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Relationship between 5th Grade Students' Attitudes towards Science and Technology Course and Misconceptions

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Abstract

The purpose of this study is to determine the attitudes of the 5th grade students towards Science and Technology course, their level of misconceptions on the subject of "Heat and Temperature", and the connection between the attitudes and misconceptions in terms of several variables. The tools used for data collection were "Attitude towards Science and Technology Course Scale" and "Concept Test". According to the results, attitudes of unsuccessful students are higher than attitudes of middle level and successful students. It is found that misconceptions of students who take extra courses are lower than those who learn only in lessons.

Keywords: Science and Technology, attitude, misconception†

1. Introduction

The aim of the modern science education is to gain required scientific attitude and cognitive process skills which are necessary for problem solving related to science that students encounter throughout their lives, rather than memorizing scientific knowledge about sciences (Bayrak ve Erden, 2007). Accordingly, in order to realize an effective science teaching; making them learn concepts that constitute the

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knowledge and also keystones of that knowledge meaningfully is needed rather than transferring available knowledge about sciences to the students (Gençer, 2006; Koray ve Tatar, 2003).

Students start their education having different experiences, ideas, and beliefs about scientific concepts. These ideas and beliefs which are far from being scientific and mostly gained by means of students' own experiences are called as misconception (Tekkaya, Özkan ve Balcı, 2002). Especially for the science and technology curriculum, due to its spiral nature, the misconceptions held in previous years are transferred to the years ahead and students continue to use these misconceptions increasingly (Yurd ve Oğlun, 2008). Among the subjects in Science and Technology course, "Heat and Temperature" is a topic where misconceptions are encountered the most. One of the greatest reasons of this situation is that the concepts of heat and temperature are used as substitutes for each other (Turgut ve Gürbüz 2011).

In recent years, research in science education has concentrated on revealing of various conceptual understandings of students who have different levels of learning capacity. These studies have mostly been conducted for the purpose of creating a solution with respect to determining the difficulties that students encounter on understanding of scientific concepts, revealing and explaining misconceptions, and also how to correct them (Özcan, 2006; Yurd ve Oğlun, 2008; Adıgüzel, 2006; Köse, Ayas ve Uşak, 2006; Koray ve Tatar, 2003; Ayvacı ve Çoruhlu, 2009; Yahşi, 2006; Palut, 2006; Yürümezoğlu, Ayaz ve Çökelez, 2009; Yıldırım, Yalçın, Şensoy ve Akçay, 2008; Bayrakçı, 2007).

There is no enough study encountered neither about the variables which affect these misconceptions nor about the relations between the attitude towards science and technology course and misconception in this field. In this term, this study is thought to contribute the body of literature.

In this research, determining the relationship between attitudes towards science and technology course and misconceptions about "Heat and Temperature" of 5th grade students is aimed. Moreover, it is aimed to determine the variables that affect both attitudes towards science and technology course and misconceptions about "Heat and Temperature". For this purpose five basic research questions have been asked:

For students who study at fifth grade;

1. What are the attitudes of students towards science and technology course?

2. What is the level of misconceptions about the topic of "Heat and Temperature" in science and technology course?

3. Is there a significant difference between their attitudes towards science and technology course and their gender, extracurricular learning, and final exam marks of the science and technology course?

4. Is there a significant difference between their misconceptions about the topic of "Heat and Temperature" and their gender, extracurricular learning, and final exam marks of the science course?

5. Is there a significant relationship between the students' attitudes towards science and technology course and their misconceptions?

2. Methods

2.1. Participants

Research was carried out at three different elementary schools which were selected randomly in City of Denizli on the second term of 2010-2011 academic years. A total of 90 fifth grade students have participated as a study group for this research. Some qualities of the participants are summarized in the Table 1:

Table 1. Some Qualities of the Participants

Variables	Category	N	%
Gender	Male	40	44,4
	Female	50	55,6
Extra-curricular education	Custom Classroom	0	0
	Extra School Course	67	74,4
	Private Lesson	0	0
	None	23	25,6
Final exam grades	Lower than 58,18	16	17,8
	Between 58,18 and 89,02	56	62,2
	Higher than 89,02	18	20,0
Total		90	100,0

As can be seen in Table 1, the participants consist of 40 (44, 4%) male and 50 (55, 6%) female students. The groups for the variable of extra-curricular education were coded as extra school courses (n=67; %74,4) and none (n=23; %25,6) because no students chose the options of custom classroom and private lesson.

