Chapter 8

Examine the Attitudes of Teachers Against Statistics Participating in Statistics Education in Nature

Semra Türkan[1]

Ceren Ünal[2]

Gamze Kadılar[3]

Kürşad Özkan[4]

Halil Süel[5]

Abstract

In this study, the benefits of the Learn Statistics in Nature project carried out within the scope of the scientific and technological research council of Turkey unlike classical education, emphasize on the benefits of statistics teaching in nature. Thirty-six teachers from different branches participated. The activities related to the natural applications and examples of statistics were carried out. A statistical attitude scale developed by Zumbrun (2015) for teachers in 2015 was applied to the teachers who participated in the project at the end of the activities in order to determine their attitudes towards statistics science, statistics education, and statistics teaching.

1. Introduction

Statistics is key to understanding the past, managing the present and planning for the future. For this reason, statistics are frequently used in many fields from social sciences to engineering, from medicine to natural sciences.

1 Hacettepe University, Faculty of Science, Department of Statistics, Ankara, Turkey

2 Hacettepe University, Faculty of Science, Department of Statistics, Ankara, Turkey

3 Hacettepe University, Faculty of Science, Department of Statistics, Ankara, Turkey

4 Isparta University of Applied Science, Faculty of Foresty, Departmanet of Forest Engineering, Isparta, Turkey

5 Isparta University of Applied Science, Wild Life, Isparta, Turkey

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Today, the explosion of information and data in every field has increased the need for statistics and the statistical methods. As a result, lessons with data and statistics have started to be included in many education programs. However, as in many countries, as in our country, statistics education is limited to draw bar and pie charts and calculate mean, variance, the conceptual understanding such as data collection, reading and interpretation is not sufficiently emphasized. This situation causes students to have a weak basis in terms of statistical literacy and analytical thinking skills.

According to the report of GAISE (2005), statistics education should start in primary school in order to raise individuals who are statistically literate. Based on this study, important steps have been taken to improve statistics education all over the world recently. Following these developments in the world, some steps have been taken in our country to include statistical concepts in curricula, and basic statistical concepts have started to be included in the curriculum of primary, secondary and high school curricula after the transition to the 4 + 4 + 4 education system. From this point of view, statistics is regarded as a new subject for teachers in our country, and teachers' knowledge and skills related to statistics need to be increased (Koparan, 2015). In general, studies on statistics teaching show that students mostly have statistics anxiety (Akkoç and Yeşildere, 2015). Considering these results, it is of great importance to use different methods from classical classroom teaching methods that can be used to provide statistics teaching more effectively and to develop them by using visuality in new formats.

Recently, many techniques, models, methods, tools and materials are used in the transfer of contents to students. Thanks to the use of appropriate materials in education, students' perception and learning processes are facilitated, their motivation increases, and make subjects alive and ensure permanent learning (Aslan and Doğdu, 1993; Erden, 1998; Demiralp, 2007). According to the results of the research on learning, 83% of the learned ones are learned by seeing, 11% by hearing, 3.5% by smell, 1.5% by touch and 1% by tasting (Kaya, 2006).

Strengthening the statistical literacy of students is possible with teachers who teach problem solving and interpretation with real-life applications. Teachers who have never taken statistics at university or in their previous education may be anxious while teaching statistics. Teachers' anxiety towards statistics may contribute to their displease of the subject or the feeling that statistics are not necessary and may cause them to transfer this feeling to their students later (Zumbrun, 2015). Secondary mathematics teachers, who teach

statistics in secondary education, gain significant experience while teaching statistics, even if they do not receive sufficient education at university on the subject. These teachers may show a more positive attitude towards statistics than teachers who have no experience or have little experience in teaching statistics (Zumbrun, 2015).

