluate the utility-damage balance of technological tools or innovations that make their life easier. The use of stem cells in medicine has led to emergence of ethically controversial issues. Stem cells are theoretically specialized cells capable of infinite divisibility and differentiation into different cells. They can be obtained from embryos, umbilical cord, and adult cells. While they are becoming a hope for the treatment of spinal cords injury, ALS disease, Parkinson's, and many other diseases, they can bring about many ethical problems as they are obtained from human sources. The focus of the debate on stem cells is when embryos from which embryonic stem cells are derived will be regarded as humans. Another controversial issue is that mothers give birth to new babies to obtain stem cells for their sick children. The in vitro fertilization process is applied to give birth to the child with the appropriate tissue group. While selecting the appropriate embryos during this procedure, others are destroyed [30].

The concept of technology and ethics has begun to be intertwined with the engineering profession, especially after the industrial revolution. It is intended that technological tools and innovations are made useful to their users and society [31]. The design, construction and supervision errors of engineering works can cause accidents in daily life and can cause major devastations as a result of earthquake-like disasters. Because of such concerns, it has been determined that there is a need for ethics education in engineering and some studies are needed on this subject [32].

The relationship between human beings and animals is also worth investigating ethically. In any application or experiment, the use of an animal is harmful results in some kind of harm to it [33]. Animals have been used in many cases to benefit humans, such as the elimination of certain diseases and the development or testing of medicines. However, today, alternative methods are being developed so that the use of animals in such applications can be prevented. Yet, if the use of animals in experiments

is a necessity, these experiments should be carried out using appropriate anesthetic methods [34]. New ethical problems resulting from the developments taking place in gene technologies have been reported by researchers. The Human Genome Project (HGP) has brought with it certain concerns as the technology and scientific knowledge provided by HGP has allowed the intervention in genes. One of these is that the information provided will inform people about their abilities and strengths and weaknesses and help them avoid catching any disease in the future, and that these genetic tests can be used by companies in the future to make their recruitment decisions [35]. The great power genetic that technologies have, deterioration of the natural balance of the human body, gene contamination, the risk of using genetic information as a weapon, attempts made to create super human beings or to create human labor to be used in heavy and dangerous works, gender discrimination, the failure to establish standard health quality, the increase in insurance rates of insurance companies, the uncontrolled release of microorganisms modified by gene technology all cause some ethical questions and problems [34] [36] (p. 83) [37].

The use of gene-doping methods to increase the performance of athletes in competition as a result of significant improvements in physiology and pharmacology today has brought about several ethical problems. Gene-doping is an expensive method, which means that only wealthy athletes use this method, and users suffer from consequences such as cancer and immune system collapse, resulting in adverse effects on sporting ethics. The use of this form of genetic technology, which is considered to be negative in terms of sporting ethics, poses a threat to fair competition [38].

When the issue of ethics is considered in terms of information technologies, it is understood that with the widespread use of these technologies some important problems have emerged in our daily life. Multifunctional phones, computers that get smaller while their functions increase, terabytes of storage space, touch-screen systems, and extraordinary software are continuously increasing in response to individual needs. Although technology can make people's lives easier and make their work more comfortable, it can lead to other disturbances and harms if not used correctly. Some of them are the use of unlicensed software, obtaining art works in illegal forms on the Internet, credit card fraud, damages given by using infected software and violation of privacy. The increase in the number of crimes such as internet fraud causes the individuals in the society to feel concerned while using internet banking or doing shopping on the Internet [39,40].

The ethical concerns related to technology and environmental issues that are mentioned above can be addressed by sensitive individuals who can make right decisions for next generations; thus, such problems can be resolved. Therefore, teachers who are expected to train students as individuals with high awareness and sensitivity about technology and environmental issues should first themselves be sensitive about these issues; thus, the current study focuses on the technological and environmental sensitivities of teachers. If teachers have high awareness about ethical problems they can educate the students in this way during the related lessons. This study also aims to determine whether the teachers' sensitivities vary significantly depending on their branch, gender, and professional seniority.

In this regard, the research problem of the study is "What are the science and classroom teachers' sensitivities towards technology and environmental ethics?"

In the current study, in light of the relationships reported in the literature between the sensitivities towards technology and environmental ethics and some demographic features the following hypotheses will be tested:

Hypothesis 1 (H1). *The teachers' ethical opinions about technology and environmental issues vary significantly depending on their branch [95% confidence interval].*

Hypothesis 2 (H2). *The teachers' ethical opinions about technology and environmental issues vary significantly depending on their gender [95% confidence interval].*

Hypothesis 3 (H3). *The teachers' ethical opinions about technology and environmental issues vary significantly depending on their professional seniority [95% confidence interval].*

Moreover, some scenarios were given to the teachers to elicit data providing more detailed information about the reasons behind their ethical opinions about some prominent issues of technology and the environment.

2. Materials and Methods

In this section, information is given about the model, universe, sampling and data collection tools and data analysis procedures of the current study.

2.1. Research Model

The current study employed the mixed method. The sequential explanatory design in which quantitative analysis is followed by qualitative analysis was used as the mixed design of the study; thus, it was aimed to conduct a more detailed analysis and interpretation of the collected data [41]. In this sequential approach, both types of data were integrated in the data interpretation stage to produce a better explanation of the phenomenon emerging from the data.

2.2. Universe and Sampling

The sampling of the quantitative part of the study comprised of science teachers working in elementary and middle schools and classroom teachers teaching elementary school in 3rd and 4th graders in the 2016–2017 school year (N = 239). The sampling of the qualitative part of the study on the other hand comprised of science teachers working in elementary and middle schools affiliated to Muğla provincial Directorate of National Education and classroom teachers teaching elementary school in 3rd and 4th grades (N = 30). The universe of the current research consists of the science and classroom teachers working in elementary and middle schools in Turkey. In the selection of the samplings, the convenience sampling method, one of the non-random sampling methods, was preferred. The convenience sampling method refers to the selection of the participants from among the sections of the universe, which are easily available [42]. The data collection tool used in the qualitative part of the study was administered face-to-face to the participating teachers on a voluntary basis after the required permissions were granted from the Muğla provincial Directorate of National Education. The data collection tool used in the quantitative part of the study was administered as an online form in Google docs.

2.3. Data Collection Tools

In the current study, two types of data collection tools were used, quantitative and qualitative. In the quantitative part of the study, which was conducted all over, Turkey, a quantitative data collection tool “The Technology and Environmental Ethics Questionnaire” was used. In the qualitative part of the study, which was conducted in the Muğla city, scenarios including issues of technology and the environment were used. The scenarios included the environmental subjects of Natural Resources, Forest, Environment and Global Climate Policy and the technology subject of Eugenics.

2.3.1. The Technology and Environmental Ethics Questionnaire

The quantitative data of the current study were collected with the Technology and Environmental Ethics Questionnaire. During the construction of the questionnaire, first an item pool was formed by reviewing the literature and considering the objectives of the related curriculum. The items in the pool were selected on the subjects of environmental awareness, individual behaviors towards the environment, respect for the living and non-living environments, the areas of use for technology, the applications of biotechnological developments in the field of genetics, finding reflections in human life. Correction and elimination operations were conducted on the items in the pool together with the field experts. After these operations, the measurement tool consisting of 36 items designed in the form of a four-point Likert-type scale with response options “strongly disagree”, “disagree”, “agree”

and “strongly agree” was obtained. Turan, Şimşek and Aslan [43] stated that due to the tendency of participants to mark the option in the center in Likert-type scales, they are more likely to mark the option “undecided/no idea” which is generally in the center; thus, it would be better not to use this option in scales. According to [44], as an expression not indicating any decision, the option “undecided/no idea” has no place among other options expressing a decision, therefore, it would be advised not to use this option in Likert-type scales. Thus, in the questionnaire used in the current study this option was not used.