Moreover, the final exam marks of the students in Science and Technology course are divided into three groups in terms of ranges which are determined as to sum or subtract the standard deviation value (sd= 15, 417) from the general average. According to this grouping, it is deduced that the final marks of the 56 participants (62, 2%) in Science and Technology course were in a range of "2= 58,183 and 89,017".

2.2. Instruments

The data were collected through two different scales which were "*Attitude towards Science and Technology Course Scale*" and "*Concept Test*".

"*Attitude towards Science and Technology Course Scale*" was developed by Işık (2007) and consists of 23 items (eight of them is negative and fifteen of them is positive). The content validity of the scale was calculated as 0.93. According to 5 likert-type attitude scale, the lowest score that the students can get is 23 and the highest score is 115. Internal reliability of the scale is determined as 0.91 (Işık, 2007).

For this study, in accordance with the aim of the study, three items were added to the scale in order to reach the students' personal information such as their gender, whether there are other areas that they take the Science and Technology course such as custom classroom, extra school course, or private lessons; and their final exam marks of Science and Technology course.

Developed by Seloni (2005) "*Concept Test*" consists of 10 questions. Questions are composed of one right answer and two distracters and students are asked to write down the reasons of the answers due to measure the conceptual understanding of them. 10 questions in "*Concept Test*" were evaluated (Cited in Seloni, 2005) according to an evaluation technique conducted by Abraham et al, (1992), and research technique called "Determination of Levels of Understanding Basic Science Concepts" developed by Bayram et al, (1997). Comprehension levels of students were evaluated by point scoring (ranging from 1 to 4) out of 40 points as a numerical data. It was deduced that the higher point that the students get, the less misconceptions they have.

2.3. Data Collection and Analysis

Research was conducted at the end of the spring semester 2010-2011. The data collection tools were applied throughout two different lessons by the researcher and teachers in the schools of application.

Dependent variables of this study are points that students get from "Attitude towards Science and Technology Course Scale", and points that students get from "Concept Test" in relation to "Heat and

Temperature". Independent variables of this study are gender, extra-curricular education, and students' final marks of Science and Technology course. The data were analyzed by SPSS (Statistical Package for Social Sciences, Version 11,5).

First of all One Sample Kolmogorov-Smirnov (K-S) Test was used in order to test whether the data distributed normally (Baştürk, 2010). According to the results of the analyses, it is determined that both variables show a normal distribution [(K-S(Z) concept test = 0.708; p > 0,05 and (K-S(Z) attitude scale = 0.935; p > 0,05)]. The relationship between students' attitudes towards Science and Technology course and their misconceptions about the topic of Heat and Temperature is investigated by calculating the Pearson Correlation Coefficient. Descriptive statistical methods, independent samples t-test, and One – way ANOVA were utilized for data analysis, as well. One-sample t-test was used in order to determine whether the average attitude score of the sample is different from the expected value. The significance level was taken as 0.05.

3. Findings

In this section, findings related to sub-problems are described in the tables.

Research question 1. What are the attitudes of students towards science and technology course?

Findings of students' attitudes towards Science and Technology course are given in Table 2.

Table 2. Analysis of students' attitudes towards Science and Technology course

	N	Min	Max	M	sd
The Attitude Score	90	62,00	105,00	74,41	7,33

Table 2 shows that the minimum and maximum scores of the attitude scale are 62,00 and 105.00. In this study, the mean of the attitude scores of 90 participants is 74, 41. Expected value for the mean of the attitude scores in the population, considering the highest and lowest values that can be taken from the attitude scale, is $\frac{23+115}{2} = 69$. In order to determine whether the average attitude score of the sample is different from the expected value, One-sample t-test was used and the results of the analysis are shown in Table 3:

Table 3. Analysis of students' attitude scores according to the expected value

	Test Value=69				
	N	M	t	df	p
The Attitude Score	90	74,41	7,01	89	,00*

* p<.05

As can be seen in Table 3, the difference between the students attitudes scores and the expected value is significant at 0.05 alpha level (t = 7,01; p < 0,05). Also, sample mean (M= 74, 41) is significantly higher than the expected mean of population (M= 69). Thus, it can be said that students' attitudes are closer to be in a positive manner.

Research question 2. What is the level of misconceptions about the topic of "Heat and Temperature" in science and technology course?

Findings of students' misconceptions about the topic of "Heat and Temperature" are given in Table4.

