

Determination of science and biology teachers' ethical sensitivities towards the use of experimental animals

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Abstract

It is important to determine the ethical sensitivities of teachers who have a high potential to work with experimental animals due to their branches. With this purpose, the current study aimed to determine science and biology teachers' ethical opinions about the use of experimental animals. To collect data, the questionnaire of opinions about the use of experimental animals was employed. The collected data were analysed by using descriptive statistics, percentages, frequencies, mean values and *t*-test. There were 70 participants. While the science and biology teachers approached the sixth item, 'Animals can be used in experiments in which they experience some pain for the benefits of humanity', with higher ethical sensitivity, the female participants were found to be more sensitive towards the second item, 'Alternative methods should be the first methods to be employed by researchers'. It is suggested that science and biology teachers should be subjected to training to raise their ethical sensitivities about the issue.

Keywords: Animals, ethics, laboratory experiments, teachers' sensitivity;

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1. Introduction

The subjects that teachers are expected to develop high ethical awareness for during their undergraduate education can be broadly discussed in theory, from the ethical consideration of biotechnological practices to them being ethical in their behaviours and attitudes towards their students. However, one of the situations where teachers can make practical ethical inquiries is the practice-oriented courses in undergraduate education. In this connection, when the content of the undergraduate programmes in which teacher training is given, it is understood that there are laboratory practices lessons in which science and biology teachers interact with live animals (YÖK, 2020). Situations such as the approach of teachers to a live animal for practice purposes or the progress of the practice to be conducted according to the course content in a way that respects animal welfare may lead them to make ethical inquiries. It can be thought that these processes will constitute the first step of pre-service teachers' approach to experimental animals with ethical sensitivity. However, although the use of experimental animals is limited to these applications for teachers, it is important in many scientific studies.

Experimental animals are used primarily to develop diagnosis and treatment methods in medical research, as well as for safety tests of drugs and education. It is not possible to seek the consent of animals, and exposing animals to interventions that cause pain, distress or permanent damage during experiments causes ethical controversies (Tüfek & Özkan, 2018). The increase in animal experiments conducted in scientific research has led to an increase in the number of people opposing such experiments. While the anti-vivisectionist movement (those against testing, experimentation and training activities that are harmful to live animals) carried out their first protests in England in 1963, the first anti-vivisectionist organisation, 'The Victoria Street Society', was established in London in 1875.

After the Second World War, the increase in the use of animals in experiments caused some people to try to protect animals (Yaşar & Yerlikaya, 2004). Animal welfare has been an issue that has been discussed in different parts of the world since the 1960s. In our country, the first legal regulation for animals raised on farms for meat, milk, leather, wool and sports and animals to be used for scientific research was created with the 'Animal Protection Law' issued by the Ministry of Environment and Forestry in 2004 (Yaşar & İzmirli, 2006). Stating that the use of experimental animals is necessary for controlling and combating diseases in humans and animals, the 'World Veterinary Medical Association' argued that the use of animals in experiments should be minimal; the animal resources to be used should be well organised; the experiments should be in accordance with scientific qualifications; and unnecessary repetitions should be avoided (Yiğit, Sinmez, & Aslım, 2015). In addition, the discussion of animal behaviour can only be achieved if there are ethical concerns about animal life.

The use of animals in any practice or experiment is harmful to it in any case (Ögenler, 2015). Animals have been used in many situations that would yield various benefits, such as the eradication of certain diseases or the development or testing of drugs. However, today, alternative methods are developed not requiring the use of animals. However, if the use of animals in experiments is a necessity, then these experiments should be performed using appropriate anaesthesia methods (Sungurbey, 1992, as cited in Çobanoğlu & Aydoğdu, 2009).

At this point, it will be useful to talk about the basic principles that can guide researchers in animal experiments. These principles, defined as the 3R principle, are named after the initials of the terms Replacement, Reduction and Refinement. These principles were put forward by Tannenbaum and Taylor Bennett (1959), with the publication of 'principles of humane experimental technique'. Thus, in the period when there were no legal obligations for animal welfare, it was called to act with a sense of responsibility towards improving the concept of ethics in animal experiments. According to the 3R principle, it is aimed to minimise the use and suffering of animals and at the same time to lay the groundwork for quality and valid science. According to the 'replacement principle' in the 3R principle, it is aimed to use alternative models instead of laboratory animals, if possible.