After the piloting of the measurement tool on fourth-year students attending the department of science teaching at Muğla Sıtkı Koçman University (N = 60), some more corrections were made on the items. The questionnaire items were also submitted to the review of an expert from the department of Turkish teaching to make sure that the items were comprehensible. Then the reliability and validity studies of the scale were carried out by conducting explanatory and confirmatory analyses on the data obtained from the actual sample made up of 239 teachers. First explanatory factor analysis (EFA) was conducted to reveal the latent structure of the measurement tool and to determine the number of factors under which the items were collected. Prior to the factor analysis, the relevant literature was reviewed to decide which rotation technique would be used. The purpose in factor rotation is to obtain factors that can be interpreted and named. In this regard, Varimax rotation which is the most preferred method and through which independent factors can be obtained was selected [45] (pp. 322–323). As a result, of the explanatory factor analysis, a 10-factor construct was found. These factors explained 56.5% of the total variance. Factor loadings explain the correlations of items with the sub-dimensions (Table 1). According to Kalaycı [45] (p. 322), the items with a factor loading smaller than 0.5 were discarded and then factor analysis was repeated. In this way, the total variance explained increased and more meaningful factor groups were obtained. The items with a factor loading smaller than 0.5 were discarded in the first results of the explanatory factor analysis and then the factor analysis was repeated. This operation was repeated until no item with factor loading smaller than 0.5 was left. In this way, a five-factor construct was obtained. The items subsumed under these five factors are as follows: Items 9, 8, 2, 13, 15, 11, 1 and 3 under the first factor, 16, 6, 5, 12 and 10 under the second factor; item 7 under the third factor; item 14 under the fourth factor and item 4 under the fifth factor. Yet, as there was only one item under each of the last three factors and because of the analysis of the scree plot, it was decided that the measurement tool could be reduced to three factors. According to Kalaycı [45] (p. 323), in the determination of the factor number, the scree plot can be used effectively because the point where the curve ends in this plot is accepted to be cut-point showing the number of factors. In the plot obtained in the current study, the curve reached almost a plateau after the third factor. This showed that the number of factors could be reduced to 3. In our study, one item found in the third, fourth and fifth factors each was related to “the environment and threat to life”, they were all subsumed under the third factor. At the end of the analysis, a measurement tool consisting of 3 factors and 16 items was obtained.

These three factors were found to explain 58.4% of the total variance. According to Erdoğan, Bayram and Deniz [46], it is not possible to reach a high variance in social sciences; therefore, the explained variance ranging from 40 to 60% is considered to be ideal. The higher the rate of variance is, the stronger the factor groups will be [46]. In the current study, the common meanings expressed by the factor groups were investigated, and then the first factor group was named as “Environmental Sensitivity”, the second factor group as “Caring about the Benefits to Living Things” and the 3rd factor as “Threat to the Environment and Life”. As a result, a three-factor measurement tool whose factor groups/loadings/variances are given in Table 1 was developed. The Cronbach’s alpha internal consistency coefficient of this measurement tool was found to be 0.71. According to Kalaycı [45] (p. 322) if this coefficient is in the range of $0.60 < \text{Alpha} < 0.80$, then this questionnaire is highly reliable. This value showed that the 16 items in the questionnaire expressed a unity having a homogenous structure. The results of the explanatory factor analysis in the current study are summarized in Table 1.

Table 1. Results of the explanatory factor analysis showing the factor groups, factor loadings and factor variances.

Factors	Factor Loadings	Factor Variance (%)
F1: Environmental Sensitivity		22.632
1. I adopt conscious attitudes towards technology and environmental problems.	0.593	
2. Environmental sensitivity encourages individuals to take the responsibility for their own behaviors.	0.520	
3. I take great care to make environmentally friendly choices in my daily life and shopping.	0.633	
8. Environmental awareness and sensitivity are not regional but global requirements.	0.624	
9. Teaching individuals how to make efficient use of resources by introducing them to the environment should be an objective of education.	0.613	
11. I make individual efforts such as using energy-saving bulbs, public transportation and use of water in a controlled manner while brushing my teeth to prevent global warming.	0.548	
13. I think that warning students about environmental hygiene and health is effective in developing their environmental sensitivity.	0.637	
15. I think that we need an approach that will guide balanced human-nature-animal interaction.	0.592	
F2: Caring about the Benefit to Living Things		13.203
5. I find it correct that countries should be able to use their own natural resources as they wish even if they may lead to some environmental risks.	0.599	
6. Opening natural habitats to human dwelling is a necessity of today's life.	0.583	
10. I think that determination of the race of people by using genetic technologies can lead to racial discrimination.	0.562	
12. I support all the activities that aim to increase agricultural productivity to meet the increasing needs of growing populations.	0.566	
16. When it is necessary for human benefit, plant and animal species and natural entities such as caves and travertines can be damaged.	0.520	
F3: Threat to the Environment and Life		22.558
4. I think by expanding the shelf-life of foods through biotechnological developments, it is aimed at making more profit rather than making foods healthier.	0.584	
7. I think that the misuse of land and some biotechnological applications pose a threat to food safety.	0.559	
14. I think that the reason for the environmental problems experienced today is the wrong decisions made from the past to present.	0.710	
Total		58.39

To test the accuracy of the constructs found with the explanatory factor analysis, confirmatory factor analysis (CFA) was conducted by using the AMOS 22 program. In CFA, first the model should be

determined. This model can be constructed by the researcher or the model obtained from explanatory factor analysis can be used [47].

In our study, analyses were conducted on the model obtained from EFA and the goodness-of-fit indices were examined (Table 2 [46,48]). In this stage, great care was taken for each factor to include two or more items. Based on the examined goodness-of-fit indices, evaluation of the model was performed. In CFA, when the chi-square value is 3 or smaller than 3, it is considered to be acceptable ($CMIN/df$ (χ^2/df)). This value was found to be 2.78 in the current study. The RMR value refers to the absolute difference between the observed covariance and the covariance predicted by the model. If this value is equal to or smaller than 0.05, the it is considered to be acceptable [49]. In the current study this value was found to be 0.038. The values for RMSA, GFI, AGFI and CFI selected as the other goodness-of-fit indices of CFA were found to be at the desired levels or close to the desired levels; thus, it can be argued that though not a very good fit was obtained, it seems to be sufficient to confirm the factor structure of the questionnaire. As a result, a 16-item measurement tool to determine the sensitivity towards technology and environmental ethics was developed.

Table 2. Goodness-of-fit Indices used in CFA and the obtained values.