Applied nature education in which nature is used as a laboratory environment is a teaching approach that enables individuals to acquire skills related to research and problem solving and permanent learning with the active participation of individuals (Ozaner 2004). TÜBİTAK has implemented the 4004-Nature Education and Science Schools program in order to enable a wide audience from students to public employees to touch science. The projects supported in this context offer important opportunities in terms of eliminating the deficiencies in nature-environment, bringing nature-friendly individuals to the society, and transferring them by establishing connections between various branches of science and nature (Oğurlu et al., 2013; Tekbıyık et al., 2013).

Since the information that is not transferred to practice is easy to forget, providing students with the opportunity to collect and analyze their own data can provide permanence in learning for statistics teaching (Watson, 2006). In this respect, nature is an open laboratory where a teacher can present data collection to a student in a simple, fun and educational way. Due to nature, it can be ensured that teachers comprehend the "cause-effect" relationship and transfer it to their students more easily, and also create awareness in their students thanks to nature and help them to internalize and reinforce the knowledge they have acquired. One of the prominent methods on this subject is the Nature Experience model, which predicts direct interaction of the person with nature and enables them to absorb the gains they have obtained in nature. According to this model, it is very important for the student to interact with nature, that is, to see, touch and measure objects in nature (Rickinson, 2001). Within the scope of the project, this model was utilized and it was thought that the students would be able to enjoy the science of statistics by living, touching, observing and measuring in nature and complete their knowledge about nature. Since it is necessary to raise awareness among teachers that statistics and nature can be handled together in order to students to receive such an education, the target audience of the project has been determined as teachers.

When the studies revealing the results of the projects within the scope of TÜBİTAK 4004-Nature Education and Science Schools are examined, it is stated that the responsibilities of the participants towards the environment

increased as a result of the activities in the projects (Güler, 2009; Özdemir, 2010); contributed to environmental awareness (Keleş et al., 2010); increased sensitivity towards the natural environment, environmental pollution and living species (Feyzioğlu et al., 2012); learning environments are more efficient and enjoyable (Buluş et al., 2011); contributed to their positive attitude towards science (Akay, 2013; Tekbıyık et al. 2013); information became easier to transform into behavior (Oğurlu et al., 2013); it was helpful in establishing the relationship between science and life (Marulcu, 2014).

This project, supported in 2020, was carried out between 19-24 August 2020. Within the scope of this project, in addition to statistics and scientific studies on nature, it was provided to the participant teachers to analyze and interpret the data obtained from nature with PAST statistical software used by nature scientists. In addition, it was built for activities related to music, visual arts and geography. At the end of the project, an attitude scale developed by Zumbrun (2015) was applied to measure teachers' attitudes and opinions towards statistics. In the literature, there are any study which teachers' attitudes towards statistics in Turkey are investigated.

When the scales developed for statistics in the literature are examined, it is seen that most of the scales developed are aimed at measuring students' attitudes towards statistical science (Roberts and Bilderback, 1980; Wise, 1985; Harvey et al., 1985; Cruise, et al., 1985; Zeidner, 1991; Berk and Nanda, 1998; Sutaro, 1992; Schau et al., 1995; Estrada et al., 2011; Hanna et al., 2008).

In Turkey, Köklü (2005) developed a statistical attitude scale that measures the attitudes of students who took statistics courses in ten departments for 1992-1993 academic year at Ankara University Faculty of Educational Sciences and the Faculty of Agriculture. Diri (2007) applied the attitude scale that investigates the attitudes and opinions of students studying at Bursa Uludag University İnegöl Vocational School of Business and Accounting Department for 2005-2006 academic year. Yolcu (2012) examined whether there is a relationship between statistical literacy of 1074 eighth grade students and their attitudes towards statistics in the spring semester of the 2011-2012 academic year and stated that there is a positive relationship between them. Doğan and Başokçu (2010) developed a statistical attitude scale to measure the attitudes of students studying in Science Education, Psychological Counseling and Guidance, Mathematics Education in Primary Education and Computer Teaching