The 'reduction principle' can be expressed as working on the smallest number of animals in a way that will not affect the statistical calculation. The 'refinement principle' refers to animal welfare. According to this principle, it is emphasised that the priorities of the researcher should be to prevent/minimise the distress and pain felt by the animals used in the experiments and to use the animals in accordance with the rules (Tüfek & Özkan, 2018). Today, university ethics committees have the function of evaluating the scientific studies submitted to them, taking into account these principles.

In this way, they evaluate the study independent of the researcher and protect the rights of experimental animals (Ergün, 2011).

Teachers have a status of guiding society, so they have to consider ethical values in their behaviours. Given the tendency of primary school students to model their teachers, the importance of ethical values is once again understood (Kocayığıt, 2010). In this regard, the teacher should primarily be equipped with an ethical formation and have a high awareness of ethical issues (Ceyhan, 2013). Based on the fact that science and biology teachers use animals in practice-oriented lessons as experimental or educational materials, the research problem and sub-problems of the current study were created.

1.1. Purpose of the study

The above-mentioned regulations have been made to protect animal welfare during the use of experimental animals in scientific studies or training. The current study aims to determine the ethical sensitivities of science and biology teachers, which are two of the branches where experimental animals are used, towards experimental animals and on which topics the participating teachers' opinions on this issue come to the fore.

To determine the ethical sensitivity of science and biology teachers towards the use of experimental animals, an answer to the research problem '*What are the ethical views of science and biology teachers about the use of experimental animals?*' was sought. To this end, the following sub-problems were developed:

- 1) Do science and biology teachers' ethical views on the use of experimental animals vary significantly depending on their branch?
- 2) Do science and biology teachers' ethical views on the use of experimental animals vary significantly depending on their gender?
- 3) Do science and biology teachers' ethical views on the use of experimental animals vary significantly depending on whether they have been involved in animal experiments before?

2. Materials and methods

2.1. Data collection instrument

The current study employed the general survey model, which is used to describe the situation being researched as it is and in its conditions. In the current study, as the data collection tool, the questionnaire of opinions about the use of experimental animals, developed by Yiğit et al. (2015), was employed. The questionnaire is designed in a 5-point Likert-type format of strongly disagree, disagree, undecided, agree and strongly agree. The questionnaire was prepared using 'Google Forms' in the online environment and administered to the voluntary participants all over Turkey.

2.2. Participants

The population of the study comprised all the science and biology teachers working in elementary and secondary education in Turkey and the sample consists of 70 science and biology teachers working in elementary and secondary education in Turkey. Roscoe (1975) stated that, for many studies, if the sample size is bigger than 30 participants and smaller than 500 participants and when the sample is divided into sub-samples (female/male, science teachers/biology teachers, whether having been involved in animal experiments/or not), if the size of the sub-sample meets the criterion of at least 30 participants, then this sample is considered to be enough to conduct the study. In the current study, only in the gender category, the number of male participants was found to be smaller than 30 (23). However, as in all the other sub-samples, the criterion of at least 30 participants was met and as the difference was not too large ($30-23 = 7$). This inadequate number of participants in this sub-sample was ignored.

As the sampling method, the convenience sampling method, one of the non-random sampling methods, was preferred in the current study. Convenience sampling refers to the selection of the sample from easily accessible units which are feasible to work with in terms of time, labour and existing limitations (Büyükoztürk, Çakmak, Akgün, Karadeniz, & Demirel, 2017).

2.3. Data analysis

A total of 70 science and biology teachers returned the questionnaire consisting of 11 items and as a result of the analysis of the data obtained from these 70 questionnaires, Cronbach's alpha reliability coefficient was found to be 0.52. As a result of the reliability analysis, the ninth item of the questionnaire 'Stray, unattended animals should not be used in research' was found to increase the internal consistency of the questionnaire when removed, and as a result, it was excluded from the questionnaire. Then, Cronbach's alpha reliability coefficient was calculated again and found to be 0.64. According to Kalaycı (2010), if it is $0.60 < \alpha < 0.80$, the questionnaire is quite reliable; this value indicates that the 10 items in the questionnaire represent a whole showing a homogeneous structure.

Based on the assumption that the intervals of the questionnaire used in the study are equal, average weight values were calculated with the following formula: Score interval = (The highest value – the lowest value): the number of categories (Ceyhan, 2013). Correspondingly, the following operation was conducted: $5-1 = 4$, $4:5 = 0.80$, to determine score intervals:

A score between 1 and 1.80 means 'strongly disagree';

A score between 1.81 and 2.61 means 'disagree';

A score between 2.62 and 3.42 means 'undecided';

A score between 3.43 and 4.23 means 'agree';

A score between 4.24 and 5.00 means 'strongly agree'.