Indices	Acceptable Value	Fit Values in Our Study
$CMIN/df$	≤ 3	2.78
RMR	≤ 0.05	0.038
RMSA [48]	< 0.08	0.086
GFI [48]	> 0.9	0.87
AGFI [46]	> 0.85	0.82
CFI [48]	> 0.9	0.73

2.3.2. Scenarios

The qualitative data were collected through the scenarios related to subjects of technology and the environment. The scenarios were developed by reviewing the literature focusing on problems caused by technological advances, their effects on living things and the environment and their effects leading individuals to dilemmas. While developing the scenarios, the results of the exploratory factor analysis and the confirmatory factor analysis were also taken into consideration. In this way, it was intended to conduct an in-depth investigation into the opinions elicited through the qualitative measurement tool. In the preparation stage of the scenarios, field experts' opinions were also taken into consideration and great importance was attached to originality. Pilot application of the scenarios was conducted with the fourth-year students attending the department of science teaching in Muğla Sıtkı Koçman University ($N = 10$). During the pilot testing, the scenarios were also examined in terms of their language and comprehensibility. The statements found to be difficult to understand by the participants were noted and some corrections were made to the scenarios. With the help of the field experts, the open-ended questions placed to the end of the scenarios were reexamined to test their compliance with the purpose of the study (see Appendix A). As a result, of these works, three scenarios were developed. The first scenario had the title "Natural resources, forest and environment" aiming to elicit the participants' opinions about the use of forest resources and what kinds of consumption patterns have been adopted in response to needs. This scenario was related to "environmental sensitivity" which is the first factor group of the qualitative measurement tool. The second scenario was related to biotechnology and has the title "Eugenics" aimed to elicit participants' opinions about the concerns related to attempts made to create a perfect race and directing the participating teachers towards the questioning of profit and loss balance as this technology can be used to eliminate genetic diseases. It was related to "benefit to living things" which was the second factor group of the qualitative measurement tool. The third scenario has the title "Global climate policy" aiming to elicit the participants' opinions about the decisions of the presidents of countries powerful enough to effect the decisions made about global environmental problems. It was related to "Threat to the environment and life" which was

the third factor group of the measurement tool. With the open-ended questions placed to the end of the scenarios, it was intended to learn the details of the participants' opinions. In each of the scenarios given to the participants, they were asked to explain the reasons for their responses with the open-ended questions at the end of the scenarios. In this way, the participants were encouraged to explain their dilemmas more clearly.

2.4. Data Analysis

Before attempting to seek for an answer to the research question and to test the hypotheses, descriptive statistics (means, medians, mode, skewness, and kurtosis) were calculated and Kolmogorov Smirnov test was administered. To be able to determine the analysis methods to be applied in a study, the assumptions need to be checked with these analyses. The assumptions checked in our study are,

Data should be scattered or proportional;

Data should be suitable for normal distribution (As skewness and kurtosis values [+1, -1]; mode, median, mean values are close to each other and the number of participants is more than 35, it was checked with Kolmogorov-Smirnov test);

Group variances should be equal (It was tested with Levene test).

In cases where the size of the sampling is larger than 35 participants, Kolmogorov Smirnov test is used to test the normality assumption. Yet, with increasing size of the sampling, the likelihood of finding a significant difference between the observed and expected distributions also increases; therefore, the use of other descriptive analyses or graphics is suggested [50]. Thus, due to the sensitivity of Kolmogorov Smirnov test, it was investigated whether the skewness and kurtosis values are in the range of +1 and -1 to test the normality assumption in the current study. Skewness is known as a measurement of the symmetry of the data distribution to the mean value. When data show a normal distribution, mode, and median and mean values are quite close to each other or equal, in the case of deviation from the normal, these values distance from each other [51]. The fitness of the responses given to the questionnaire to the normal distribution was investigated in terms of the total score and the factor groups, and the results of the Kolmogorov Smirnov test were found to be smaller than 0.05, thus significant. Yet, when the skewness and Kurtosis values testing the assumption of normal distribution were examined, the total score and factors groups were found to be in the range of +1 and -1. Then mode, median and mean values were examined, and they were found to be very close to each other (Table 3). Based on these results, it was accepted that the data exhibit a normal distribution and thus suitable analyses were conducted.

Table 3. Mean, Mode and Median values used to test the normal distribution of the data.

	Total Score	Environmental Sensitivity (1st Factor Group)	Caring about the Benefit to Living Things (2nd Factor Group)	Threat to the Environment and Life (3rd Factor Group)
Mean	3.09	3.53	2.19	3.44
Mode	3.06	3.62	2.20	3.67
Median	2.94	3.63	2.20	3.67

Based on the assumption that the intervals are equal in the Technology and Environmental Ethics Questionnaire, the mean weighted values were calculated with the following interval number formula; Score interval = The highest value—the lowest value [52].

Thus, as a result of the $4-1 = 3$, $3:4 = 0.75$ operation, the values of the means were found to be as follows:

- 1–1.75 score interval “strongly disagree”;
- 1.76–2.51 score interval “disagree”;
- 2.52–3.27 score interval “agree”;
- 3.28–4.00 score interval “completely agree”.

The participants' rates of sensitivity towards technology and environmental ethics were expressed as high or low according to these intervals.

Whether the group variances were equal was decided by examining the Levene test results together with *t*-test analysis results for the variables of gender and branch having two or more options. In cases where Levene test was found to be significant, *p* (significance) value corresponding to the area where the group variances concerning the variable are not equal in the analysis table was taken into consideration. In the stage of the analysis where seven variables in relation to professional seniority were defined (1–5 years, 6–10 years, 11–15 years, 16–20 years, 21–25 years, 26–30 years and 31 years and more), in cases where the group variances were equal according to the results of Levene test, one-way variance analysis (ANOVA) and in cases where they were not equal Kruskal Wallis was used in SPSS 20 program package.

The qualitative data were analyzed through content analysis. Cohen, Marion, and Morrison [53] (pp. 476–483) provide a guide in this study for content analyze. This content analysis is based on Cohen, Marion and Morrison's [53] guidance. Firstly, all data transferred to word document. The data have been coded very coarsely, in terms of two, three or four main categories. Data sorted into key headings and named subcategories. In the final stage, the data organized and defined under themes and categories and presented together with the excerpts from teachers. Then, the teachers' rates of being involved in a theme were given in the form of percentages and frequencies (see Appendix B). Then the represented data are exemplified by drawing attention to general and special points. The responses of the science teachers (who is teaching science 5th, 6th, 7th. and 8thgrade of primary school also their branch are science) (N = 15) and classroom teachers (who is teaching science 3rd and 4th grade of primary school and also their branch are not science) (N = 15) to the scenarios were assigned with numbers between 1 and 15 and the excerpts of the teachers were coded as Teac.1/Science, Teac.1/Classroom, etc.

3. Findings

In this section, the findings obtained from the statistical analyses conducted on the question and hypotheses addressed in the current study and the findings obtained from the qualitative part of the study are presented. First the findings derived from the results of the descriptive statistics in relation to the total scores, factor groups and individual items are given. Then the findings concerned with the testing of the hypotheses are given. The findings obtained within the context of the qualitative part of the study are presented under a different sub-heading after having been organized in line with the question and the purposes of the study.

3.1. Findings Related to the Quantitative Data

In this section, the findings obtained from the statistical analyses conducted to test the research problem and hypotheses are presented. First, the demographic features of the participating teachers are presented. Of the participating teachers, 65.3% are science teachers and 34.7% are classroom teachers and 72% are females and 28% are males. When their distribution according to professional seniority is examined, it is seen that 28.6% have been working for 1–5 years, 18% for 6–10 years, 17.6% for 11–15 years, 10% for 16–20 years, 7.6% for 21–25 years, 9.2% for 26–30 years and 6.3% for 31 years and more.

