The Effect on the 8th Grade Students' Attitude towards Statistics of Project Based Learning

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This study investigates the effect of the project based learning approach on 8th students' attitude towards statistics. With this aim, an attitude scale towards statistics was developed. Quasi experimental research model was used in this study. Following this model in the control group the traditional method was applied to teach statistics wheras in the intervention group project based learning approach was followed. The attitude scale towards statistics was applied as pre-test and post-tests to 70 students studying at two different 8th grade classes of a middle school in Trabzon during the 2011–2012 Academic Year. The results of the study revealed that the project based learning increased students' attitude towards statistics in the intervention group. Therefore, the use of project based learning approach during statistics course in mathematics classes is recomended.

Keywords: statistical literacy, attitude, project based learning, statistics education

Introduction

In most disciplines, students' academic attitudes are considered extremely important. Statistics is increasingly taking part in all school mathematics curriculums. Some researchers have expressed that performance on statistics assesments is also clearly shown to be related to students' attitudes towards statistics (Dempster & McCorry, 2009). In the past two decades a large number of instruments to measure attitudes and anxiety towards statistics have been developed in order to assess the influence of emotional factor on students (Carmona, 2004).

McLeod (1992) separates emotions, attitudes and beliefs. Attitudes are intensive feelings in learning statistics. The interest towards beliefs, attitudes, and expectations is increasing in statistics education, since "such factors can impede learning of statistics, or hinder the extent to which students will develop useful statistical intuitions and apply what they have learned outside the classroom" (Gal & Ginsburg, 1994, p.1).

Research on students' attitudes towards statistics is enhancement, although it is still scarce when compared with research related to attitudes towards mathematics and has not focused specifically on students. Attitudes are expressed along a positive-negative continuum (like-dislike, pleasant-unpleasant), and may represent, for example, feelings towards a textbook, a teacher, a topic, a project or activity, the school, etc. Students often enter an introductory statistics class with less positive attitudes about the subject. They tend to believe statistics is difficult and irrelevant to their lives (Carnell, 2008).

Conceptual Framework

Researchers and statistics educators consistently suggest that students will learn statistics more effectively by conducting projects through which they actively engage in a broad spectrum of tasks integral to statistical inquiry, in the authentic context of a real-world application (Bailey, Spence, & Sinn, 2013).

Project-based learning is the learning method that places students at the center of the learning process. It is widely used to replace the traditional teaching method in which the teacher, who is the center, strictly follows the teaching plan. In a project-based learning classroom, the teacher leads the students to the learning that they desire or to the learning which follows the project objectives. The project-based learning process thus involves an in-depth learning process with systematic learning management to get useful and applicable results, to create motivation, and to reinforce necessary living skills (Buck Institute for Education, 2010; Harris & Katz, 2001; Moursund, 1999). Project-based learning has complicated working procedure and requires more time for operation. However, it is flexible and the learning process involves interaction and cooperation among learners, between learners and teachers. More importantly, when the teacher implements the project and the project is completed, the learners will feel proud of themselves. This generates motivation to learners to perform better projects in the future (Jung, Jun, & Gruenwald, 2001). In a project-based learning classroom management, students are divided into groups of different sizes. For smaller groups, all students will have equal roles and responsibility in creating the project. The project enables learners to deeply understand the ideology and standard of project-making. It can reinforce lifelong working skills and behavior. The project also provides the learners with an opportunity to solve community problems, survey future careers, consult specialists and communicate with the intellectuals using internet technology. The learners can also present their projects to the target groups outside of the classroom. The project can also motivate other low-motivated learners, who view studying as boring and useless, to see the significance and value of learning (Buck Institute for Education, 2010).

The present study was designed to examine the effect of projects based learning approach to students' attitude towards statistics (ATS). This paper reports on the size of the change that (14–15 years old) students' attitudes towards statistics using the new approach. Thus, the research question guiding the present analysis was as follows: Does the use of project based learning approach in statistics course have a positive impact on student's ATS?

Methodology

Quasi-experimental research model was used in this study. In experimental models, the data to be observed are produced directly under the control of the researcher with the aim of determining cause-effect relationships. In some cases, it may be impossible to randomly assign individuals to experimental and control groups. Quasi-experimental research model is used in these cases. In this model, individuals are not randomly assigned to intervention and control groups. Quasi-experimental research model is also used when existing educational system does not allow randomly assigning students to groups.