and Technologies Education departments of Faculty of Education at Hacettepe University. Yolcu (2012) examined whether there was a relationship between statistical literacy of 1074 eighth grade students and their attitudes towards statistics in the spring semester of the 2011-2012 academic year and stated that there was a positive relationship between them. Yaşar (2014) has developed a statistical attitude scale that will determine the attitudes of students who take statistics course or a course related to statistics at Faculty of Education of Pamukkale University fot 2011-2012 academic year. It is to examine whether there is a relationship between the attitude towards statistics and success in statistics course in the study. Aydın and Sevimli (2019), examined candidate of mathematics teachers' self-efficacy beliefs and attitudes towards statistics lesson. They concluded that the candidate of teachers' self-efficacy beliefs towards the statistics course were high, whereas their attitudes towards the statistics course were moderate.

In recent years, there have been studies of teachers' attitude scale studies on statistical science, but these studies are limited and all of them have been conducted abroad. In the last few decades, researchers in mathematics education have shown more interest in studies on students' and teachers' attitudes and opinions towards mathematics and statistics, but the first study of secondary mathematics teachers' attitudes and opinions towards statistics was developed by Zumbrun (2015).

In the literature shows that the studies carried out in Turkey usually students at department of teacher and other departments at university and secondary school students is designed to measure attitudes and opinions concerning statistics. In all of these studies, the statistical attitude scale developed for students was used. There is no scale study in which the attitudes and opinions of teachers as teachers, students or learners were investigated at the same time, or any study in which the scale developed for teachers was used.

In this study, it was aimed to reveal the general attitudes towards statistics of the teachers participating in the project named Learn Statistics in Nature, their attitudes towards statistics as students or learners, and their attitudes towards statistics as a teacher. The Science of Labor Statistics in Turkey focused on secondary education programs in place. Activities related to statistics in the Learn Statistics in Nature project have been announced. As a result of the activities, a statistical attitude scale was used to reveal the participants' attitudes and views on statistics, and the results obtained were discussed.

1.1. The Place of Statistics Science in Teaching Programs

Statistics is an important science used in all areas of life and is generally taught in detail in universities (Gürbüz and Uçan, 2005). Statistics interact with other branches of science. It is known that it is used extensively in many fields such as medicine, engineering and biology, especially in social sciences (Çakır, 2000). In many departments of universities, an introduction to statistics course is given and there are some teaching departments within these departments. The development of computer package programs has greatly facilitated statistics education in universities recently. However, it is necessary to teach what statistics are included in the package programs, what it is for, and what it is used for. In short, teaching statistical literacy is necessary (Gürbüz and Uçan, 2005).

There are many definitions of statistical literacy in the literature. According to Gal (2002), statistical literacy is defined as the ability of individuals to interpret the results related to statistical data, to evaluate them with a critical perspective, and to express their opinions on the results. Özmen (2015) is expressed as the ability to know the basic concepts, interpret graphs and tables, make inferences and make decisions on data, approach critically and make comments.

Statistics education has been included in the secondary education mathematics curriculum in our country since 1949. When the curriculum is examined since 1949, it is seen that statistics education is generally about visualizing data. It can be said that especially since 2005, the acquisitions related to data visualization have been given in more detail by shifting towards the first years of secondary school education, and it is aimed that students can use these data visualization tools more intensively from an earlier age. It is noteworthy that with the arrangements made in the mathematics curricula in 2005 and 2013, subjects such as reading and representing data, using central tendency and dispersion measures, calculating probability, and making predictions and inferences from the data are now more common at different grade levels compared to the past. In statistics teaching, measures that enable defining the data set such as central tendency and dispersion measures are increasingly included in the programs. Similar to many countries, the interest in statistics and statistical thinking is increasing in the education programs of our country. However, there is a need for studies that will focus on the teaching and learning of Statistics content and that will produce teaching environments and applications that can be performed efficiently in Statistics education.