3.1.1. Findings Related to the Research Problem "What Are the Science and Classroom Teachers' Sensitivities towards Technology and Environmental Ethics?"

First a response to the research problem of the study, "What are the science and classroom teachers' sensitivities towards technology and environmental ethics?" was sought. The responses given to the four-point Likert-type questionnaire with the response options "Strongly agree, agree, disagree, strongly disagree" were analyzed and the results are presented as percentages (%), frequencies (*n*), mean values (\bar{X}) and standard deviations (S) in Table 4.

Table 4. Means (\bar{X}), percentages (%), standard deviations (S) and frequencies (n) for the teachers' sensitivities towards technology and environmental ethics.

ItemNo	Strongly Disagree	Disagree	Agree	Strongly Agree	\bar{X}	S	n
	%	%	%	%			
Item 1	-	0.8	50.7	48.5	3.48	0.52	239
Item 2	0.4	-	32.2	67.4	3.66	0.5	239
Item 3	-	8.4	66.5	25.1	3.17	0.55	239
Item 4	0.8	3.3	35.6	60.3	3.55	0.6	239
Item 5	32.6	47.3	16.3	3.8	1.91	0.8	239
Item 6	36.8	44.7	12.6	5.9	1.88	0.84	239
Item 7	1.7	1.3	35.1	61.9	3.58	0.61	239
Item 8	0.9	0.9	22.4	75.8	3.73	0.51	238
Item 9	0.4	-	19.7	79.9	3.79	0.44	239
Item 10	4	29	49	18	2.81	0.77	238
Item 11	0.8	2.9	42.7	53.6	3.49	0.6	239
Item 12	10.4	38.1	31	20.5	2.61	0.93	239
Item 13	0.8	5	45.2	49	3.42	0.63	239
Item 14	0.6	8.9	62.5	28	3.18	0.59	237
Item 15	-	0.8	47.5	51.7	3.51	0.52	238
Item 16	50.6	31.4	12.1	5.9	1.73	0.89	239

When the responses given to the questionnaire items were examined in terms of total scores and factor groups, the group, which had the highest, mean value was found to be "environmental sensitivity" ($\bar{X} = 3.53$). The factor group having the lowest mean score was found to be the second factor group "caring about the benefit to living things" ($\bar{X} = 2.19$). The mean score of the third factor group "threat to the environment and life" was found to be $\bar{X} = 3.43$. The total mean score found for the responses given to the questionnaire items was also found to be high ($\bar{X} = 3.09$). Thus, it can be said that the participating students' sensitivities towards the issues of technology and environment are high.

3.1.2. H1 = Findings Related to The Hypothesis 1 "the Teachers' Ethical Opinions about Technology and Environmental Issues Vary Significantly Depending on Their Branch." [95% Confidence Interval]

When the teachers' responses were examined for total scores and factor groups, it was found that their responses to the total scores ($\bar{X}_{sci} = 3.05$, $\bar{X}_{class} = 3.19$, $t(237) = 3.63$, $p < 0.05$) and to the first factor group "environmental sensitivity" ($\bar{X}_{sci} = 3.5$, $\bar{X}_{class} = 3.6$, $t(237) = 2.42$, $p < 0.05$) and to the second factor group "Caring about the Benefit to Living Things" vary significantly by the branch variable in favor of the classroom teachers. Based on the differences between the total scores, the H1 hypothesis "The teachers' ethical opinions about technology and environmental issues do not vary significantly depending on their branch." was refuted and the hypothesis "The teachers' ethical opinions about technology and environmental issues vary significantly depending on their branch." was supported.

3.1.3. H2 = Findings Related to the Hypothesis 2 "The Teachers' Ethical Opinions about Technology and Environmental Issues Vary Significantly Depending on Their Gender" [95% Confidence Interval]

The findings related to the gender variable used in the study were first examined in terms of total scores and factors groups and no significant different was found. Thus, H2 hypothesis "The teachers' ethical opinions about technology and environmental issues do not vary significantly depending on their gender." [95% confidence interval] was supported.

3.1.4. H3 = Findings Related to the Hypothesis 3 "The Teachers' Ethical Opinions about Technology and Environmental Issues Vary Significantly Depending on Their Professional Seniority" [95% Confidence Interval]

The findings related to the professional seniority variable used in the study were first examined in terms of total scores and factors groups. The total scores obtained from the questionnaire

($F(6-232) = 2.22$; $p < 0.05$) and the mean scores obtained for the first factor group “environmental sensitivity” ($F(6-232) = 2.25$; $p < 0.05$) were found to be varying significantly by the professional seniority variable. As a result of the Tukey’s HSD (honest significant difference) test conducted on the total scores and the mean scores for the first factor group “environmental sensitivity”, it was revealed that for both types of the scores, the source of the significant difference was found to be the differences between the mean scores of the teachers working for 11–15 years and the teachers working for 31 years and more. At the same time, in terms of the total scores, the difference between the mean scores of the teachers working for 1–5 years and the teachers working for 31 years and more was also found to be the source of the significant difference between the total scores. These significant differences were found to be favoring the teachers with 31 years and more professional seniority. Based on these differences, the H3 hypothesis “The teachers’ ethical opinions about technology and environmental issues do not vary significantly depending on their professional seniority.” was refuted and the hypothesis “The teachers’ ethical opinions about technology and environmental issues vary significantly depending on their professional seniority.” was supported.

3.2. Findings Related to the Qualitative Data

3.2.1. Findings from the Content Analysis of the Responses Given by the Science and Classroom Teachers to the “Natural Resources, Forest, Environment” Scenario

In this context, the teachers were asked “Can the problems such as migration from village to city, population growth, etc., leading to destruction of forests be overlooked?” and all the teachers responded that it cannot ($n_{\text{total}} = 30$, 100%).

- When the reasons behind the teachers’ responses are examined, it is seen that if it is overlooked, then the destruction of forest can accelerate ($n_{\text{science}} = 10$, 66.6%),
- Those forests should always be protected ($n_{\text{science}} = 4$, 26.6%, $n_{\text{classroom}} = 1$, 6.6%),
- That it should not be overlooked yet there is already a group of people protecting forests (people living in villages ($n_{\text{science}} = 1$, 6.6%, $n_{\text{classroom}} = 3$, 20%),
- That such problems can accelerate the depletion of resources ($n_{\text{classroom}} = 5$, 33.3%),
- That controlled residential places should be established to prevent such problems ($n_{\text{classroom}} = 5$, 33.3%).

The most frequently expressed opinion in this scenario is that such social problems will accelerate the destruction of forests. Some related excerpts from teachers’ responses are given below:

Teac.7/Science: It cannot be overlooked. Parallel to the immigration from village to city and population growth, forests are negatively affected from mines and constructions;

Teac.2/Classroom: It shouldn’t, immigration from village to city is an important problem and is not a solution to the protection of resources.