Participants
The study took place during the 2011–2012 Spring semester in two 8th grade mathematics classrooms in urban middle school in Trabzon city of Turkey. The study group consists of 35 8th grade (14–15 years old) students studying in two different classes. Of the 70 students who participated in the study, 35 were in the control group. The remaining 35 students were in the intervention group. In order to keep the inevitable variations introduced by differences between groups under control, a quasi-experimental design was employed. Control group is performed statistics course without using projects. Project based learning approach was applied on experimental group. Projects used were student-defined and authentic in that students selected their own variables, crafted their own research questions, and collected and

analyzed their own data sets. Students usually conducted these projects in groups of three. These two groups were comprised. Thus, this study aimed to evaluate the effect on students' ATS of project based learnıng approach.

Prosedure

Project based learning approach was applied on experimental group. Control group is performed statistics course without using projects. These two groups were comprised. Thus, this study aimed to evaluate the effect on the 8th grade students' attitude towards statistics of project based learning by investigators. For this aim groups were created heterogeneously in the experimental group. Groups of students were recruited from three students. Groups were held with the teachers at certain times. Projects include statistical gains and they were selected from real life and familiar context. Students were given about one month to prepare projects. Students crafted their own research questions, collected and analyzed their own data. They used appropriate data representations and they made predictions and inferences from the data. At the end of this term, each group presented their projects in front of other students. Each group gave a presentation about 20 minutes. These presentations were recorded with camera. Traditional teaching methods were used in control group and teacher supported lesson with exercises and examples. Some of the topics students have chosen to investigate include:

- The average monthly income and expenses of a family.
- Statistics of the blood groups of students.
- Turkey super league teams score statistics.
- How many seconds 100 meters is run?
- Students' height and weight statistics.
- Students' success in math classes.
- Trabzon Airport aircraft and passenger statistics.
- Waste in our invironment.
- Statistics of daily activity.
- Usage statistics for internet and mobile phone TV.
- Popular career statistics in class.

The structured activities supply the basic statistical concepts and skills. The research project motivates students to become responsible for the construction of their knowledge of statistical concepts and methods of inquiry, and provides them with a sense of relevancy, enthusiasm, and ownership.

Data Collection

The data in this study are collected using the ATS for students'attitude. In our research, each statement was valued in a range from 1 to 5, where 1 indicates "Strongly Disagree" and 5 indicates "Strongly Agree". Negative statements were coded reversely. The ATS was developed by the researchers after relevant literature review. All use statements for which respondents mark their agreement or disagreement on 5-point or 7-point Likert-type scales. The most commonly mentioned and used include: Statistics Attitude Survey (Roberts & Saxe, 1982), Statistical Anxiety Rating Scale (Cruise, Cash, & Bolton, 1985), Attitudes Towards Statistics (Wise, 1985), Survey of Attitudes Toward Statistics (Schau, Stevens, Dauphinee, & Del Vecchio, 1995; Dauphinee, Schau & Stevens, 1997). Draft form (32 items) was prepared as result of review of the previous studies. Developed scale was then examined by two mathematics educators and two mathematics teachers. Teachers and academicians confirmed that the scale may appropriately serve the aim of the study. The draft form was applied to 76, 6th grades, 64, 7th grade, 100, 8th grade-240 in total- students in a primary school in Trabzon province in 2010-2011 academic year. Using the data gained, the validity and reliability of the scale were analysed. In the reliability analysis, Cronbach-alfa internal coefficient of consistence, split-half reliability, item-total correlations, t test for the test of item means point difference of lower and

upper groups; and in the validity analysis, results of factor analysis were evaluated. As a consequence a 20-items valid and reliable scale *(α=0,815)* was gained. The developed scale was used in this study.

Data Analysis

The data were analysed using Rasch (1980) measurement techniques, which allowed both students' performance and item difficulties to be measured using the same metric and placed on the same scale. Rasch calibration was used to evaluate the fit of data to the unidimensionality of the Rasch model and for the construction of the ATS. The 20 items were analyzed using the rating scale model. The Rasch rating scale model (Wright & Masters, 1982) was used to provide estimates of person and item scores for the used efficacy scale. This analysis was performed via *Winsteps 3.72* program (Linacre, 2011).