By using these score intervals, the participating teachers' ethical sensitivity towards the use of experimental animals was expressed as high or low. After the administration of the attitude questionnaire regarding the use of experimental animals to a sample group of 70 teachers, from among the statistical methods, percentage (%), arithmetic mean (\bar{X}), standard deviation (SD) and frequency (f) values were used to analyse the collected data. Assumptions should be checked to determine the analysis method to be used in a study. In the current study, the Kolmogorov–Smirnov test, which tests the assumption of normality, was used and the data were found to show a normal distribution. To test whether the participating teachers' views on the use of experimental animals vary significantly, depending on the branch, gender and whether having been involved in animal experiments before, the independent samples t -test, one of the parametric tests, was used.

3. Results

In this section, the findings obtained as a result of the statistical analyses conducted to test the research problem and sub-problems are presented. First, the demographic features of the participating teachers are given in Table 1. Of the participating teachers, 45.7% are science teachers and 54.3% are biology teachers. 67.1% of the participants are female and 32.9% are male. Of the participating teachers, 47.1% have been involved in animal experiments before (Table 1).

Table 1. Percentage (%) and frequency (f) values related to the teachers' demographic features

Variable	%	f
Science teachers	45.7	32
Biology teachers	54.3	38
Female	67.1	47
Male	32.9	23
I have been involved in animal experiments before	47.1	33
I haven't been involved in animal experiments before	52.9	37

3.1. Statistical analyses

First, an answer was sought to the main research problem 'What are the ethical views of science and biology teachers about the use of experimental animals?' The responses given to the questionnaire items by the teachers by using one of the response options of strongly disagree, disagree, undecided, agree and strongly agree were analysed by means of percentage (%), frequency (f), mean (\bar{X}) and SD values (Table 2).

In Table 2 seen, when the responses given to the questionnaire items were analysed, it was

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found that the item with the highest level of agreement is 'The experiments including animals should

be conducted in certified animal breeding and/or keeping units' (87.1%), while the item with the lowest level of agreement was found to be 'Animals can be used in experiments in which they experience some pain for the benefits of humanity' (15.8%). On the other hand, the item for which the highest number of participants was found to be 'undecided' is 'Experimental animal use is more humane than raising animals for meat production' (25.7%).

Table 2. Mean, percentage and SD values regarding teachers' views on the use of experimental animals

	Strongly disagree	Disagree	Undecided	Agree	Strongly agree	M	SD
	%	%	%	%	%		
1. It is a necessity to use animals in scientific research.	15.7	21.4	20	27.1	15.7	3.06	1.328
2. Alternative methods should be the first methods to be employed by researchers.	4.3	5.7	5.7	45.7	38.6	4.09	1.032
3. Use of a small number of animals reduces the scientificity of research.	18.6	37.1	15.7	24.3	4.3	2.59	1.173
4. If the study is not species-specific, the cost is important in selecting animal species.	15.7	18.6	18.6	32.9	14.3	3.11	1.314
5. In animal experiments, human interests must take precedence over animal interests.	22.9	42.9	12.9	8.6	12.9	2.46	1.293
6. Animals can be used in experiments in which they experience some pain for the benefit of humanity.	38.6	30	15.7	12.9	2.9	2.11	1.149
7. The experiments including animals should be conducted in certified animal breeding and/or keeping units.	-	4.3	8.6	30	57.1	4.40	0.824
8. Animals should be used instead of alternative methods for the sake of animal health and welfare.	28.6	37.1	15.7	15.7	2.9	2.27	1.128
9. (If the study is not species specific), species should not be differentiated when using animals.	15.7	40	14.3	22.9	7.1	2.66	1.202
10. Experimental animal use is more humane than raising animals for meat production.	21.4	35.7	25.7	10	7.1	2.46	1.151

3.2. Findings related to the sub-question 'Do science and biology teachers' ethical views on the use of experimental animals vary significantly depending on their branch?'

The results of the analysis conducted to determine whether the science and biology teachers' views on the use of experimental animals vary significantly depending on their branch are given in Table 3.

Table 3. Results of the independent samples t-test according to the branch variable

Item no.	Branch	M	N	SD	t	p
6. Animals can be used in experiments in which they experience some pain for the benefit of humanity.	Science	1.78	32	1.039	-2.293	0.025
	Biology	2.39	38	1.175		

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* A statistically significant test result $p < 0.05$.