The teachers were asked the question “To what extent can the idea that forests can be used to meet the human needs resulting from economic, social and cultural reasons even if it poses threats such as erosion and desertification be supported?” and a few of them ($n_{\text{total}} = 5$, 16.6%) stated that some of them can be used to meet human needs ($n_{\text{science}} = 2$, 13.3%, $n_{\text{classroom}} = 3$, 20%). Yet, a large majority of the teachers ($n_{\text{total}} = 83.4\%$) stated that they should not be used ($n_{\text{science}} = 13$, 86.6%, $n_{\text{classroom}} = 12$, 80%). The reasons behind their responses are given below:

- Natural balance should not be distorted, and forests should be protected ($n_{\text{science}} = 8$, 53.3%);
- Humans should be made more conscious about forests ($n_{\text{science}} = 2$, 13.3%);
- Different alternatives should be formed for human needs ($n_{\text{classroom}} = 2$, 13.3%);
- Forests have many benefits to humanity ($n_{\text{classroom}} = 9$, 60%).

The idea most expressed by the teachers within the context of this scenario is that natural balance should not be distorted and the benefits of forests to humanity are many. Some related excerpts from teachers' responses are given below:

Teac.11/Science: *For the comfort of humans that will last 10–20 years, it would not be correct to destroy forests;*

Teac.5/Classroom: *I think that there can be no legitimate reason for the destruction and unconscious exploitation of forests;*

Teac.1/Classroom: *This cannot be defended. Forests are the lungs of our country.*

3.2.2. Findings from the Content Analysis of the Responses of The Science and Classroom Teachers Given to the “Eugenic” Scenario

In the Eugenic scenario, first the teachers were asked whether the efforts made to create a perfect race and to eliminate the bad characters are ethical or not. A content analysis was conducted on the teachers' responses to this question and it was found that very few of the teachers ($n_{\text{total}} = 1$, 3.3%) have no idea on this issue ($n_{\text{science}} = 1$, 6.6%), and few ($n_{\text{total}} = 2$, 6.6%) think that some manipulation can be made on ethical values and that this can be considered to be an ethical behavior, not leading to any problem in the future ($n_{\text{classroom}} = 2$, 13.3%). A large majority of the teachers on the other hand ($n_{\text{total}} = 27$, 90%) believe this is not ethical, stating the following reasons for their thought:

- This behavior does not comply with the natural selection, everything should be kept in their natural state ($n_{\text{science}} = 7$, 46.6%, $n_{\text{classroom}} = 4$, 26.6%);
- This is not ethical, yet it can be used to some extent if ethical diseases are considered ($n_{\text{science}} = 6$, 40%, $n_{\text{classroom}} = 3$, 20%);
- Such an application does not have any ethical side and ending the life of an embryo as its intellectual capacity is low is a murder ($n_{\text{classroom}} = 6$, 40%);
- There is nothing like genetic race, race is a political and religious phenomenon ($n_{\text{science}} = 1$, 6.6%).

In this scenario, the idea that the efforts made to create a perfect race and to eliminate bad characters is the most mentioned idea. Some related excerpts from teachers' responses are given below:

Teac.5/Science: *It is not absolutely an ethical behavior. It is an artificial selection. The nature is already making this selection to a great extent. Perfectionism is a relative concept. No living thing can be deprived of its right to live, especially that of man!*

Teac.6/Classroom: *Certainly no. Ending the life an embryo due to limited intellectual capacity is a murder.*

The teachers were asked whether the use of eugenic to decide on character selection could be overlooked considering its important use to eliminate genetic diseases. Their responses to this question were subjected to content analysis. While few teachers ($n_{\text{total}} = 3$, 10%) stated no opinion about this issue, a large majority of them ($n_{\text{total}} = 27$, 90%) stated that this could not be overlooked. The reasons behind this belief of the participants are given below:

Ending the life of embryos not having the basic characteristics is not an ethical behavior ($n_{\text{science}} = 1$, 6.6%),

- This might lead to discrimination and disputes in the society ($n_{\text{science}} = 4$, 26.6%);
- This is against human rights and freedoms ($n_{\text{science}} = 3$, 20%);
- It may allow the misuse of science ($n_{\text{science}} = 1$, 6.6%);
- It may result in the creation of one type of person ($n_{\text{classroom}} = 6$, 40%);
- It can be used to prevent diseases, but not for character selection ($n_{\text{science}} = 3$, 20%, $n_{\text{classroom}} = 1$, 6.6%);

- Alternative methods can be developed to prevent diseases; it should not be used for character selection ($n_{\text{classroom}} = 6, 40\%$).

The idea that alternative methods should be developed to prevent diseases and it should not be used for character selection as it may lead to creation of one type of person in the society is the most mentioned idea in this scenario. Some related excerpts from teachers' responses are given below:

Teac.5/Classroom: Diseases can be prevented with other medical methods without changing the genetic structure;

Teac.3/Classroom: One type of people. The intention is good but the result is disastrous.

In the Eugenic scenario, the participants were asked whether it would be right to give a birth to a child who has been determined to have a genetic disease with genetic screen tests. Majority of the participants stated that they are undecided in response to this question. In their responses, the following statements come to the fore:

- Only one teacher ($n_{\text{total}} = 1, 3.3\%$) said that he/she would not have such a test ($n_{\text{science}} = 1, 6.6\%$);
- More than half of them ($n_{\text{total}} = 18, 60\%$) stated that it would be difficult to decide about this subject and their preferences could change depending on the degree to which the baby could meet his/her needs for personal care ($n_{\text{science}} = 10, 66.6\%$, $n_{\text{classroom}} = 8, 53.3\%$);
- Some of them ($n_{\text{total}} = 6, 20\%$) stated that they would prefer giving birth to baby because every living thing has the right to live ($n_{\text{science}} = 3, 20\%$, $n_{\text{classroom}} = 3, 20\%$);
- Some of the teachers stated that they would prefer ending the life of the embryo as they did not want the family, society, and the baby himself/herself to experience some serious problems in the future ($n_{\text{total}} = 5, 16.6\%$), ($n_{\text{science}} = 1, 6.6\%$, $n_{\text{classroom}} = 4, 26.6\%$).

Some examples of the undecided responses of the teachers are given below:

Teac.4/Science. If this disease is a disorder not effecting the life much, then I prefer his/her living but if he/she is not self-sufficient, then I prefer ending his/her life;

Teac.7/Classroom: It is now difficulty to say something about it. A reasonable decision can be to end his/her life, but an emotional decision can be to let him/her live.

When the teacher's responses given to the question whether determining the desired and undesired genes is an ethical behavior within the eugenic scenario were examined, it was found that some of the teachers stated no opinion about the subject ($n_{\text{total}} = 4, 13.3\%$) ($n_{\text{classroom}} = 4, 26.6\%$), some of them ($n_{\text{total}} = 10, 33.3\%$) stated that this behavior could be considered to be ethical ($n_{\text{science}} = 7, 46.6\%$, $n_{\text{classroom}} = 3, 20\%$). The reasons behind these decisions are given below:

- If it is related to genetic diseases ($n_{\text{total}} = 7, 23.3\%$, $n_{\text{science}} = 7, 46.6\%$) and
- If it is for the happiness of humanity, children can be prevented from having a bad character or a defect ($n_{\text{total}} = 3, 10\%$, $n_{\text{classroom}} = 3, 20\%$).

More than half of the teachers ($n_{\text{total}} = 16, 53.3\%$) believe this behavior cannot be ethical. The reasons behind this decision are given below:

- Intervening in nature is not correct; it may lead to discrimination ($n_{\text{total}} = 8, 26.6\%$, $n_{\text{science}} = 8, 53.3\%$);
- It cannot be ethical but when treatment to an illness is considered, this may change ($n_{\text{total}} = 7, 23.3\%$, $n_{\text{classroom}} = 7, 46.6\%$);
- It cannot be ethical, yet this may change if the policy adopted by the state is to allow everyone to use this technology ($n_{\text{total}} = 1, 3.3\%$, $n_{\text{classroom}} = 1, 6.6\%$).