The scale so produced is a genuine interval scale that allows comparision of person performance on the set of items used (Bond & Fox, 2007). Each item score was then transcribed to an individual student data line within a larger data file inclusive of all children's performances (see Figure 3). Each data line consisted of the following types of data: the first two digits indicate the participant's identifying code; the following 20 digits represent the participant's score on the 20 ATS of number items (see example below).

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Each data line represents the transformation of qualitative data to quantitative data, which can then be subjected to Rasch analysis. The statistical analysis was completed using Winsteps software (Linacre, 2011), a computer program developed from Rasch principles. Rasch models of measurement use the interaction between persons (cases) and items to place both persons and items on a single measurement scale. The unit of measurement is the logit, the natural logarithm of the odds of success.

The usual meausre of fit reported is the infit mean square and outfit mean square statistic (The most ideal value is 1.00), acceptable levels of fit lie between 0.5 and 1.7 (Bond & Fox, 2007). The standardised fit measured fit measure provides a z statistic, providing the statistical significance of the fit figure, using the usual accepted values of ∓ 2.00. The Person Separation Reliability indicates the extend to which the set of items separates the persons along the scale. It has an ideal value of 1, and values above approximately 0.7 provide acceptable separation, allowing persons to be compared onthe basis of their measured ability. Estimates of person ability were obtained in logits. Logit is logarithm of the odds of succes. Item (RI) and Person (RP) Separation Reliabilities indicate the extent to which the test provides a wide spread of items or persons along the variable, and avoids a "ceiling" or "floor" effect. These statistics provide a measure of internal consistency. Cronbach alpha statistics were also obtained as a measure of the reliability of the test.

Two mean square fit statistics are used to determine how well individual items fit the Rasch model. These statistics assess the extent to which unpredicted responses to an item are given by students whose position in the hierarchy, as determined by their academic self-concept is either close to the item's position (Infit statistic) or far from the item's position (Outfit statistic) in the hierarchy of items. For the data to fit the model adequately, it is generally recommended that the two fit statistics range from 0.6 to 1.4 (Bond & Fox, 2001). Fit statistics higher than 1.4 and below 0.6, respectively, indicate too much and too little variation in response patterns. Items with poor fit statistics should be considered for removal from the instrument.

Findings

In this part, the data obtained from the ATS were analyzed using Winsteps 3.72 computer programme and the results were presented as summary statistics, infit and outfit values for items, person measures, person item maps, t test and covariance analysis.

The Rasch model was applied to the responses of 70 students to the A in its original form of 20 items. First, the item and person separation and reliability were examined prior to any interpretations of the data. The person separation and reliability values for the data were 2.00 and 0.80 respectively. This person separation indicates the number of groups the students can be separated into according to their abilities. Considering the moderate sample size, person and item reliabilities are acceptable for the analysis to continue. Table 1 shows summary statistics.

Table 1. Summary statistics

	Total		Model		Infit		Outfit	
	Score	Count	Meausre	Error	mnsq	zstd	mnsq	zstd
Mean	75.8	20.0	.65	.23	1.05	.0	1.04	.0
S.D.	12.4	.0	.61	.08	.47	1.5	.45	1.4
Max.	98.0	20.0	2.58	.65	3.01	3.7	2.88	3.5
Min.	43.0	20.0	-.60	.18	.18	-5.0	.18	-5.0

Summary of 20 Measured (Non-extreme) Person

REAL RMSE .27 TRUE SD .54 SEPARATION 2.00 Person RELIABILITY .80
MODEL RMSE .24 TRUE SD .56 SEPARATION 2.29 Person RELIABILITY .84

Person RAW SCORE-TO-MEASURE CORRELATION = .89
CRONBACH ALPHA (KR-20) Person RAW SCORE "TEST" RELIABILITY = .85

	Total		Model	Infit	Outfit			
	Score	Count	Meausre	Error	mnsq	zstd	mnsq	zstd
Mean	533.0	140.0	.00	.08	1.00	.0	1.04	.3
S.D.	32.3	.0	.21	.00	.18	1.6	.20	1.5
Max.	592.0	140.0	.46	.09	1.29	2.5	1.34	2.3
Min.	456.0	140.0	-.41	.07	.66	-3.4	.65	-2.9

