European Journal of Educational Research
Volume 8, Issue 2, 545 - 558.
ISSN: 2165-8714
http://www.eu-jer.com/

# Evaluation of Pre-service Science Teachers' Argumentation Skills, Knowledge Levels and Attitudes Regarding Organ Transplantation and Donation

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*Received: February 5, 2019 ▪ Revised: March 20, 2019 ▪ Accepted: March 27, 2019*

**Abstract:** The purpose of this study was to evaluate pre-service science teachers' argumentation skills, attitudes and knowledge levels regarding organ transplantation and donation (OTD). Teachers play a fundamental role in providing information to children/adolescents and could influence their attitudes. Organ transplantation is a life-saving hope for many people, but shortage of organs for transplantation is a universal problem. Having a positive attitude and true knowledge are essential for teachers that affect students' future attitude toward this topic. The research method was descriptive and cross-sectional. The sample of research was 472 pre-service science teachers, who were sampled by using convenient sampling method and are students of Science Education Department at four different public universities. Data collection instruments were developed by researchers as valid and reliable questionnaire in order to determine the attitudes, knowledge levels and argumentation skills of pre-service teachers regarding OTD. Results observed that the pre-service science teachers' argumentation skills in a socio-scientific subject such as OTD were at a very low level, their attitudes were at a moderate level, and their knowledge level was above the average. Results of the study have shown that graduated high school type and grade level have played important roles in the positive attitudes, high argumentation skills and high knowledge level about organ donation. No significant difference was found in the attitudes and knowledge level of pre-service science teachers toward OTD in terms of gender. The gender only affected the ability of argumentation.

**Keywords:** *Pre-service teacher attitude, argumentation skill, knowledge level, organ transplantation, organ donation*

**To cite this article:** Gurkan, G., & Kahraman, S. (2018). Evaluation of pre-service science teachers' argumentation skills, knowledge levels and attitudes regarding organ transplantation and donation. *European Journal of Educational Research*, *8*(2), 545-558. doi: 10.12973/eu-jer.8.2.545

## Introduction

Individuals are constantly confronted with socio-scientific issues. Socio-scientific issues are open-ended, controversial, ill-structured and debatable issues (Sadler & Donnelly, 2006; Wu & Tsai, 2011), which have scientific base (Sadler & Zeidler, 2005), implementations in one or more fields (medicine, biology, sociology, ethics, politics, economy, and environment) (Simonneaux, 2007) and within which opposing views are supported. Representing dilemmas that include both scientific and social dimension simultaneously, socio-scientific issues should not be considered separately from science education (Sadler, 2011; Sadler, Amirshokoohi, Kazempour, & Allspaw, 2006). Therefore, in many countries these issues are included in science curriculum, and it is aimed to develop students' comprehension regarding these issues. Including socio-scientific issues in science education is regarded as a way to strengthen scientific literacy by encouraging students to develop their capacity for evaluating information that they come across during their daily lives (Pouliot, 2008).

Organ donation, which is a socio-scientific issue, is practiced on two people simultaneously by its very nature. As a third party the donor is also included in the accustomed bilateral doctor-patient relationship. Having more than one person within the organ transplantation and donation (OTD) process increases the importance of the ethical dimension of organ transplantation (Akin, 2007). Society's education level, socio-economic status, morals, cultural and religious structure are significantly important in terms of organ transplantation and organ donation. Although there is no immorality regarding organ transplantation and organ donation, society's views based on false beliefs and idle fears seem to affect organ donation negatively. In order to solve the problem of insufficient organ donation, which falls

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behind the current developments regarding the transplantation surgeries, required studies should be conducted to determine the sources of these negative views and awareness should be created (Zambak, 2014).

The lack of proper understanding of scientific concepts limits the use of scientific knowledge in daily life (Hogan, 2002; Sadler & Fowler, 2006). Being engaged in socio-scientific issues in daily life, taking information or revealing new claims, requires evaluating the claims with available evidence (Xiao, 2015). Making informed decisions about such controversial and public issues has been an important target of science education all over the world (OECD, 2006; Ryder, 2001). The New Generation Science Standards emphasize the importance of raising students as individuals who criticize scientific knowledge about their daily lives and emphasizes that students should have qualifications to make informed decisions about social problems related to science, also known as socio-scientific subjects (National Research Council, 2011). Organ transplantation as a socio-scientific issue is a life-saving hope for many people around the world. However, the number of recipient patients on waiting lists for different organs continues to increase. The major concerns causing organ shortage are lack of awareness and correct information among public, myths and misconception clouding organ donation due to religious and cultural barriers, etc. (Adithyan, Mariappan, & Nayana, 2017) Undoubtedly, having argumentation skills, true information and positive attitude about organ donation process are one of the most important factors decision-making period of organ donation (Saylan, 2014). It is important to measure the attitude of social groups that might have a strong influence on the public opinion, such as medicine staff, teachers, journalists and religious authorities (Febrero et al., 2014). Therefore, it is necessary to provide a suitable platform for encouraging people to organ donation through the involvement of other groups of society (especially teachers) in the culture building practices in this regard. Argumentation is an important tool for scientific discourse and participation. Jiménez-Aleixandre and Erduran (2008) summarize the contribution of argumentation to educational environments from different perspectives. These are promoting cognitive and metacognitive processes, developing communicative skills and critical thinking, developing scientific reading and writing skills, understanding scientific culture and epistemologies, understanding rationality and developing logical reasoning. Therefore, in science education, researchers should use various arguments in the classroom to search for a variety of ways to develop students' argumentation skills.