The idea that determination of desired and undesired genes is not an ethical behavior has been more emphasized within this scenario. Some related excerpts from teachers' response are given below:

Teac.1/Science: *It cannot be considered ethical; I do not find intervening in the nature correct;*

Teac.2/Classroom: *This is related to genetically modified organisms. There is a way to be followed in the science of medicine. Even changing the stream bed of a river can lead to negative results. The type and extent of the “determination” operation is important. If it allows the person to get rid of a problem, then it is OK. If commercial interests are involved, then it cannot be approved.*

3.2.3. Findings Obtained from the Content Analysis of the Responses Given to the “Global Climate Policy” Scenario by The Science and Classroom Teachers

The pre-service teachers were asked what kinds of threats can be created to the future of the humanity as the sole decision makers on such an important issue are the presidents of countries and when their responses to this question were analyzed, it was found that:

- Very few of the teachers stated no opinion about this issue ($n_{\text{total}} = 2, 6.6\%$, $n_{\text{science}} = 2, 13.3\%$);
- Some of them ($n_{\text{total}} = 13, 43.3\%$) stated that this would result in famines, droughts, and disasters in countries ($n_{\text{science}} = 7, 46.6\%$, $n_{\text{classroom}} = 6, 40\%$);
- Some of them stated that some problems could be caused by presidents not globally thinking and by country-specific policies ($n_{\text{total}} = 6, 20\%$, $n_{\text{science}} = 6, 40\%$);
- They also stated that decisions made by individual authorities could lead to great losses; thus, referendums need to be held to make decisions ($n_{\text{total}} = 9, 30\%$, $n_{\text{classroom}} = 9, 60\%$).

Within the context of this scenario, the most emphasized idea is that if the decisions on environmental issues are made only by presidents, then countries can be confronted with problems such as famine, drought, and disasters. In this regard, some excerpts from teachers’ responses are given below:

Teac.12/Science: *The natural balance is destroyed. Climate changes are experienced. Natural resources are depleted;*

Teac.5/Classroom: *This might lead to destruction of masses, climate changes, droughts, and famines.*

Within the context of the global policy scenario, the teachers were asked whether the decisions made by presidents of countries from past to present have effects on the global warming and climate change we are experiencing today. When their responses to this question were analyzed, it was found that a small portion of them did not state any opinions on this issue ($n_{\text{total}} = 2, 6.6\%$, $n_{\text{science}} = 2, 13.3\%$); few of them stated that these decisions did not have any effects ($n_{\text{total}} = 2, 6.6\%$, $n_{\text{science}} = 1, 6.6\%$, $f_{\text{classroom}} = 1, 6.6\%$). A large majority of them believe these decisions have affected ($n_{\text{total}} = 26, 86.6\%$), ($n_{\text{science}} = 12, 80\%$, $n_{\text{classroom}} = 14, 93.3\%$). The reasons stated by the participants for their opinions are given below:

- Government authorities do not take the required precautions ($n_{\text{science}} = 12, 80\%$, $n_{\text{classroom}} = 13, 86.6\%$);
- Besides them, the publics do not take the required precautions either ($n_{\text{classroom}} = 1, 6.6\%$);
- Within the context of this scenario, the most emphasized idea is that the climate problems experienced today are mostly the result of the decisions made by government authorities from past to present. In this regard, some sample excerpts are given below:

Teac.1/Science: *Of course, as they are the authorities to make decisions;*

Teac.2/Classroom: *Yes. The presidents of the countries controlling, managing, and exploiting the world are responsible for.*

4. Results and Discussions

The analysis of the quantitative data in the current research has revealed that the teachers’ ethical sensitivities towards the items related to technology and environmental issues, natural habitats,

environmental sensitivity, the use of genetic technologies and development of ethical sensitivity in students are high. From the responses given to the Technology and Environmental Ethics Questionnaire, it is clear that the teachers think that teaching students how to make conscious use of the environment and natural resources should be an indispensable part of education, the natural habitats should not be opened to human dwelling and the environment should not be destructed in this way. In the related literature, it is also emphasized that the concept of ethics should be made a part of education and the school should have a role of imparting ethical values to their students [54–56]. In addition to this, in some studies, it was reported that elementary school students' attitudes towards the environment are high [51,57].

In the current study, it was determined that the participants' ethical sensitivities about the issues of technology and environment are high. As a result, of the literature review, this finding was found to concur with the literature to a great extent [18–22]. Yet, different results have also been reported by some other studies. In another study, conducted on the pre-service classroom teachers, the interest of the participants in the environment and environmental problems teachers study teachers' sensitivity was found to be weak [58].

In the current study, significant differences were found for total scores and some factor groups to the branch variable. The total scores, the mean scores for the first factor group "environmental sensitivity" and the mean scores for the second factor group "caring about the benefit to living things" were found to vary significantly by the branch variable in favor of the classroom teachers. When the related literature is reviewed, it is seen that environmental awareness of science teachers is lower than the expected level [59], classroom teachers' self-efficacy is higher than that of science teachers [60] and science teachers' environmental attitude scores are at the medium level [61].

When the participating teachers' responses given to the quantitative measurement tool were examined in relation to the gender variable, no significant differences were obtained in terms of total scores and factor groups. When the effect of the gender variable is examined in the literature on the environment and biotechnology, it is seen that there are studies reporting results similar to ours [6,20,58,62–68] yet there are also some studies reporting results in favor of female participants [19,23,51,57,61,69–71].

In the current study, the participating teachers' responses to the quantitative measurement tool were analyzed in terms of the professional seniority variable, it was found that the teachers working for 31 years and more approach more sensitively towards the issues of technology and environment. Lazarowitz and Bloch [6] found that the biology teachers having more professional experience have higher levels of ethical awareness of the issues of biotechnology than the biology teachers with relatively less professional experience. Weeks, Moore, McKinney and Longenecker [68] investigate the effect of the length of service on judgment and found that those with longer length of service have more positive ethical judgments.

In the current study, three scenarios were formed, and these scenarios were constructed based on the 9th item in the first factor group representing environmental sensitivity; 10th item in the second factor group representing benefit to living things and 14th item in the third factor group representing threat to the environment and life. Here the findings derived from the analysis of the teachers' responses to these scenarios are presented in an integrated manner. The teachers' agreement with the statement "Teaching individuals how to make efficient use of resources by introducing them into the environment should be an objective of education." is high ($\bar{X} = 3.79, 99.6\%$). The details of the responses given to this statement were elicited through the scenario "Natural resources, forest and environment" and the data obtained from this scenario were found to comply with the data obtained from the questionnaire. The participating teachers are against the use of natural resources such as forests to meet our needs to a great extent and support the efficient use of resources. In this regard, while the science teachers believe intervening in natural resources is a wrong behavior no matter what the rationale is, the classroom teachers emphasize the numerous benefits of forests. Kızılaslan and Kızılaslan [72] conducted a study to determine the rural people's level of consciousness of environmental problems

and found that the farmers think that the destruction in forestlands is excessive and this is because of the illegal cutting. At the end of the study, the researchers suggested that for the protection of forests and for the prevention of unconscious use of pesticides, greater attention should be paid to the education of farmers' children on environmental issues to make them more sensitive.