2. Conceptual framework

2.1. The Model of Study

The relational screening model, which examines the relationship between two or more variables, was used in the study (Creswell, 2003). In the study, the attitudes and opinions of teachers participating in the TUBITAK Learn Statistics in Nature project as students and teachers regarding statistics were determined, and it was examined whether these attitudes and opinions changed according to the variables of gender, branch, experience in the profession and whether or not they took the statistics course before.

2.2.Participants

The sample of the study consists of 36 teachers from different provinces and branches, participating in the Learn Statistics in Nature project supported by TUBITAK. 36 people were selected among 1317 applicants, taking into account the groups in which interest in the project, applications and gender are predominant.

Project activities are designed to be suitable for different educational programs. In the activities, it was aimed to ensure that teachers get to know and protect natural life, land and water ecosystems, and interact with nature and statistics, in parallel with the curriculum. Since statistics is an auxiliary discipline that can be applied to the data collected in all branches, it is not limited to mathematics, but it is thought that all teachers in different branches are suitable for activities. Statistical tables and graphs can be considered as an ideal visual teaching material for transferring basic concepts and information to students for the Social Studies course, where especially students are in a listening position and traditional teaching methods in the form of direct instruction and question-answer are used. For this reason, there is no limitation regarding the field of mathematics in the participation of teachers who train future students to the "Learn Statistics in Nature" project within the scope of TUBITAK 4004 Nature Education and Science Schools. The participation of teachers in all branches was ensured.

2.3. Instruments

Statistics education has an important place today. For this reason, the quality and competence of this training should also be high (Özdemir, 2014). Despite the increasing importance given to statistics in all education levels and branches, statistics is still seen as a difficult and unpopular field by many students (Chance et al., 2008). The project aims to combine statistics teaching with nature education outside the classroom.

The project activities that enable teachers to explain statistical issues through observations and practices in order to raise awareness on statistics science and technology were conveyed through sample applications on land and freshwater ecosystems in Ilgaz Mountain National Park, Tosya Dipsiz Lake Nature Park, Homa Canyon in Pınarbaşı District of Kastamonu and Ilıca Waterfall. With these activities, the information, warning, regulation, awareness, development, protection and etc processes were provided. It was aimed to develop positive behaviors in this direction in 36 participating teachers.

Basic activities related to statistics included in this training are summarized as below:

Event Name	Event Content Summary
Ecological Statistics	Basic Statistical Concepts (Mean, Variance, Mode, Median), Graphs (Pie, Histogram, Bar, Scatter), Data Analysis with SPSS Program
Relationships of Nature	Correlation and Regression Analysis, Data Analysis with PAST program
Statistics from Water	Aquatic Ecosystems and Statistical Measurements
Fun Stats with Mother Earth	Soil Types, Soil Analysis and Statistics
Nature School	Tree Age, Diameter Measurement, Data Collection
Nature is A Riddle	Catch-Recap Sampling Method, Ecological Prediction, Card Matching, Snake and Ladder Game and Probability Calculations
Ways to Save Nature with Artificial Intelligence	Machine Learning and Artificial Intelligence Techniques Used in Natural Sciences
Statistics of Natural Flavor	Statistical Calculations in Biodiversity Research

In this study, a statistical attitude scale developed by Zumbrun (2015) in order to measure the attitudes and opinions of mathematics teachers towards statistics was applied to the teachers participating in the education. This scale was translated into Turkish with the permission of the author and was applied for the first time in Turkish within the scope of this training. The aim here is to measure the attitudes and opinions of the teachers participating in the education towards statistics. The statistical attitude scale developed for teachers consists of three parts. In the first part, questions about teachers' general attitudes and opinions towards statistics are included. In the second part of the scale, there are questions that measure teachers' attitudes and opinions as students while learning statistics. In the last part of the scale, questions measuring teachers' attitudes and opinions about statistics as instructors are included. The 7-point Likert scale was used in the study.