Participation in the argumentation process involves students making assertions, using the data to support these claims, guaranteeing their claims with scientific evidence and further supporting or refuting claims and guarantees when presented with additional data. Students also use support, rebuttal and qualifiers to further their justification as arguments to become more complex. Throughout this process, students learn both scientific concepts and deal with authentic science practices. Therefore, it is expected that the argumentation will not only allow students to consolidate existing scientific knowledge, but also to build new knowledge for themselves based on the ideas of others (Brown & Campione, 1990).

Studies showed that pre-service teachers with more field knowledge have developed knowledge transformation skills, express their arguments to the other party better. Pre-service teachers with lower field knowledge, on the other hand, have trouble expressing their views (Demiral & Cepni, 2018). This result is consistent with some studies in the literature (Cross, Taasoobshirazi, Hendricks, & Hickey, 2008; Khishfe, 2012; Sadler & Donnelly, 2006; Sadler & Fowler, 2006; Sadler & Zeidler, 2005). According to these researchers, students need to have an advanced scheme to transfer the information. The researchers observed that while the preliminary information influenced participation in the argumentation process, the new information on the subject made individuals more willing to learn, and the students who had high knowledge had put forward their claims more clearly. Educational institutions play the biggest role in generating a solution to controversial issues with both social and scientific dimension such as organ transplantation and donation. Schools, where teacher-student and student-student communication is the most common, are places these kinds of controversial and science-based issues are addressed with an interdisciplinary approach by taking beneficence-maleficence situations into consideration. Looking at the factors that affect the decision of organ donation, it is seen that characteristics like race, age, income, education level and gender are also determinative. The common characteristics of organ donors are being young, well-educated and having a high socio-economic status (Ozdag, 2001). Studies showed that cadaveric organ donation rates are pretty high in countries, which place importance to education regarding organ transplantation and organ donation and are able to create a level of awareness about this issue in society. In addition to that, comparisons between east-west or developed-developing countries determined that in all societies younger people compared to older people, women compared to men, well educated people compared to less educated people have a more positive view regarding organ donation. It was also found out that people with bachelor's degree or higher education levels accept donating organs more often (Alat et al., 2007). In order to increase organ donation rates, studies suggest that in every level of education- from primary to higher education- this subject should be addressed, the number of organ donation campaigns should increase, and society's positive attitude toward organ donation should be developed by raising awareness (Kocak, Aktas, Senol, Kaya & Bilgin, 2010).

Organ donation is a humane action, which is practiced completely with one's free will and voluntarily. It is significant that teachers have information, argumentation skills, awareness and positive attitudes regarding these issues, which include these kinds of controversies. Teachers are the ones who will first-handedly discuss these issues with their students in both scientific and socio-scientific contexts.

It is thought that students use scientific information for making decisions and reasoning about socio-scientific issues. In addition to that, it is also determined that they usually rely on their personal experiences, values and moral concerns. Therefore, worldwide important science education research centers emphasize the need to develop student's skills for discussing and analyzing socio-cultural issues and making information-based decisions.

Within this context, teachers and pre-service teachers addressing socio-scientific issues like organ transplantation and donation during the scientific discussion processes with their students would cause multi-thinking people, who consider other disciplines while reasoning, become a part of society, take part in social decision-making processes and affect those decisions. Low organ donation rates in Turkey due to lack of understanding requires more emphasis on socio-cultural aspect of organ transplantation and donation. In order to make an informed decision during these processes, individuals should comprehend both scientific and socio-scientific aspects of the issue. At this point, people should be raised as individuals who have good argumentation skills about organ transplantation and donation within the scientific and socio-scientific context, positive attitude and correct information.

The importance of the role of science teachers, who undertake one of the most important tasks for raising science literate individuals, is obvious, and it is significant to reveal teachers and pre-service teachers' attitudes and knowledge levels regarding this situation, in addition to the belief-based reasons lying behind their arguments about these kinds of socio-scientific issues. In order for the students to comprehend scientific subjects that they learn in science classes and to develop qualified arguments, they need to have argumentation skills (Kuhn, 1993). Teachers also need to have argumentation skills and help students to gain these skills, in order for them to develop their students' attitudes and conceptual comprehensions about scientific issues in accordance with modern science education.

Therefore, the argumentation skills, attitudes and knowledge levels of pre-service science teachers about OTD, which is a socio-scientific subject, were examined and differences were analyzed according to gender, grade level and high school type variables.

*The Aim of the Study*

The role of teachers and their influence in the education and raising the level of students' awareness and consequently, raising their accountability in the education of society is important. Therefore, they can act as an influential body of the society in institutionalizing the culture of organ donation.