Table 4. Analysis of students' misconceptions about the topic of "Heat and Temperature"

	N	Min	Max	M	sd
Misconceptions Scores	90	2	34	18,82	6,551

When Table 4 is examined, it is seen that students get minimum 2 and maximum 34 points from the Concept Test. The mean score of 90 students participated in the survey was calculated as 18.82. Descriptive statistics are presented in Table 5 for items belonging to the Concept Test:

Table 5. Descriptive statistics of Concept Test substances

Items' Content	N	Min.	Max.	M	sd
1. The effect of heat on matter	90	0	3	1,30	,76
2. Heat and temperature measurement	90	0	4	1,44	1,08
3. Heat conduction	90	0	4	2,28	1,02
4. The effect of heat on matter	90	0	4	2,02	1,32
5. Heat transfer	90	0	4	2,47	1,13
6. The effect of heat on matter	90	0	4	2,03	1,19
7. Thermal insulation	90	0	4	1,94	1,17
8. Heat conduction and isolation	90	0	4	1,58	1,16
9. The effect of heat on matter and expansion	90	0	4	1,80	1,38
10. Thermal insulation	90	0	4	1,96	1,45
Total	90				

When Table 5 is examined, it is seen that the most common misconception that the students have is "The effect of heat on matter" with an average of 1.30, which is the first question of Concept Test. It is striking that according to the analysis, none of the students could get a full score of 4 from the first question. In this case, it shows that all of the students participating in the survey have misconceptions about the effects of heat on matter. On the other hand, the least common misconception that the students have is "Heat transfer" with an average of 2.47, which is the fifth question of Concept Test.

Research question 3. Is there a significant difference between the students' attitudes towards science and technology course and their gender, extracurricular learning, and final exam marks of the science and technology course?

To examine whether the gender and the extra-curricular education areas (custom classroom, extra school course, private lessons, or none) affect the students' attitudes towards Science and Technology course, Independent Samples T-test was used in this study. The results of the analysis are shown in Table 6.

Table 6. Students' attitudes towards Science and Technology course analysis by gender and extra-curricular education areas variables

Variables	Category	N	M	sd	t	p
Gender	Male	40	73,08	5,46	-1,559	0,122*
	Female	50	75,48	8,44		
Extra-curricular education	Extra School Course	67	74,33	6,51	-0,182	0,856*
	None	23	74,65	9,48		
	Total	90				

*p>.05

As a result of the Independent Samples T-test analysis, the difference between attitudes scales scores of male and female students is not significant at 0.05 alpha level (t = -1,559; p > 0.05). In other words, as shown in Table 8, both male (M= 73,08) and female (M= 75,48) students' attitudes towards Science and Technology courses are similar to each other.

Also, the difference between attitudes scales scores of students who attend extra school course and of students who study only in course is not significant at 0.05 alpha level, (t= -0,182; p>0.05). In other words, as shown in Table 8, both the students who attend extra school course (M= 74,33) and the students who study only in course (M= 74,652) are similar to each other.

To determine whether there is a significant difference between students' attitudes towards Science and Technology course and students' final exam mark of the science and technology course, One -way ANOVA Test was used and the results of this test are presented in Table 7.

Table 7. Students' attitudes towards Science and Technology course analysis by final exam mark in Science and Technology course

Source of Variance	Sum of Squares	df	Sum of Squares	F	Sig.
Between-groups	438,42	2	219,21	4,393	0,015*
Within-groups	4341,37	87	49,90		
Total	4779,79	89			

* p<.05

According to the results of One-way ANOVA, there is a significant difference between the attitudes towards Science and Technology course of students who are in different ranges of the final exam marks (unsuccessful, average, or successful) in Science and Technology course (F = 4,393; p < 0.05). Descriptive analysis of students' final exam marks in Science and Technology course is described in Table 8.

Table 8. The students' marks range's mean and standard deviations

Variable	Category	N	M	sd
Range of students final exam marks	Unsuccessful	16	79,13	11,79
	Average	56	73,55	5,74
	Successful	18	72,89	5,12
Total		90	74,41	7,33

Tukey's Post Hoc Test was conducted to determine the source of the difference. The mean of attitude scores of unsuccessful students (M_U = 79,13) is lower than the mean of attitude scores of average students (M_A = 73,55) and the mean of attitude scores of successful students (M_S = 72,89).

Research question 4. Is there a significant difference between the students' misconceptions about the topic of "Heat and Temperature" and their gender, extracurricular learning, and final exam marks of the science course?