Summary of 20 Measured (Non-extreme) Item

REAL RMSE .08 TRUE SD .19 SEPARATION 2.27 Item RELIABILITY .84
MODEL RMSE .08 TRUE SD .19 SEPARATION 2.36 Item RELIABILITY .85

All items fit the expectations of the Rasch model. In other words, all items had zstd infit and/or outfit statistics between -2 and 2 (Table 1). Fit to the model, of both items and persons, was evaluated using the infit mean square (Imsq) statistic and the standardized infit (Infit t). The acceptable values lie between 0.6 and 1.4 (Bond & Fox, 2007) with an ideal value of 1.00. For both items ($Imsq_I$ = 1.00, s.d. =.18; Infit t = .0) and persons ($Imsq_P$ = 1.05, s.d. =.47; Infit t =.0) the overall fit was acceptable indicating that the performance tasks were composed of items that worked together consistently to measure a single unidimensional construct, and that the students who responded to the task did so in ways that were coherent with the intentions of the task developers. Reliability figures were also satisfactory (RI = 0.84; RP = 0.80; Cronbach alpha = 0.85) is indicating that the internal consistency of the tasks was good. These findings indicated that all items worked together to measure a single underlying construct, and the persons who attempted the tasks performed in expected ways. The Person Separation Reliability indicates the extend to which the set of items separates the persons along the scale. It has an ideal value of 1, and values above approximately 0.7. Looking at the Table 1 person separation is good (2.00), provide acceptable separation, allowing persons to be compared on the basis

of their measured ability. Fit statistics were also obtained for items. Table 2 summarizes fit statistics of ATS' items.

Table 2. Fit statistis for ATS' item

Item	Items	Infit MNSQ	Outfit MNSQ
1	I don't use statistics in my daily life.	.96	1.25
2	I can interpret the graphics in newspapers and magazines.	.86	.78
3	I enjoy studying statistics.	.95	1.24
4	People see many different uses of statistics on newspapers, TVs and internet.	.79	.84
5	Tables in newspapers appeal my attention because I know very well how to interpret them.	.93	.87
6	I don't have difficulty in understating the presented statistics during the elections.	.93	.99
7	I didn't have difficulty in understanding the statistics shown on TV during the latest elections.	.94	.90
8	Understanding the statistics doesn't provide benefits for customers.	1.29	1.34
9	I am aware that statistics is used in medicine	1.00	1.01
10	Many problems could be solved easily by using statistics.	.84	.80
11	Knowing statistics is nothing to the politicians.	1.28	1.18
12	Statistics could be necessary as a part of my job in the future.	1.15	1.15
13	Statistical skills make me more supported	.66	.65
14	Statistics is not beneficent for every job.	1.28	1.28
15	Statistical thinking is applicable except for work life.	1.17	1.16
16	Statistics has nothing to do with my life.	1.22	1.20
17	Most people have to learn statistics as a new way of thinking.	1.13	1.26
18	I can understand almost all statistical terms that I see in newspapers, magazines and on TV, internet.	.77	.89
19	It is necessary to know a little about statistics to be conscious customer.	.82	.74
20	I know what average fuel consumption for cars means.	1.08	1.15

The usual measure of fit reported is the infit mean square and outfit mean square statistic (The most ideal value is 1.00), acceptable levels of fit lie between 0.6 and 1.4 (Wright & Linacre, 1994). Table 3 shows summary of student's attitude towards statistics. This table summarizes infit, outfit, reliability, means and standard deviation of both raw score and Rasch measure for two groups.

Table 3. Summary of student's attitude towards statistics

		Raw Score		Rasch Score		Infit	Outfit	Reliability	N
		Mean	Standart Error	Mean	Standart Error				
Intervention									
	Pre test	72.8	13.7	.51	.63	1.15	1.11	.78	35
	Post test	84.1	9.8	1.02	.58	1.01	.99	.72	35
Control									
	Pre test	72.9	9.0	.55	.44	1.01	1.02	.70	35
	Post test	73.7	12.8	.57	.54	1.01	1.01	.82	35
Total									
	Pre test	72.9	11.6	.51	.56	1.09	1.07	.76	70
	Post test	78.8	12.6	.78	.60	1.01	1.01	.80	70

Infit and outfit close to ideal value (1.00). Person reliability is between .70 and .82 (good). As is shown in this table, learners' performance has improved in posttest. But intervention group shows important improvement in attitude, from .51 to 1.02 logits. Table 4 shows pre test and post test person measures for two groups.