The aim of this study is to evaluate pre-service science teachers' attitudes, concept knowledge levels and argumentation skills regarding OTD. It is important to determine whether the pre-service science teachers (PST) are different in terms of their thoughts, feelings and behaviors related to the concept of OTD depending on the different demographic characteristics. If there is a significant difference in attitudes toward OTD due to these features, this will be discussed in the conclusion. In order to give an idea about teacher education and practice, it is important to conduct research on socio-scientific subjects such as OTD with teacher candidates. The results of these studies may encourage policy makers to revise the education of socio-scientific subjects.

The overarching purpose of the study concerned investigating pre-service science teachers' attitudes, knowledge levels and argumentation skills regarding OTD. Specifically, the study was based on the following three research questions:

- Is there any difference in the level of attitude/knowledge/argumentation skills about the concept of OTD according to the gender of PST?
- Is there any difference in the level of attitude/knowledge/argumentation skills about the concept of OTD according to the grade level of PST?
- Is there any difference in the level of attitude/knowledge/argumentation skills about the concept of OTD according to the graduated high school type of PST?

## Methodology

*Research Design and Participants*

In the study, the survey method, which is used to determine the current situation, is adopted from the descriptive research methods in the scope of the quantitative methodology. In the survey methods, latitudinal survey method was applied. With this method, the researcher applies a measurement tool to explain the situation, feature or phenomenon in a single time period (Fraenkel, Wallen, & Hyun, 2012). The study was conducted with a total of 472 pre-service teachers who were studying in the science education programs of a four different public university in Turkey in the 2017-2018 academic year and were selected according to the convenient sampling method out of purposive sampling methods. In this sampling method, the researcher selects a situation that is close and easy to access, which gives the research speed and practicality (Yildirim & Simsek, 2006). Anonymity and confidentiality of respondents were maintained and participation was voluntary. The necessary approval for study received from the administrators of Education Faculties. Table 1 shows the distribution of pre-service teachers according to demographic characteristics.

*Table 1. Demographic characteristics of pre-service science teachers*

| Demographic Features | | f | % |
|---|---|---|---|
| **Gender** | Female | 381 | 80.9 |
| | Male | 91 | 19.1 |
| **Grade** | 1st Grade | 99 | 20.3 |
| | 2nd Grade | 147 | 30.8 |
| | 3rd Grade | 147 | 30.6 |
| | 4th Grade | 79 | 18.3 |
| **Graduated High School Type** | Anatolian High School | 123 | 26.0 |
| | Vocational High School | 133 | 28.2 |
| | General High School | 216 | 45.8 |
| **Total** | | **472** | **100** |

*Research Instruments*

In this research three different data collection tools were used. These scales are organ transplantation and donation argumentation skills inventory (OTDASI), organ transplantation and donation attitude scale (OTDAS) and organ transplantation and donation knowledge test (OTDKT).

*Organ transplantation and donation argumentation skills inventory (OTDASI).* In the related literature, there are studies based on the Toulmin Argument Model to determine the quality of scientific argumentation of individuals (Erduran, Simon, & Osborne, 2004; Jimenez-Aleixandre, Rodriguez, & Duschl, 2000). In the light of Toulmin's Argument Model, 4 scenarios including "species cross-organ transplantation", "whole body and head transplant", "organ production with three-dimensional printers" subjects were constructed for evaluating the arguments developed by participants within a scientific context. Each scenario consists of four questions and these questions were developed by taking Toulmin's argumentation model's basic elements (See Appendix A for sample scenario). For the stage of the creation of the scenarios, the texts originating from the news which are related to the development of a large number of organ transplants and donations, which are considered to be appropriate, have been selected and these texts are arranged to create a dilemma.

While determining the evaluation criteria, they were classified as strong if claim, data, warrant, backing and rebuttal components were certain and sufficient; as weak if components were certain but insufficient; as nonexistent if components were uncertain and insufficient or left empty (Table 2). Studies about argumentation in the literature were taken into consideration during the determination of these criteria.

*Table 2. Evaluation rubric of argumentation skills*

| **Claim** | **0 (no)** | **1 (weak)** | **2 (strong)** |
|---|---|---|---|
| Answer a claim or original question | There is no claim or an unquestionable claim | Exact but incomplete claim | Exact and complete claim |
| **Evidence** | **0 (no)** | **1 (weak)** | **2 (strong)** |
| Scientific data supports the claim; the data need to be adequate and appropriate to support the claim. | Wrong or none given | Data from their daily life experience | Provided data by comparison. Experimental and scientific data were used. |
| | Wrong or none given | Inadequate reasoning | Sufficient reasoning supported by scientific data. |
| **Backing** | **0 (no)** | **1 (weak)** | **2 (strong)** |
| Conceptual quality of backing | No backing, wrong or not given at all. | There's one backing. | There are more than one backing. |
| **Rebuttal** | **0 (no)** | **1 (weak)** | **2 (strong)** |
| Explanation of the opposing claim | No rebuttal, wrong or not given at all. | There's a rebuttal. | There's more than one rebuttal. |