The 10th item of the questionnaire is "I think that determination of the race of people by using genetic technologies can lead to racial discrimination" point to a kind of eugenic movement. More than half of the teachers agreed with this statement ($\bar{X} = 2.81$, 67%). The "Eugenic" scenario was formed based on this item and the teachers' response given to this scenario seem to support the questionnaire findings. In the scenario, the same think is asked to the participants as whether the determination of desired and undesired genes is ethical. More than half of the teachers stated that it is not ethical. This is because the science teachers think that this application will lead to discrimination in the society. Chabalengula, Mumba and Chitiyo [63] found that after a course program organized for science teachers about advanced scientific methods, the teachers were found to be opposed to intervention on genes by using biotechnological methods to a large extent.

The teachers' agreement with the 14th item of the questionnaire "I think that the reason for the environmental problems experienced today is the wrong decisions made from past to present." is high ($\bar{X} = 3.18$, 90.5%). This finding is supported by the teachers' responses given to the scenario "Global climate policy" developed based on this item. The teachers believe the decisions made by government authorities from past to present have effect on global warming and climate changes. According to them, the reason for this belief of theirs is that as the decision-making authorities they have not taken the necessary precautions.

When the qualitative data obtained from the scenarios were analyzed in detail, it was found that in the scenario "natural resources, forest and environment" corresponding to the first factor group (environmental sensitivity) in the quantitative measurement tool, all of the teachers responded negatively to the question "Can the problems such as migration from village to city, population growth, etc., leading to destruction of forests be overlooked?" In the current study, while both groups of teachers argue that social problems should not be overlooked, the science teachers more strongly emphasize that forests should always be protected than the classroom teachers. On the other hand, the classroom teachers point out that the problems ignored will accelerate the depletion of resources in the future and to prevent this, controlled settlements need to be constructed. As a result, it seems that while the science teachers' main motive is to protect the environment, the classroom teachers feel more concerned about the future. In the scenario "natural resources, forest and environment", the teachers were asked "To what extent can the idea that natural resources such as forests can be used to meet the human needs resulting from economic, social and cultural reasons even if it poses threats such as erosion and desertification be supported?" and a few of them stated that some of them can be used to meet human needs. However, large majority of the teachers argue that they should not be used. The science teachers here also emphasize that natural resources should not be destroyed and should be protected in any case. The classroom teachers on the other hand argue that forests have many benefits and the required precautions should be taken to prevent problems that can emerge in the future in relation to forests. Like our results in the literature they have stated that forests must be protected and that individual efforts must be made for this [73–78]. Within the context of the scenario "Eugenic" corresponding to the second factor group (caring about the benefit to living things) in the quantitative measurement tool of the study, the teachers were asked whether the efforts made to create a perfect race and to eliminate bad characters is ethical and it was found that very few teachers have no idea on this issue and a few of them think that some manipulation can be made on ethical values and that this can be considered to be an ethical behavior, not leading to any problem in the future. A large majority of the teachers on the other hand believe this is not ethical. The science teachers are more strongly against the idea of creating the perfect race and elimination of bad characters than the classroom teachers as it is against the natural selection; however, they adopt a milder attitude when it comes to elimination of genetic diseases. On the other hand, the classroom teachers are against

this idea on the grounds that it does not have any ethical aspects. In a study conducted on the 8th graders, it was found that many of the students support the use of biotechnological methods for the treatment of genetic diseases [48]. Evsel [79] found that the ratio of the participants agreeing with the statement “I want to take advantage of technological and scientific developments to have a baby with desired characteristics” is 43.3%. Among the study group consisting of urban and rural consumers and professionals, the professionals displayed the most negative attitude towards this statement.

The teachers were asked whether the use of eugenic for controversial issues such as character selection could be overlooked considering its important use to eliminate genetic diseases. While few teachers stated no opinion about this issue, a large majority of them stated that this could not be overlooked. The science teachers are against the use of eugenic applications for character selection to a great extent as they may lead to discrimination in the society and as they are against the human rights. The classroom teachers are against the use of eugenic applications for character selection on the grounds that they may lead to creation of one type of person and argue that alternative methods can be developed for the prevention of diseases. Due to possibility of selecting character, the classroom teachers are more strongly against the eugenic applications overlooking their potential benefits, indicating that they have more negative attitudes towards them than the science teachers. Erbaş and Evsel [80] also elicited the participants’ opinions about the interventions to determine the gender, health, intelligence, and beauty of the child and found that interventions directed to health were found to be agreed by the participants to the greatest extent with 40.5%. The most strongly reacted interventions were found to be those related to gender and beauty.

In the Eugenic scenario, the participants were asked whether it would be right to give a birth to a child who is likely to have a genetic disease with genetic screen tests. More than half of the participants stated that they are undecided in response to this question. A small portion of the teachers stated that they prefer giving birth to this child on the grounds that each living thing has a right to live. On this issue, the science and classroom teachers have similar opinions. Though the number of teachers thinking that life of the embryo should be ended, the classroom teachers adopted more futurist approach than the science teachers by stating that the family, society, and the baby himself/herself might experience some serious problems if the embryo is allowed to live. Uysal, Cebesoy and Karışan [56] conducted a study on pre-service science teachers and found that the participants are undecided in general about the use of genetic applications and genetic knowledge. Yet, they found that the participants support the use of genetic applications in some cases (abortion, pre-implementation, genetic diagnosis, gene therapy). Evsel [79] asked the participants whether they have an abortion if their baby is diagnosed to have a serious genetic disease because of a genetic test and 74.3% of the participants responded positively if it is within the legal abortion period (10 weeks). Yet, in case of a pregnancy exceeding the legal abortion period, this ratio has fallen to 59.3%.

When the participants were asked for their reasons behind their decisions, they provided similar answers to the ones found in the current study, stating that they did not want the mother and the baby to experience problems in the future. In a similar study, it was determined that 40.6% of the participants were against giving birth to a baby diagnosed with a mental disorder during pregnancy and 39.6% of them were against giving birth to a baby diagnosed with a physical disorder [56]. In another study, it was reported that 56.8% of the participants are against giving birth to a baby if it is revealed that the baby is going to be disabled as a result of a series of tests [81]. These findings reported in the literature support the related finding of the current study.

When the teachers’ responses given to the question whether determining the desired and undesired genes is an ethical behavior within the eugenic scenario were examined, it was found that more than half of the science and classroom teachers stated that it would not be an ethical behavior. The science teachers are against this as they think that intervening in nature is not correct because it might lead to discrimination in the society. On the other hand, the classroom teachers stated that their opinion might change when it comes to genetic diseases. Erbaş and Evsel, [80] found that the ratio of the participants agreeing with the statement “I want to take advantage of technological and scientific

developments to have a baby with desired characteristics" is 43.3%. More than half of the participants on the other hand did not agree with this statement. Similarly, Evsel [79] reported that 61.7% of the participants support the inclusion and exclusion of some characteristics through genetic analysis tests. In another study, similar results have been reported. Uysal, Cebesoy and Karışan [56] found that the pre-service science teachers are against the use of genetic interventions to make people longer or shorter (50.4%), more intelligent (51%) or to determine the gender (66%). Yet, when the treatment of diseases is considered, a large majority of the participants support the use of genetic interventions; 78% for heart disease and 85% for breast cancer. Given that ethical behaviors are shaped by social life and traditions and customs, it can be argued that the existing ethical values of our society have significant effects on the opinions stated by the participants of the current study. Yet, the number of participants supporting the idea of selecting genes when it comes to genetic diseases is not so small.