As can be seen in Table 3, the teachers' views on item 6 of the questionnaire, 'Animals can be used in experiments in which they experience some pain for the benefits of humanity' ($\bar{X}_f = 1.78$, $\bar{X}_b = 2.39$, $t_{(-2.293)}$, $p < 0.05$), were found to vary significantly depending on a branch in favour of the science teachers. The teachers from both the branches stated that they disagree with this item by 68.6%. However, the number of science teachers marking the response option 'strongly agree' for this item is higher than that of the biology teachers. Thus, it can be said that science teachers are more sensitive towards the use of experimental animals than biology teachers.

3.3. Findings related to the sub-question 'Do science and biology teachers' ethical views on the use of experimental animals vary significantly depending on their gender?'

The results of the analysis conducted to determine whether the science and biology teachers' views on the use of experimental animals vary significantly depending on their gender are given in Table 4.

Table 4. Results of the independent samples *t*-test according to the gender variable

Item no.	Gender	M	N	SD	t	p
2. Alternative methods should be the first methods to be employed by researchers.	Female	4.36	47	0.764		
	Male	3.52	23	1.275	2.915	0.007

* A statistically significant test result $p < 0.05$.

As can be seen in Table 4, the teachers' views on the second item of the questionnaire, 'Alternative methods should be the first methods to be employed by researchers.' ($\bar{X}_k = 4.36$, $\bar{X}_e = 3.52$, $t_{(2.915)}$, $p < 0.05$), vary significantly depending on gender in favour of the female teachers. While the female participants stated that they 'strongly agree' with this item, the male participants stated that they 'agree' with it. Thus, it can be argued that the female teachers show higher ethical sensitivity towards this item than the male teachers.

3.4. Findings regarding the sub-problem 'Do science and biology teachers' ethical views on the use of experimental animals vary significantly depending on whether they have been involved in animal experiments before?'

The results of the analysis conducted to determine whether the teachers' views on the use of experimental animals vary significantly depending on whether they have been involved in animal experiments before are given in Table 5.

Table 5. Results of the independent samples *t*-test according to whether they have been involved in animal experiments before

Item no.	Using experimen t animal	M	N	SD	t	p
4. If the study is not species-specific, the cost is important in selecting animal species.	Yes	3.45	33	1.252		
	No	2.81	37	1.309	2.096	0.040

* A statistically significant test result $p < 0.05$.

The teachers who have been involved in animal experiments were found to have a higher level of agreement with the item, 'If the study is not species-specific, the cost is important in selecting animal species', than the teachers who have not been involved in animal experiments ($\bar{X}_e = 3.45$, $\bar{X}_h = 2.81$, $t_{(2.096)}$, $p < 0.05$). While the teachers who have participated in animal experiments before were found to 'agree' with this item, the teachers who did not participate in animal experiments were found to be 'undecided'.

4. Discussion

Article 9 of the Animal Protection Law in Turkey state that, 'Animals cannot be used for non-scientific diagnosis, treatment, and experimental purposes. If there is no other option, animals can be

used as experimental animals in scientific studies' (Coşkun et al., 2007). In the current study, the science and biology teachers were found to agree/strongly agree with the item 'Alternative methods should be the first methods to be employed by researchers' (84.3%), indicating that they have high ethical sensitivity towards the animal rights put under protection in the Animal Rights Law. In the study where Coşkun et al. (2007) asked physicians and veterinarians to compare animal experiments with alternative methods, the participants in both professions (physicians 85%, veterinarians 82%) found alternative methods more humane than animal experiments.

When the literature is examined in terms of similar results, it is seen that Dedeoğlu and Özen (2017) stated that the participants in their study, in which they aimed to determine the approaches of Firat University student communities to animal use in scientific research, showed an animal-centred attitude similar to the results of the current study. Similar to the results obtained in the current study, Karakaya and Arslan (2016) stated that, in their study with ninth-grade students, the most strongly emphasised view was found to be that alternative methods should be given priority over animal experiments in areas such as obesity disease and the cosmetic industry. In the study in which Özen and Özen (2010) aimed to determine the views of students studying in biology, civil engineering, fine arts and veterinary medicine departments, 59.1% of the participants were found to be more inclined towards animal-centred views. Oakley (2012), in his study of science and biology teachers, aimed to elicit the participants' opinions about animal dissection (making an examination on dead animals) and alternative methods.