In order to increase the content validity and reliability, the pre-service teachers' answers were carefully read by the researcher and another expert separately and categorized into three. In order to provide internal consistency of the answers given to the scenarios, discussions were held about qualitative data until both researchers reached 100% consensus and a common idea was reached. In order to provide more internal consistency for the data analysis, the data set of a randomly chosen participant out of twenty participants was analyzed by another researcher. Internal consistency (reliability) of the findings from data analysis (code list and themes) were calculated with the formula developed by Miles and Huberman (1994) and found 0,92.

$$\text{Reliability} = \frac{\text{Consensus}}{\text{Consensus} + \text{Disagreement}}$$

One qualitative research in the literature stated that, in order to ensure reliability, conformity level between researchers should at least be 80% (Creswell, 2013). The difference between the researchers was caused by detailed and supportive reasons.

*Organ transplantation and donation attitude scale (OTDAS).* In the research, in order to determine the attitudes of PST regarding organ transplantation and donation, the scale developed by Gurkan and Kahraman (2018) was used. The 5-point likert scale, within which validity and reliability studies were done, consists of 20 items. In the attitude scale 11 items refer to negative attitudes, and 9 items refer to positive attitudes toward organ transplantation and donation. In the scale statements are graded as follows; "1- Strongly disagree", "2- Disagree", "3- Slightly agree", "4- Agree", "5- Strongly agree". As result of the exploratory factor analysis and conducted parallel analysis, in order to verify the two-factor structure and provide structural validity of the scale, confirmatory factor analysis was carried out. In order to calculate the reliability of 20 items in the organ transplantation and donation scale, internal consistency coefficient "Cronbach Alpha" was calculated. General consistency of the scale was found $\alpha$ =0.900. Examining goodness of fit criteria after confirmatory factor analysis $\chi^2/df$ = 1.98 was found, and in case of a $\chi^2/df$ value of 5 or smaller it is accepted that model data fit is perfect. GFI was found 0.94. Having the value of GFI >.90 points to an acceptable fit (Simsek, 2007). AGFI was found 0.92 and this value shows an acceptable fit. RMR was found 0.041, and having a RMR value <0.050 shows good fit. RMSEA value was found 0.045, having a RMSEA value <0.050 shows good fit (Munro, 2005). Analyses results point out that scale has a good fit in terms of determined factor structure since fitness statistic model calculated by confirmatory factor analysis is concordant on an acceptable level with real data gathered from the participants.

*Organ transplantation and donation knowledge test (OTDKT).* In order to develop the institutional framework of OTDKT, which was developed by the researchers, literature was widely reviewed, and item pool consists of 30 multiple choice questions regarding OTD was generated by examining the data collection tools used in related research. In the direction of expert views, 10 items were removed from the test, and the draft test consists of 20 items was made ready for pretest. For the draft scale performed with 106 Science Education undergraduate students enrolled in their 3rd and 4th years TAP statistics program was used for item analysis. As the result of item analysis items with low distinctiveness and difficulty indices were removed and item number was reduced to 12 (See Appendix B for sample questions).

For OTDKT mean distinctiveness level was found 0.47, mean difficulty value was found 0.60, and KR-20 reliability coefficient was found 0.706. Provided as evidence for reliability and validity of multiple choice tests developed to measure mental processes, these values should be evaluated together (Downing & Haladayna, 2006; Kubiszyn & Borich, 2013). According to this, examining these values together, it can be concluded that scores obtained from the developed test is able to differentiate pre-service teachers enrolled in their 1, 2, 3 and 4th years with various cognitive understanding levels regarding organ transplantation and donation; the test is medium difficulty and shows internal consistency.

*Data Analyses*

In the analyses of the data, besides the descriptive statistics, "independent samples t-test" and "one-way analysis of variance" were used. LSD (equal variances assumed), and Dunnett's C (equal variances not assumed) tests were used in Post Hoc Tests in order to determine the intergroup differences. In this study, the statistical significance level was accepted as .05.

## Results

The descriptive statistics analysis shows that the average in the total scores of the attitudes toward OTD was above the medium level (62.44). According to mean scores, it was found out that pre-service science teachers' knowledge level regarding organ transplantation and donation was found 7.91. Thus, it was found that pre-service science teachers' OTDK levels were above average. In scenarios, where argumentation skill was determined, mean score of students was found 10.95. Examining the answers of pre-service science teachers given to the argumentation scenarios developed based on Toulmin's Argumentation Model, it was found out that their argumentation skills- except from claim step- were on a low level (claim step mean score: 5.75; warrant step mean score: 2.46; backing step mean score: 1.35; rebuttal step mean score: 1.64). While the highest score that any PST could get from the all argumentation scenarios was 32, the highest score for each component (claim, warrant, backing and rebuttal) was 8.

Table 3 presents the results of the t-test, which indicates whether the pre-service science teachers' argumentations skills, attitudes and knowledge levels about OTD differ according to the gender variable.