Rasch measures of item were subjected to analyses because they are both linear and interval. The Rasch model is a quantitative, probabilistic measurement model that can convert raw data from the participants' ATS performances into equal-interval scales suitable for comparison. Table 5 shows person ability measures for pretest and post test.

Winsteps software includes an item-person map in which person movement quality and item difficulty relations can be seen. Estimates of fit and error are tabulated along with movement quality and difficulty estimates. Item difficulty is expressed in terms of logits: zero is average; negative is easier; and positive is becoming more difficult. Person movement quality is estimated in relation to item difficulty estimates the higher the positive values the better the quality of movement (Bond & Fox, 2001). Figure 1 shows person item map for intervention group at ATS' pre and post test.

Note that the measurement unit is common to both person movement quality and item. Persons left side of the map are located. Items are located in right side of the map. It is a logit scale an interval scale. Persons and items are located on the map according to their movement quality and difficulty estimates, respectively (Bond & Fox, 2001). "M" markers along the map indicate the location of the mean measure. Likewise, a marker of "S" indicates one standart deviation from the mean and "T" indicates two standard deviations from the mean, as shown by Figure 1. The mean of item difficulties is adopted by default as the 0 point. Each X represents the estimate for one subject person. As shown in Figure 1 project-based learning has led to changes in the attitudes of students. Independent t-test was performed by Rasch scores in Table 5 to determine whether a significant difference exists between the pre-test scores of the students in experimental and control groups and the results were given in Table 5.

Table 4. Raw scores and Rasch scores of person

	Intervention				Control			
	Pre-test		Post-test		Pre-test		Post-test	
P	Raw Score	Rasch Score	Raw Score	Rasch Score	Raw Score	Rasch Score	Raw Score	Rasch Score
1	64	.10	96	1.84	70	.37	96	1.95
2	61	.00	88	1.07	69	.33	92	1.47
3	73	.40	80	.68	59	-.08	62	.09
4	90	1.27	77	.57	69	.33	48	-.41
5	84	.88	98	2.34	63	.08	89	1.24
6	84	.88	71	.36	82	.98	51	-.30
7	78	.60	94	1.56	74	.56	78	.67
8	73	.40	72	.39	81	.92	56	-.12
9	52	-.28	65	.17	69	.33	81	.80
10	70	.30	82	.77	65	.16	77	.63
11	58	-.09	96	1.84	62	.04	76	.59
12	75	.48	95	1.68	87	1.32	78	.67
13	77	.55	88	1.07	77	.70	76	.59
14	51	-.31	97	2.05	75	.60	86	1.05
15	67	.20	95	1.68	81	.92	64	.16
16	72	.37	87	1.01	70	.37	77	.63
17	66	.16	80	1.20	80	.86	62	.09
18	71	.33	88	1.07	72	.46	50	-.34
19	71	.33	73	.43	58	-.13	63	.12
20	76	.51	100	3.91	69	.33	81	.80
21	69	.26	78	.60	64	.12	70	.37
22	87	1.05	96	1.84	79	.81	56	-.12
23	86	.99	87	1.01	74	.56	74	.52
24	89	1.19	93	1.45	81	.92	82	.85
25	96	2.04	84	.86	76	.65	80	.76
26	92	1.46	74	.46	74	.56	83	.90
27	92	1.46	87	1.01	77	.70	66	.23
28	76	.51	90	1.20	57	-.17	68	.30
29	43	-.59	87	1.01	57	-.17	82	.85
30	52	-.28	65	.17	82	.98	90	1.31
31	80	.68	75	.50	84	1.11	55	-.16
32	96	2.04	82	.77	79	.81	87	1.11
33	59	-.06	65	.17	84	1.11	86	1.05
34	64	.10	100	3.91	92	1.80	88	1.17
35	53	-.25	80	.68	61	.00	71	.40