2.4. Statistical Methods

In this study, parametric and nonparametric methods were used to detect difference between independent two and more than two groups in the analysis of the data. When the data is normally distributed, the parametric t test is used to compare two independent groups, and the non-parametric Mann-Whitney U test is used to compare groups if the data are not normally distributed. If there are more than two independent groups showing normal distribution, the ANOVA method is used to compare these groups, and the non-parametric Kruskall-Wallis test is used when normality is not provided. In this study, it was investigated whether the attitudes towards statistics, the attitudes towards learning statistics and the attitudes towards statistics teaching of the teachers participating in the project differ according to gender, education level, branch, and whether they took the statistics course before, with parametric and non-parametric independent two-group tests such as t test and Mann-Whitney U test. Whether the teachers' attitudes towards statistics, their attitudes towards learning statistics and their attitudes towards teaching statistics change according to the time spent in the profession were investigated with parametric and non-parametric independent k group tests such as ANOVA.

3. Results

The distribution of teachers participating in the project according to their gender and marital status is shown in Fig.1, respectively. Most of the participants (70%) are female teachers. Considering the marital status of the teachers participating in the training, it is seen that 58% of them are single.

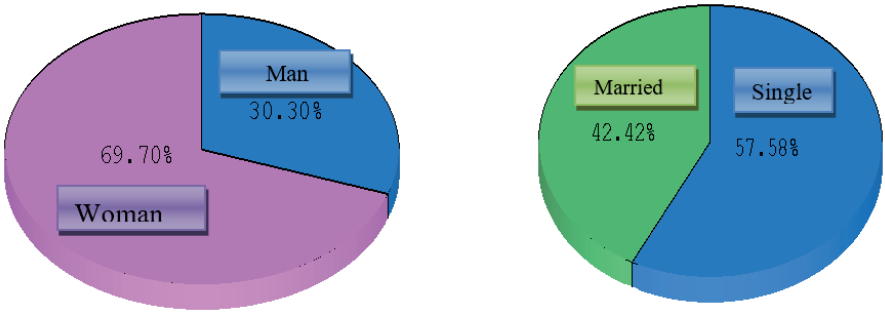

Figure 1. Distribution of teacher by gender and marital status.

The distribution of teachers as to education level and their experience (years) in the profession is shown in Fig.2. Accordingly, 52% of the teachers participating in the training are graduate and 48% are undergraduate

degrees. 43% of teachers participating in the training have been teaching for five or less than five years.

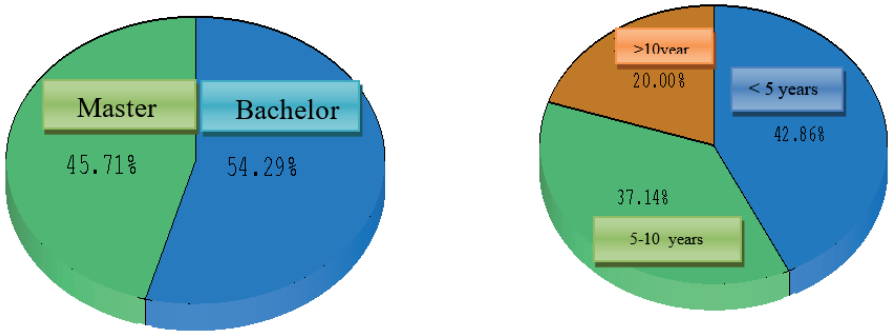

Figure 2. Distribution of teacher by education level and experience in profession.

It is seen that 30% of the teachers are science teachers, 15% are biology teachers and 12% are primary mathematics teachers.

Summary statistics of the variables of age, years in the profession, the number of participation in nature education before and the number of participation in statistics education before are given in Table 1.

Table 1. Summary statistics.

	Min	Max	Mean	Std. Dev.
Age	23	50	30.917	5.045
Experince(years) in profession	1	28	7.730	5.416
The number of participation in nature education before	0	10	0.694	1.769
The number of participation in statistics education before	0	2	0.111	5.416

According to Table 1, it is seen that the average age of teachers participating in the activity is 30 years, their experience in the profession is an average of 8 years, and they almost never participate in nature education and statistical education. The low number of teachers' participation in nature education is due to the fact that the participants selected within the scope of TUBITAK 4004 Nature Education and Science Schools have not participated in another activity with this code projects.