*Table 3. The findings according to the gender variable*

| | Groups | N | Mean | SD | df | t | p |
|---|---|---|---|---|---|---|---|
| **OTDASL (0≤x≤32)** | Female | 381 | 11.21 | 5.27 | 470 | 2.04 | **.018** |
| | Male | 91 | 9.91 | 6.16 | | | |
| **OTDAL (20≤x≤100)** | Female | 381 | 63.00 | 15.78 | 470 | 1.93 | .783 |
| | Male | 91 | 60.10 | 16.29 | | | |

*Table 3. Continued*

| | Groups | N | Mean | SD | df | t | p |
|---|---|---|---|---|---|---|---|
| **OTDKL** | Female | 381 | 7.97 | 1.81 | 470 | 1,64 | .917 |
| **(0≤x≤12)** | Male | 91 | 7.62 | 1.84 | | | |

(**OTDASL:** Organ Transplantation and Donation Argumentation Skill Level**, OTDAL:** Organ Transplantation and Donation Attitude level, **OTDKL**: Organ Transplantation and Donation Knowledge level)

According to the results of the t-test in Table 3, the hypothesis is accepted that pre-service science teachers' argumentation skills about OTD shows a significant difference according to their gender (t (470) = 2.038, p = .018 <0.05). In other words, the mean scores of female PST argumentation skills toward on organ transplantation and donation were higher than those of male pre-service teachers. But, according to Table 3, the level of knowledge and attitude of PST about organ transplantation and donation does not differ according to their gender.

Table 4 shows the results of the one-way variance analysis, indicating whether the argumentation skills, attitudes and knowledge levels of the PST on organ transplantation and donation differ according to the grade level variable.

*Table 4. Results of the one-way variance analysis, indicating whether the argumentation skills, attitudes and knowledge levels of the PST on OTD differ according to the grade level variable.*

| | Variants | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| | Between Groups | 13574.58 | 3 | 182.54 | 6.29 | **.000** |
| **OTDASL** | Within Groups | 547.64 | 468 | 29.00 | | |
| **(0≤x≤32)** | Total | 14122.23 | 471 | | | |
| | Between Groups | 107302.83 | 3 | 3951.28 | 17.23 | **.000** |
| **OTDAL** | Within Groups | 11853.84 | 468 | 229.28 | | |
| **(20≤x≤100)** | Total | 119156.67 | 471 | | | |
| | Between Groups | 1503.17 | 3 | 22.80 | 7.10 | **.000** |
| **OTDKL** | Within Groups | 68.41 | 468 | 3.21 | | |
| **(0≤x≤12)** | Total | 1571.58 | 471 | | | |

(**OTDASL:** Organ Transplantation and Donation Argumentation Skill Level**, OTDAL:** Organ Transplantation and Donation Attitude Level, **OTDKL**: Organ Transplantation and Donation Knowledge Level)

According to the results of the One-Way Analysis of Variance in Table 4, the argumentation skills, attitudes, knowledge levels of PST about organ transplantation and donation showed a significant difference according to the grade level. Levene test was used to determine whether the groups' variances were equal in order to determine which groups differed according to the grade level (Table 5).

*Table 5. Test results for homogeneity of variables*

| Variables | Levene Statistic | df1 | df2 | Sig. |
|---|---|---|---|---|
| **OTDAL** | 3.42 | 3 | 468 | .017 |
| **OTDKL** | 4.76 | 3 | 468 | .003 |
| **OTDASL** | 19.89 | 3 | 468 | .000 |

(**OTDASL:** Organ Transplantation and Donation Argumentation Skill Level**, OTDAL:** Organ Transplantation and Donation Attitude Level, **OTDKL**: Organ Transplantation and Donation Knowledge Level)

According to the Levene test results in Table 5, OTDAL, OTDKL and OTDASL; since *p <0.05*, it was concluded that the variances were not equal, and Dunnett's C Test was used from Post Hoc Tests in cases where the variances were not homogeneously distributed (Table 6).

*Table 6. Post Hoc Test results for determining to the differences grade*

| Post Hoc Tests | Variables | Grade Level (I) | Grade (J) | Mean Difference (I-J) | Std. Error |
|---|---|---|---|---|---|
| | | | 2nd Grade | **9.15*** | 2.01 |
| | | 1st Grade | 3rd Grade | **9.90*** | 1.97 |
| **Dunnett's C** | **OTDAL** | | 4th Grade | -1.67 | 2.41 |
| | | | 1st Grade | 1.67 | 2.41 |
| | | 4th Grade | 2nd Grade | **10.82*** | 2.20 |
| | | | 3rd Grade | **11.57*** | 2.17 |
| | | | 1st Grade | .74 | .31 |
| **Dunnett's C** | **OTDKL**: | 4th Grade | 2nd Grade | **1.14*** | .30 |
| | | | 3rd Grade | **.85*** | .30 |
| | | | 1st Grade | 2.00 | .96 |
| **Dunnett's C** | **OTDASL** | 4th Grade | 2nd Grade | **2.54*** | .93 |
| | | | 3rd Grade | **3.19*** | .95 |

(**OTDASL:** Organ Transplantation and Donation Argumentation Skill Level**, OTDAL:** Organ Transplantation and Donation Attitude Level, **OTDKL**: Organ Transplantation and Donation Knowledge Level)

According to Table 6, 1st grade students' attitudes toward OTD were found to be higher than the 2nd and 3rd grade students. Also, 4th grade students' attitudes toward OTD were found to be higher than the 2nd and 3rd grade students. The level of knowledge about OTD of 4th grade students was higher than the 2nd and 3rd grade students. 4th grade students' argumentation skills toward OTD were found to be higher than the 2nd and 3rd grade students.