Table 5. Independent two sample t test results

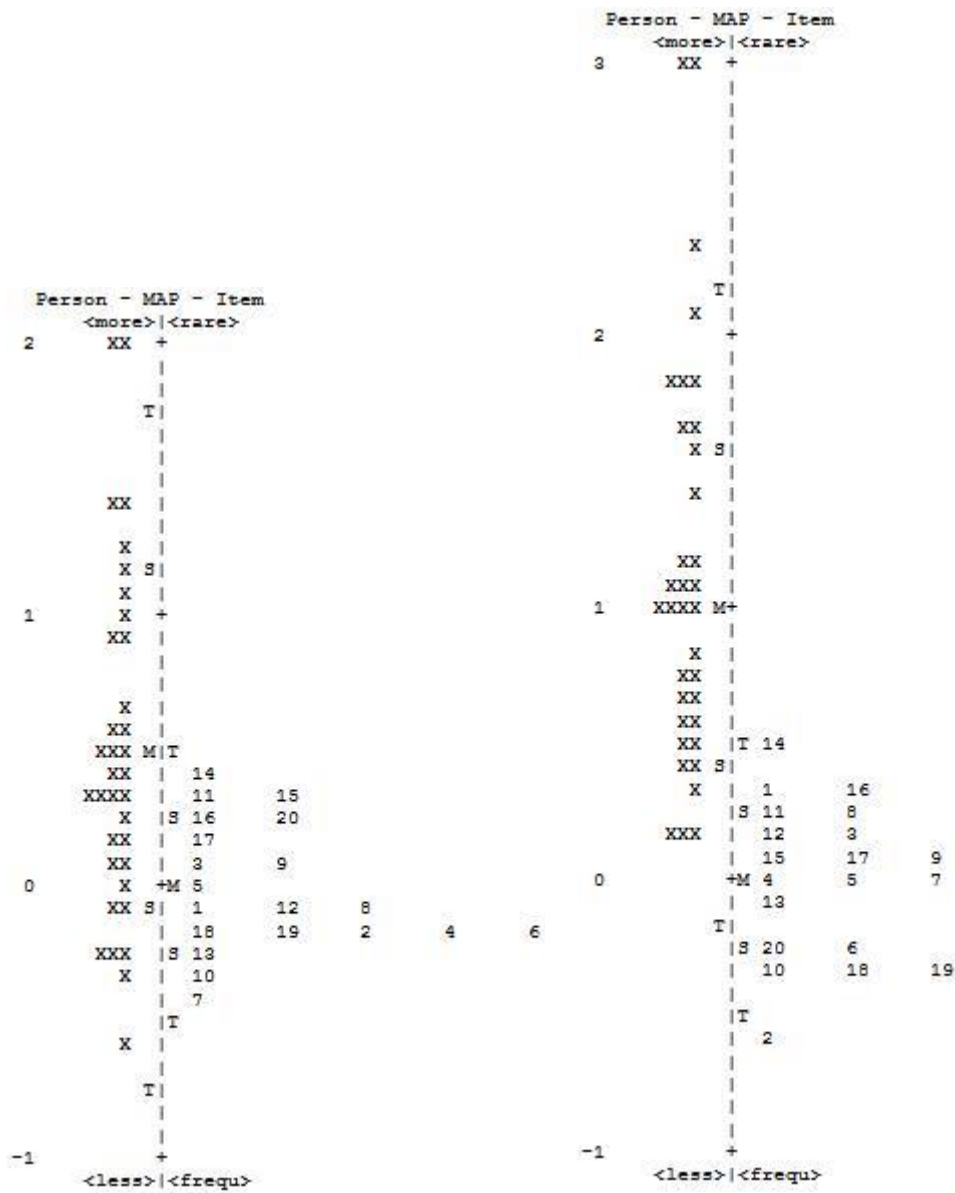|	Group	N	Mean (Logit)	SD	SD Error Mean	sd	t	p
Pre-test	Intervention	35	.51	.64	.11	68	-.336	.738
	Control	35	.55	.46	.08			

Figure 1. Person item maps for intervention group at ATS' pre and post test

Looking at the measures of the two groups pre-test averages are very close to each other (.51 and .55). The result of the intervention and control groups compared to pretest prior to the application by the t test results, there is no difference between ATS of groups $t(68) = -.336$, $p > .05$.