It was investigated whether the participants' attitudes towards statistics, their attitudes towards learning statistics and their attitudes towards statistics teaching differ according to gender, time spent in the profession,

education level, branch, and whether or not they took the statistics course before. Branch variable was reduced to two levels as "social" and "science" and included in the analysis. The questions in the scale are generally positive. For this reason, the reverse of the scores given to some questions posed in a negative structure was taken and included in the analysis. In this way, the general score values obtained represent a positive opinion against the statistics. Whether the scores given to the questions related to the three parts of the scale are normally distributed according to the variables of gender, time spent in the profession, education level, branch and statistics lesson was examined.

Kolmogorov-Smirnov and Shapiro-Wilk tests were used. It is known that the Shapiro-Wilk test gives more reliable results when the number of observations less than 50. When the Shapiro-Wilk test results were examined, it can be said with 95% confidence that the distribution of the answers given by the female teachers regarding the attitude towards statistics as a student is not normal (p value=0.027<0.05) Since the distribution of the answers given by the female teachers regarding the students' attitude towards statistics questions was not normal, the Mann-Whitney U test was used to examine whether there was a difference between male and female teachers in terms of student attitude towards statistics. Similarly, it can be said with 95% confidence that the distribution of the answers given by the teachers who did not take the statistics course regarding the attitude towards statistics questions before was not normal (p value=0.021<0.05). For this reason, the Mann-Whitney U test was used to investigate whether there is a difference between the teachers who took the statistics course and those who did not. Other comparisons made according to the variables of gender, education level, branch and statistics course previously were analyzed with the independent T test. Whether the answers given by the teachers to the statistics attitude scale questions differ according to the time spent in the profession was investigated by ANOVA. Independent T test results are given in Table 2, Mann-Whitney U test results are given in Table 3 and ANOVA results are given in Table 4.

Table 2. Results of Independent T Test.

	n	Mean	T value	p-value
Gender				
General attitude as a teacher towards statistics				
Female	23	5,144	1,323	0,195
Male	11	4,851		
Attitude towards teaching statistics as an instructor				
Female	18	5,544	1,695	0,102
Male	11	5,064		
Education level				
General attitude as a teacher towards statistics				
Bachelor	18	5,126	0,772	0,446
Master	16	4,963		
Attitude towards learning statistics as a student				
Bachelor	16	4,731	-0,059	0,953
Master	14	4,750		
Attitude towards teaching statistics as an instructor				
Bachelor	16	5,468	0,828	0,415
Master	13	5,230		
Branch				
General attitude as a teacher towards statistics				
Social	10	4,813	-1,478	0,149
Sciences	24	5,148		
Attitude towards learning statistics as a student				
Social	9	4,122	-2,928	0,007*
Sciences	21	5,001		
Attitude towards teaching statistics as an instructor				
Social	10	5,280	-0,413	0,683
Sciences	19	5,405		
Status of taking statistics course				
Attitude towards learning statistics as a student				
Yes	25	4,875	1,807	0,081
No	6	4,200		
Attitude towards teaching statistics as an instructor				
Yes	25	5,165	-2,204	0,036*
No	9	5,800		

***Significiance level 0.05**

Table 3. Results of Mann-Whitney U Test.

	n	Mean of rank	U value	p-value
Gender				
Attitude towards learning statistics as a student				
Female	20	17.900	52.00	0.034*
Male	10	10.700		
Status of taking statistics course				
General attitude as a teacher towards statistics				
Yes	24	16.080	86,0	0,198
No	10	20.900		

****Significiance level 0.05***

Table 4. Results of ANOVA.