Table 7 shows the results of the One-Way Analysis Variance, indicating whether the argumentation skills, attitudes and knowledge levels of the PST on organ transplantation and donation differ according to the graduated high school type variable.

*Table 7. Results of the one-way variance analysis, indicating whether the argumentation skills, attitudes and knowledge levels of the PST on OTD differ according to the graduated high school type variable.*

| | **Variants** | **Sum of Squares** | **df** | **Mean Square** | **F** | **Sig.** |
|---|---|---|---|---|---|---|
| **OTDASL (0≤x≤32)** | Between Groups | 780.34 | 2 | 390.17 | 13.71 | **.000** |
| | Within Groups | 13341.89 | 469 | 28.44 | | |
| | Total | 14122.23 | 471 | | | |
| **OTDAL (20≤x≤100)** | Between Groups | 23060.41 | 2 | 11530.20 | 56.27 | **.000** |
| | Within Groups | 96096.25 | 469 | 204.89 | | |
| | Total | 119156.67 | 471 | | | |
| **OTDKL (0≤x≤12)** | Between Groups | 24.04 | 2 | 12.02 | 3.64 | **.027** |
| | Within Groups | 1547.53 | 469 | 3.30 | | |
| | Total | 1571.57 | 471 | | | |

(**OTDASL:** Organ Transplantation and Donation Argumentation Skill Level**, OTDAL:** Organ Transplantation and Donation Attitude Level, **OTDKL**: Organ Transplantation and Donation Knowledge Level)

According to the results of the One-Way Analysis of Variance in Table 7, the argumentation skills, attitudes, knowledge levels of PST about organ transplantation and donation show a significant difference according to the high school type variable. Levene test was used to determine whether the groups' variances were equal in order to determine which groups differed according to the grade level (Table 8).

*Table 8. Test results for homogeneity of variables*

| **Variables** | **Levene Statistic** | **df1** | **df2** | **Sig.** |
|---|---|---|---|---|
| **OTDAL** | 1.17 | 2 | 469 | .311 |
| **OTDKL** | .01 | 2 | 469 | .996 |
| **OTDASL** | 1.64 | 2 | 469 | .194 |

(**OTDASL:** Organ Transplantation and Donation Argumentation Skill Level**, OTDAL:** Organ Transplantation and Donation Attitude Level, **OTDKL**: Organ Transplantation and Donation Knowledge Level)

According to the Levene test results in Table 8, since *p> 0.05*, variances were found to be equal, and LSD test from Post Hoc Test was used in cases where the variances were distributed homogeneously (Table 9).

*Table 9. Post Hoc Test results for determining to the differences graduated high school type variable*

| **Post Hoc Tests** | **Variables** | **Grade Level (I)** | **Grade (J)** | **Mean Difference (I-J)** | **Std. Error** |
|---|---|---|---|---|---|
| **LSD** | **OTDASL** | Anatolian High School | General High School | **2.16*** | .60 |
| | | | Vocational High School | **3.43*** | .66 |
| **LSD** | **OTDAL** | Anatolian High School | General High School | **15.09*** | 1.61 |
| | | | Vocational High School | **16.88*** | 1.78 |
| **LSD** | **OTDKL** | Anatolian High School | General High School | .05 | .21 |
| | | | Vocational High School | **.52*** | .23 |

(**OTDASL:** Organ Transplantation and Donation Argumentation Skill Level**, OTDAL:** Organ Transplantation and Donation Attitude Level, **OTDKL**: Organ Transplantation and Donation Knowledge Level)

According to Table 9, pre-service science teachers who graduated from Anatolian High School argumentation skills and attitudes about OTD were found to be higher than general and vocational high school graduates argumentation skills. In addition, the level of knowledge about OTD of the pre-service teachers who graduated from the Anatolian High School was found to be higher than vocational high school graduates.