As a result of the study, it was found that 87.5% of the teachers are in favour of traditional dissection methods and think that they are vital for biology teaching. In the same study, 56.3% of the participants were found to be of the opinion that nothing can replace real animal dissection. As a result of the study, it was argued that ethical practices in science education should be implemented in order for teachers to look more deeply at the ethical problems underlying these practices. In another study, Navvaro, Maldonado, Pedraza, and Cavas (2001) stated that 65.7% of the psychology students participating in their study support animal experiments. In their study on veterinary faculty students and academicians, Yerlikaya et al. (2004) found that the participants are of the opinion that animal experiments are cheaper, more reliable and more scientific than alternative methods.

However, the participants were found to have a high level of agreement with the item 'Animal experiments are less conscientious', indicating that they are in a dilemma and this could be overcome by adding subject-specific courses to their curriculum. When the relevant literature is examined in light of the findings of the current study, it can be reached that the generalisation of more individuals shows high ethical sensitivity in their approaches to experimental animals, who consider animal welfare to a large extent and who think it would be more appropriate to turn to alternative methods if possible.

With the bylaw issued in the Official Gazette on 16 May 2004, by the Ministry of Agriculture and Rural Affairs in Turkey on the Protection of Experimental Animals Used for Experimental and Other Scientific Purposes, the Production Sites of Experimental Animals and the Establishment, Operation, Inspection, Procedures and Principles of Laboratories that Will Conduct Experiments, it is aimed to establish and operate the production sites of the animals used for scientific purposes in good technical and hygienic conditions in such a way as to take care of the welfare of animals. In the current study, the highest level of agreement was found for the item 'The experiments including animals should be conducted in certified animal breeding and/or keeping units' (87.1%). The level of agreement found for the same item in the study by Yiğit et al. (2015) was 74%. When the literature on animal studies to be carried out in licensed units is examined, it is emphasised that animals should be provided with the best possible and closest conditions to their natural environment (Ergün, 2011). If, in research or education, alternative methods are not sufficient and the use of experimental animals is required, then doing this in areas where appropriate conditions are provided and necessary permits are taken can be enforced for animal welfare.

When the results of the current study were examined in terms of the demographic variables, a significant difference was obtained in a different item for each demographic variable. When the participants' responses were examined in terms of a branch, the science teachers were found to exhibit a more sensitive approach towards the item 'Animals can be used in experiments in which they experience some pain for the benefits of humanity' than the biology teachers (Table 3). Navvaro et al. (2001), in their study comparing different branches, stated that biology and psychology students' attitudes towards animal experiments were similar. Yiğit et al. (2015) stated that they obtained a

significant difference in the views of the necessity of using animals in scientific research in terms of the faculty who graduated. It is understood that the existing research is not sufficient in terms of branch comparisons, and it can be thought that the ethical approaches to animal rights and animal welfare in the curriculums of faculties can be effective in structuring the ethical sensitivities of university students towards the subject in different ways.

When the results of the current study were examined in terms of the gender variable, female teachers were found to highly support working with alternative methods rather than experimental animals than the male teachers. According to Navvaro et al. (2001), men approved of animal experiments more than women. İzmirli, Yiğit, and Phillips (2014) stated that they did not find a significant difference in terms of gender in the study in which they aimed to determine the attitudes of Australian and Turkish first- and third-year veterinary faculty students towards animal welfare and rights. According to Özen and Özen (2010), in animal experiments, men think more anthropocentric rather than animal-centred compared to women.

5. Conclusion

It can be concluded that women have a mindset that cares about animal life more than men. However, in the literature, different results have been reported on the effect of gender on the views of using alternative methods rather than animal experiments. Yet, more results are showing that men support animal experiments more than women. Therefore, it can be stated that women approach this issue with more ethical sensitivity than men.

It is understood that the science and biology teachers, who agree to conduct studies involving experimental animals in licensed and appropriate areas and to apply alternative methods rather than animal experiments, approach the subject with ethical sensitivity. It is pleasing for future generations that teachers who train future decision-makers are sensitive to issues that take into account the welfare of experimental animals. However, the presence of statements that the participating teachers are indecisive about making it necessary to make suggestions for restructuring the course contents in undergraduate education.

The subjects that teachers are most indecisive about include whether the use of experimental animals in scientific studies or education is a necessity and if it is a necessity, under which conditions this should be conducted should be explained with the relevant law and the 3R principle, and teachers' concerns and indecision about these issues should be minimised. To achieve this, it is thought that besides re-organising the course contents, seminars or in-service training will be beneficial. In addition to the importance of the ethical sensitivity of the teachers who will take part in animal experiments for educational purposes during their undergraduate studies, having knowledge about the relevant legal regulations can minimise the issues in which they can experience a dilemma.

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