Within the context of the "global climate scenario" corresponding to the third factor group "threat to the environment and life", the teachers have concerns about the environmental losses that can be brought about by the decisions made by presidents on their own in critical meetings and organizations about environmental issues. They also stated that decisions made by individual authorities could cause countries to face famines, droughts, and disasters; thus, referendums need to be held to make such decisions. The opinions of science and classroom teachers on this issue are parallel. The teachers also believe that the decisions made by presidents of countries from past to present have effects on the global warming and climate change we are experiencing today. According to them, the reason for this belief of theirs is that as the decision-making authorities they have not taken the necessary precautions. The teachers find the decision of the president mentioned in the global climate policy scenario about withdrawing from the global climate treaty unethical to a great extent. The teachers think that this is a selfish decision. The reason for the increasing number of teachers undecided about this issue may be because they consider this scenario to be political; thus, they do not want to express their opinions. From another perspective, it might be that while the participants feel more hesitant when the scenario wants them to express their opinions about others, they feel more relaxed to express their own opinions when they themselves are concerned. Global climate change is on the agenda of countries as a growing problem with each day. At the Rio conference in 1992, attention was drawn to the issue of climate change, and in the Kyoto Protocol, which was signed in 1997 and entered into force in 2005, the decision to reduce greenhouse gases was made. However, it has been argued that countries should take more responsibility for the problem of climate change and that developing countries should also take part in these agreements [82]. With the Paris Climate Treaty put into force in 2016, the two countries, America and China, which have had the greatest contributions to the emission of greenhouse gases, stipulated that they would reduce the emission of these gases, which is of vital importance to keep the global climate increase under 2 degrees [82]. However, America declared to withdraw from this treaty in 2017. As a result, it has been said that all countries should strictly abide by this treaty; otherwise, irreversible losses would occur [83].

Through the current research, the teachers' awareness is believed to have been raised by determining their ethical sensitivities with the administered measurement tools. Teachers with high ethical sensitivity are believed to educate their students with the same sensitivity. Thus, children can be raised as individuals with high sensitivity towards environmental issues and with awareness of the risks posed by technological developments. With their high level of ethical sensitivity, they can take responsibility in terms of using technologies involving great risks, protecting natural resources, and preventing environmental destruction. The current study was conducted in Turkey, but it addresses a global issue. Today, destruction of forests, fast depletion of natural resources and potential benefits and harms of technological applications concern all nations. All over the world, teachers specialized in natural sciences are knowledgeable about these issues. How successful they will be in informing their students about these issues depends on their own ethical sensitivity.

In light of the findings of the current study, some suggestions were made to contribute to the development of ethical sensitivities of teachers;

The participating teachers' ethical sensitivities towards the issues of technology and environment were found to be high. However, the classroom teachers were found to have more positive attitudes towards some certain statements than the science teachers; thus, science teachers can be supported with in-service training about ethical issues.

As the science and classroom teachers do not have any ethics courses in their undergraduate education, they should be encouraged to establish associations of ethics so that they can take part in effective discussions about ethical issues. In this way, their ethical sensitivities can improve.

The current study was conducted with science and classroom teachers who, when compared to teachers of other branches, have more opportunities to teach about the issues of technology and environment.

However, future research can focus on teachers from other branches with relatively less emphasis on the issues of technology and environment. Thus, data can be gathered about the ethical sensitivities of teachers from other branches and if any branch with low ethical sensitivity is determined then the curricula of this branch can be renewed in such a way as to put greater emphasis on ethical issues.

Author Contributions: B.C. contributed to the article in gathering data, scanning the literature, analyzed the results and drafted the manuscript. N.S. conceived the study, designed and supervised the study, participated in results analysis and reviewed the manuscript. Both authors have read and approved the final manuscript.

Funding: This paper is a part of first author's doctoral thesis and has been granted by the Muğla Sıtkı Koçman University Research Projects Coordination Office through Project Grant Number: (17/096).

Acknowledgments: Authors wish to thank the members of dissertation committee for generously offering their time, discussion, ideas, and feedback.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix

Open-ended questions for Scenario 1: Natural Resources, Forest, and Environment.

(a) Is it possible to overlook social problems such as immigration from country to city resulting in the destruction of forest resources? Why?

(b) To what extent can the idea that natural resources such as forests can be exploited to meet human needs be supported based on economic, social, cultural, and political causes even if it poses risks such as erosion and desertification?

Open-ended questions end of the Scenario 2: Eugenic.

(a) Is it ethical to attempt to create a genetically perfect race and to eliminate bad characters? Why?

(b) Is it possible to overlook the use of this movement for controversial issues such as character selection considering its important use to eliminate genetic disorders? Why?

(c) Let's assume that there is a genetic disorder in your family. In addition, you want to learn whether your child will suffer from this disorder; do you prefer to end or not to end the life of the embryo if the result has been found to be positive? Why?

(d) Can the determination of the desired and undesired genes be an ethical behavior? Please write a detailed description of your point of view.

Open-ended questions end of the Scenario 3: Global Climate Policy.

(a) What kinds of dangers can be brought about when such an important decision for the world and humanity is made by a president of a government?

(b) Do you think that decisions made by the presidents of countries from past to present have effects on the threats posed by global warming and climate changes to our world? Why?

(c) Do you find the decision of the president mentioned in the text about withdrawing from the global climate treaty ethical? Why?

Appendix

Table A1. Themes, Categories, Subcategories, % and Frequency Values Derived from the Content Analysis of the Responses Given to the Scenarios.

Theme	Categories	Subcategories	n	%
Natural resources, forest, environment	Whether social problems such as migration from country to city, population growth leading to the destruction of forests can be overlooked	Cannot be overlooked	30	100
	Whether natural resources such as forest can be exploited based on economic, social, cultural, and political arguments to meet human needs even if it poses risks such as erosion and desertification	Can be exploited	5	16.6
		Cannot be exploited	25	83.4
Eugenic	Whether the efforts invested to create a genetically perfect race and to eliminate bad characters are ethical	Ethical	2	6.6
		Not ethical	27	90
		No idea	1	3.3
	Whether the use of this movement for controversial issues such as character selection can be overlooked considering its important use to eliminate genetic disorders	Cannot be overlooked	27	90
		No idea	3	10
	Whether it would be right to give birth to a baby who will likely to have a genetic disease as a result of genetic screening tests	Would be right	6	20
		Would not be right	5	16.6
		Undecided	18	60
		Never use such a test	1	3.3
	Whether determination of desired and undesired genes is an ethical behavior	Ethical	10	33.3
Not ethical		16	53.3	
No idea		4	13.3	
Global climate policy	What kinds of dangers can be brought about when such an important decision for the world and humanity is made by a president of a government	It can lead to disasters for countries	13	43.3
		It can yield some implications for the policies of countries	6	20
	Whether decisions made by the presidents of countries from past to present have effects on global warming and climate changes	One-sided decisions can lead to huge losses; thus, referendums should be held	9	30
		No idea	2	6.6
	Whether decisions made by the presidents of countries from past to present have effects on global warming and climate changes	They have	26	86.6
		They do not have	2	6.6
		No idea	2	6.6

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