	n	Mean	F value	p-value	Multiple comparisons
Experience (years) in profession					
General attitude as a teacher towards statistics					
<= 5 years	15	5,236	5,419	0,010*	< 5 yars & 5-10 years
5-10 years	13	4,667			5-10 years & >10 years
>10 years	6	5,409			
Attitude towards learning statistics as a student					
<= 5 years	13	4,657	0,636	0,537	
5-10 years	14	4,707			
>10 years	3	5,267			
Attitude towards teaching statistics as an instructor					
<= 5 years	11	5,427	0,882	0,426	
5-10 years	12	5,158			
>10 years	6	5,650			

****Significiance level 0.05***

4. Conclusion and Discussion

Although it is easy to access data today, it is important to select, collect and interpret the correct data. For this reason, statistical curriculums are getting more and more attention (Shaughnessy, 2007; Gattuso & Ottaviani, 2011). As a result, statistics education has an important place. Therefore, the quality and competence of this education should also be high (Özdemir, 2014).

The main purpose of education and training is to ensure that young people, who are the future of the country, grow up in a healthy and conscious

way in terms of knowledge, behavior and skills. For this purpose, the attitude of teachers towards statistics is also important.

In this study, the statistical attitude scale developed by Zumbrun (2015) for teachers was applied for the first time to teachers working in schools affiliated to the Ministry of National Education, participating in the "Learn Statistics in Nature" project. The aim of the research is to reveal the factors affecting the attitudes and opinions of teachers participating in the project towards statistics. Analysis results for this purpose are given in Table 2-4.

When Table 2 is examined, it is seen that there is no difference between the general attitudes and opinions of teachers towards statistics, their attitudes and opinions towards statistics as students and teachers according to education level. Education level has no effect on the attitude towards statistics. When Table 2 and Table 3 are examined, there is no difference between male and female teachers' general attitudes towards statistics and their attitudes towards statistics as instructors, while there is a difference between their attitudes towards statistics as students. When Table 3 is examined, it is seen that the attitudes towards statistics learning as a student are different between male and female teachers ($p = 0.034 < 0.05$). It is clearly seen that female teachers' attitudes towards statistics as student are more positive than male teachers. As seen in Table 2, when the results regarding the branch variable are examined, it is seen that there is no difference between the general attitudes towards statistics and their attitudes towards statistics as a teacher, while there is a difference between their attitudes towards statistics as a student. When the average scores given to the questions are examined, it can be said that teachers in the numerical branch have a more positive view of learning statistics as students, as expected ($p = 0.007 < 0.05$). According to Table 3, it is seen that there is a difference in the attitudes and opinions towards statistics between the teachers who took and did not take the statistics course as instructors ($p = 0.036 < 0.05$). When the averages are examined, the opinions of the teachers who have not taken the statistics course before, about teaching statistics are more positive than the teachers who have taken the statistics course before. When Table 4 is examined, while there is no difference between the attitudes of teachers towards statistics from the perspective of students or teachers according to the time spent in the profession, there is a difference between their general attitudes towards statistics. When the results are examined, there is a difference between the teachers who have a professional career of 5-10 years and those who have 5 years or less and who have more than 10 years in angels. The group that makes the difference is the teachers with 5-10 working years. When the average values of the answers given to the questions are examined, it is seen

that the general attitudes of the teachers who are between 5-10 years in the profession towards statistics are more negative.

When the results are examined, it is seen that the general attitudes of teachers towards statistics and their attitudes towards statistics as instructors do not differ according to gender, education level and branch. However, it has been observed that as a student, their attitudes towards statistics differ according to gender and branch. Female teachers are more positive towards learning statistics, and teachers in numerical branches have a more positive perspective towards learning statistics. When the attitudes of teachers towards statistics as instructive are examined, it is seen that teachers who are new in the profession and more experienced in the profession have a more positive approach to statistics teaching. In addition, it has been observed that teachers who have not taken the statistics course before have a more positive approach to statistics teaching.

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