To examine whether the gender and the extra-curricular education areas (custom classroom, extra school course, private lessons, or none) affect the students' misconceptions about the topic of "Heat and Temperature", independent samples t-test was used in this study. The results of the analysis are shown in Table 9:

Table 9. Students' misconceptions about the topic of "Heat and Temperature" analysis by gender and extra-curricular education areas variables

Variables	Category	N	M	sd	t	p
Gender	Male	40	19,80	6,54	1,271	0,207*
	Female	50	18,04	6,52		
Extra-curricular education	Extra School Course	67	20,27	5,642	3,842	0,00*
	None	23	14,61	7,291		
Total		90				

*p>0,05

As a result of the Independent Samples T-Test analysis, there is not a significant difference between between the misconceptions of male and female students about the topic of "Heat and Temperature" (t = 1,271; p > 0.05). In other words, as shown in Table 9, both male (M = 19,80) and female (M = 18,04) students' misconceptions about the topic of "Heat and Temperature" are similar to each other.

As a result of the independent samples t-test analysis, there is a significant difference at 0.05 alpha level between the misconceptions of students who attend extra school course and who learn only in lessons (t = 1,271; p > 0.05) about the topic of "Heat and Temperature". In order to understand the reason of difference mean scores of groups was investigated. As shown in Table 9, the mean square of students who attend extra school is higher than (M = 20,27) the students' who learn only in lessons (M = 14,61). Students who attend extra school course can be said to have less misconceptions about the related topic.

One - way ANOVA Test was conducted to determine whether there is a significant difference between students' misconceptions about the topic of "Heat and Temperature" and students' the final exam points of the science course. The results of this test are presented in Table 10.

Table 10. Students' misconceptions analysis by final exam mark in Science and Technology course

Source of Variance	Sum of Squares	df	Sum of Squares	F	Sig.
Between-groups	77,56	2	38,78	,902	,410
Within-groups	3741,60	87	43,01		
Total	3819,16	89			

p >.05

According to the results there is no significant difference between the students' misconceptions about the topic of "Heat and Temperature" and their final exam marks of the science course (F = 0,902; p> 0.05). Descriptive statistics of students' final exam marks of the science course are presented in Table 11:

Table 11. Descriptive statistics of students' note range

Variable	Category	N	M	sd
Note Range	Unsuccessful	16	17,06	4,65
	Average	56	18,93	6,61
	Successful	18	20,06	7,73
Total		90	18,82	6,55

Although the mean square of the final exam marks of the successful students is higher than the unsuccessful and average students', the difference is not statistically significant.

Research question 5. Is there a significant relationship between the students' attitudes towards science and technology course and their misconceptions?

To determine the relationship between students' attitudes towards Science and Technology course and their misconceptions about the topic of "Heat and Temperature", the Pearson Correlation Coefficient was used and the results are presented in Table 12.

Table 12. The relationship between students' attitudes towards Science and Technology course and their misconceptions about the topic of "Heat and Temperature"

Variables	N	M	sd	r	p
Attitude	90	19,80	6,54	-0,133	0,212*
Misconception	90	18,00	6,62		
Total	90				

* $p > 0,05$

As seen in Table 12, there isn't a significant relationship between students' attitudes towards Science and Technology course and their misconceptions about the topic of "Heat and Temperature" ($r = - 0,133$; $p>0.05$). In other words, there is no positive or negative effect of misconceptions on the attitudes of students towards science and technology course.

4. Results and Discussion

According to the findings, students' attitudes towards science and technology courses are positive. However, any significant difference could not be found according to gender and extra-curricular education variables for the students' attitudes. It is surprising that attitudes of unsuccessful students are more positive than the attitudes of average and successful students. It is not necessary for a student to be successful in this course for having a positive attitude towards it. However, any research is encountered in the body of literature which supports this result.

When students' misconceptions about the topic of "Heat and Temperature" are examined, there seem to have common misconceptions about the effect of heat on matters. Moreover, students could not differentiate the concepts of heat and temperature. Although they know the units of heat and temperature and how to measure them, they could not transfer the same knowledge to the various situations on different items. Here are some examples they gave; "The heat of thermometer was found to be ºC 39" or "Only body heat can be measured by thermometer". In their research, Kırıkkaya and Güllü (2008), and Aydoğan and et.al. (2003) found a similar misconception such as "Weather heat is measured by ºC". The least common misconception of the students is the heat-exchange.

There is no significant relationship between misconceptions of students according to gender and final exam grades on the other hand students who take extra school courses have less misconceptions than those who learn only in lessons. In this case, it is possible to say that misconceptions can be reduced when students have more opportunities for extra learning.

A reasonable relation could not be identified between students' attitudes towards science and technology course and misconceptions about the topic of "Heat and Temperature". In other words, students' attitudes toward Science and Technology course do not affect the misconceptions as positive or negative way.

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