## Discussion

According to the data analyses results, it was found that pre-service science teachers' attitudes toward OTD were at a medium level, and that the levels of knowledge about organ transplantation and donation of pre-service science teachers were higher than the mean score. While the highest score that the pre-service science teachers can get from the argumentation scenarios was 32, the 10.95 mean score from the argumentation scenarios shows that the pre-service science teachers' argumentation skills were quite low. Furthermore, it is seen that the highest mean scores of the pre-service science teachers in the argumentation skills were taken in the claim step. In other words, the majority of pre-service teachers had a definite view on organ transplantation and donation. However, the mean scores of the pre-service teachers from the steps including supporting and rebuttal arguments were found to be quite low. According to this result, it can be said that pre-service science teachers' level of evidence was low, and they offer very low level of support to their evidence. The reason for this situation is the use of traditional methods rather than the methods and techniques to develop the argumentation skills of pre-service science teachers in the education and training processes. In an argumentation quality study conducted by Ciftci (2016), there were no supporting and rebuttal elements in student dialogues. The results of this study support our results. The level of knowledge of pre-service teachers about organ transplantation and donation was found to be close to the high level when the mean scores were examined. In the literature, no studies were conducted to determine the knowledge levels of science teachers and/or pre-service science teachers on organ transplantation and donation. However, Kavurmaci, Karabulut and Koc (2014) reported that in a study conducted with university students studying in four-year undergraduate programs of different faculties, students do not have enough knowledge about organ transplantation and donation. It has been found that the students mostly get information from mass media such as TV, internet, newspaper/journal. Similarly, university students studying in medical schools and other health-related faculties in many studies where knowledge levels in organ transplantation and donation were determined, it was stated that the level of knowledge was close to the middle and upper level and significantly differentiated especially according to the grade level variable (Kavurmaci et al., 2014; Kocak, et al., 2010; Lai, 2012; Ríos et al., 2010; Sadler & Donnelly, 2006).

The science teachers are an influential group that plays an important role in introducing the students to OTD by providing them with accurate educational orientation about the subject. However, there are not many studies conducted with science teachers in the literature. In the literature, few studies have been found assessing the attitude of secondary school teachers (Febrero et al., 2014; Lopez-Navidad et al., 1999; Rios et al., 2010) and both primary and secondary teachers (Khoddami-Vishteh, Ghorbani, Ghasemi, Shafaghi, & Najafizadeh, 2011; Mohammadpour, Mohammadpour, Ajam-Zibad, & Najafi, 2018) toward organ donation. In addition, only one study has been investigated knowledge of the brain-death concept among secondary school teachers (Rios et al., 2012). In Spain, the results of the study by Febrero et al., (2014) showed that 75% of teachers support the organ donation, and their attitude was influenced by the psychosocial factors. In Lopez-Navidad et al. (1999), research have reported on this matter, and only 20 teachers were interviewed, all of whom were sensitive to the issue of OTD, demonstrating a good knowledge of the general concepts related to OTD. Khoddami-Vishteh et al., (2011), in their study with 93 secondary school teachers in Iran, 70% of teachers have the opinion that they have a view to donate their organs. Rios et al., (2012) showed that a third of secondary school education teaching staff did not know or understand the concept of brain death as the death of an individual. The knowledge of brain death positively affects attitude toward organ donation. Mohammadpour et al., (2018) studied to determine the awareness, attitude and performance of teachers toward organ donation. The results of this data analysis indicated the moderate level of awareness, positive attitudes and a relatively weak performance of teachers regarding the organ donation. Based on the results of the present study, the teachers had a favourable attitude toward the organ donation, but did not have a good performance in this regard.

Compared to studies above mentioned, the results of our study are similar in terms of positive attitude and high level of knowledge. A positive attitude and the highest knowledge about organ donation are expected from teachers because they are supposed to be role models. It is also very promising to obtain these results from pre-service teachers. When examining the attitude and knowledge level concerning OTD attitudes in literature, it was seen that these studies were performed mostly with the medical students, high school students, middle school students and relatives of the patients (Lisowska, Budzińska, Ścieranka, Mazur & Smoleń, 2017; Ozturk-Emiral et al., 2017; Saleem et al., 2009; Shi & Salmon, 2018; Weiss et al., 2017; Zampieron, Corso & Frigo, 2010). In these studies, findings show that being an organ donor is affected by multiple factors; the knowledge level, socio-economic and socio-cultural status, awareness, religious beliefs, legal and medical processes. Also, although the participants state that they want to donate their organs, the number of individuals carrying the organ donor card is very small. In this context these studies suggested that issues related to organ transplantation and donation should be included early in the training programs to improve the attitudes of students to organ donation, and a more intensive interdisciplinary approach could bring about an even more positive attitude toward organ donation.

Also, in this research cross-sectional survey study assessed argumentation skill, knowledge and attitude regarding OTD among pre-service science teachers according to different variables (gender, grade level and graduated high school type). In this population we found that knowledge levels about OTD significantly differ with grade level and high school type. This difference for grade level is in favor of 4th grade pre-service science teachers. It can be said that 4th grade

pre-service teachers have higher knowledge levels about the OTD concept than the 2nd and 3rd grade pre-service teachers. This difference for high school type is in favor of Anatolian High School. The level of knowledge of pre-service science teachers who graduated from Anatolian High Schools was higher than the level of knowledge of graduated from Vocational High School.

Similarly, we found that attitudes regarding OTD affected with grade level and high school type. No significant difference was found in the attitudes of pre-service science teachers toward OTD in terms of gender. This finding is consistent with the results of the study conducted by Mohammadpour et al., (2018), who assessed the awareness, attitude and performance of teachers with regard to organ donation. However, our results were not consistent with the study of Febrero et al., (2014), who examined the attitude of secondary school working in the Southeast of Spain toward the organ donation and transplantation. 4th grade pre-service teachers' attitudes toward organ transplantation and donation were found to be higher than the 2nd and 3rd grade students. This result is consistent with the research results of Sturgis, Cooper and Fife-Schaw (2005). The attitudes of pre-service teachers who graduated from Anatolian High Schools toward organ transplantation and donations were found to be higher than the attitudes of general high school and vocational high school pre-service teachers toward organ transplantation and donation.

## Conclusions and Suggestions

Organ transplantation is one of the most important treatment modalities in diseases without treatment. With the increasing number of patients waiting for organ and tissue transplantation, the importance of the issue is raised more and more. From this point of view, it is thought that the positive attitudes of the students regarding the related subject in the education and training process will positively affect the organ donation behavior. Teachers can influence attitudes at the first hand. It will be inevitable that teachers who have a positive attitude toward organ donation will reflect this attitude positively to the class.

In conclusion, the study results have shown that gender, graduated high school type and grade level have played important roles in high argumentation skills and high knowledge level about OTD. Also, graduated high school type and grade level have played important roles in positive attitudes about OTD. Increasing organ donation rates is possible by changing and improving the socio-economic situation, but it is impossible to change religion, gender and age. In addition, it is possible to give correct knowledge about myths regarding organ donation. The sources of information on organ donation, which is a socio-scientific subject, are usually mass media, health workers and religious figures. These sources of information can be used for training in organ donation. It is accepted that effective integration of issues about organ donation into the curriculum can be achieved by teachers who have positive attitude and high knowledge level on issues such as OTD.

There are important responsibilities for the teachers who take the role of director and guide in the discussions. They present on the basis of the claims based on the valid data. It is an undeniable fact that the upbringing of active individuals who are aware of the socio-scientific issues such as OTD, which are aware of the necessity of modern societies, depends on the quality of the teachers who conduct the system.

This study measured the attitudes, knowledge level and argumentation skills of PST toward OTD. In our study, it was seen that pre-service teachers' level of knowledge and attitudes about organ transplantation and donation was higher than intermediate level and argumentation skills were very low. Also, it is concluded that the high level of knowledge and attitudes in the related subject does not mean that the argumentation skills in the subject matter will be high. Pre-service science teachers need to have an advanced understanding of argumentation, as this will affect the nature of classroom activities and how students learn what they do. Deficiencies in pre-service teachers' argumentation skills may be an obstacle to the development of science education programs in parallel with the development of scientific education. In particular, studies should be conducted to determine the factors affecting the pre-service teachers' argumentation skills, and education-training programs should be developed to improve the argumentation skills of pre-service teachers.

Studies similar to this which measures knowledge, attitude and argumentation skills of OTD can be carried out in other occupational groups and in-service teachers that constitute the society, because it will only be possible for the society to be sensitive toward organ donation in this way.

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## Appendix A. Sample Scenario for Argumentation Skills

**Scenario 1**

Scientists who worked for organ transplantation among species managed to run the heart they had taken from the pig and transferred to a babuna (a monkey breed) for 2 and a half years. In a study conducted jointly by American and German scientists, the baboon genes were modified and immunosuppressive drugs were used in order to avoid rejecting the pig's heart scientists have stated that the baboons of the pig heart transplanted have survived an average of 298 days. In addition, the heart of pigs is similar to that of people, and the risk of transmission of the virus is matured faster.

1. What would be your decision to transfer the heart from the pig if you needed a heart transplant because of your illness?

……

2. What are your evidence if you are asked to provide reasons for making your decision?

……

3. What would you say to persuade him/her if a friend did not agree with you?

……

4. What is the opinion or justification of this friend who does not agree with you?

……

**Scenario 1. Example Student-3 Sentences**

**Question 1 (Claim Step):** *I certainly would not want such a thing* (Exact and complete claim, point=2).

**Question 2 (Evidence Step):** *I do not believe that inter-species transplantation will generally succeed* (Inadequate reasoning, point= 1).

**Question 3 (Backing Step):** *I respected* (No backing, point= 0)

**Question 4 (Rebuttal):** *I don't know* (No rebuttal, point= 0)

In a scenario where a total score of 8 can be taken, the student received 3 points in total. In our study, 472 pre-service teachers' responses to 4 scenarios were scored as given in the example sentences above.

**Appendix B. Sample Questions from OTDKT**

**1. In order for a person to donate organs and tissues, which of the following conditions does not need to be carried?**

A. To be in the balance of mind

B. To declare a donation in the presence of two witnesses

C. Being 18 years and over

D. Fill the organ donation form

E. Not to exceed 50 years old

**2. Which are the criteria of death for the removal of tissues and organs?**

I. Brain Death

II. Herbal Life

III. Stopping Heart Rate

A. Only II B. I and II C. I, II and III D.I and III E. Only I

**3. Which of the following are tissue samples?**

I. Heart Cap

II. Bone marrow

III. Cornea

IV. Cartilage

A. I and IV B. II and III C. I, II and III D. II, III and IV E. All