Table 6. Intervention group pre and post test t test results

Intervention Group	N	Mean (Logit)	SD	SD Error Mean	sd	t	p
Pre-test	35	.51	.64	.11	34	-3.553	.001
Post-test	35	1.18	.87	.15			

Looking at the measures of the intervention groups the average score of students at the pre-test was .51 (*SD* = .64), while the average score at post was 1.18 (*SD* = .87). Results from a dependent *t*-test indicate that this difference was significant, $t(34) = -3.553$, $p < .05$. Project-based learning approach may be regarded as a positive effect on students' ATS.

Table 7. Control group pre and post test t test results

Control Group	N	Mean (Logit)	SD	SD Error Mean	sd	t	p
Pre-test	35	.55	.46	.08	34	-.163	.871
Post-test	35	.57	.55	.09			

Looking at the measures of the control groups the average score of students at the pre-test was .55 (*SD* = .46), while the average score at post-test was .57 (*SD* = .55). Results from a dependent *t*-test indicate that this difference was significant, $t(34) = -.163$, $p > .05$. Traditional teaching method may not be regarded as if it has a positive effect on students' ATS.

Table 8. Analysis of Covariance results

Source	SS	df	MS	F	p
Pretest	.043	1	.043	.078	.781
Method	6.494	1	6.494	11.738	.001
Error	37.070	67	.553		

A one-way analysis of covariance (ANCOVA) was conducted for this study. The independent variable project based learning approach, the dependent variable was the students' statistics ability scores and the covariate was the students' score on the pretest. The ANCOVA was significant, $F(1, 67) = 11.738$, $p < .05$ and $\omega^2 = .15$. According to the results of ANCOVA, the intervention group's and control group's pre-test scores are under control, a statistically significant difference was found between post-test scores.

Discussion and Conclusion

The purpose of this study was to investigate the effects of project-based learning on attitudes of eighth grade students. For this reason, experimental and control groups were formed for the study. Whereas project-based learning was applied to the experimental group, traditional teaching (instruction based on student textbooks) was applied to the control group in the study. With this aim, projects and ATS were developed and applied to the students. The results of the study revealed that the attitude towards statistics, there was a significant difference between the experimental and the control groups. As presented in the pre-test findings of attitude towards statistics of students, there was no significant difference between the experimental and control groups in terms of their attitudes towards statistics. Post-test findings showed that the experimental group performed better than the control group. In other words, the students who were educated by project-based learning had more positive attitudes towards statistics than those who were educated by the instruction based on student textbooks.

These results support project-based learning approach can be applied in other studies. Baert, Beunens and Dekeyser (2002) emphasizes that, project based learning approach makes learning easier and more enjoyable. They advocated that project based learning may constitute an excellent learning

environment. Projects enable students to carry out an activity in accordance with their own interests (Cruickshank, Jenkins & Metcalf, 2003; Shearer & Quinn, 1996). Looking at this perspective positive change in attitudes can be seen as a factor that is expected in a project based learning environment. Papastergiou (2005) expressed that design and development of web sites related to teachers' educational projects were increased their interest in the educational process of web page design. Solomon (2003) emphasized that a well-designed project will increase the students' desire and interest. Erdem and Akkoyunlu (2002), Aladağ (2005), Gültekin (2005), Çiftçi (2006), Özdemir (2006), Yalçın, Turgut and Büyükkasap (2009) and Baş and Beyhan (2010) carried out studies by project-based learning in different learning atmospheres. They explored students' attitudes towards courses by project-based learning. In their studies, they found that there was a significant difference in the attitude levels towards the lesson between the groups, which project-based learning and the other group for which the instruction based on student textbooks were used. The students who were educated by project-based learning had developed more positive attitudes towards the lesson than the students who were educated by the instruction based on student textbooks. These results resemble to the result of this study. It can be said based on the findings; project-based learning was more effective on the development of students' attitudes towards lesson than the instruction based on student textbooks. However, some researchers investigated the effects of project-based learning approach on learning process and learners' attitudes (Demirel et all., 2000; Yurtluk, 2003). In their researches, it was found that there was no significant difference between pre- and post-test results of attitude scale in control and experimental groups.

There are research studies that explain the advantages of using project-based learning in educational settings (Demirel et al., 2000; Korkmaz, 2002; Yurtluk, 2003; Gültekin, 2005). However, only a few of them have focused on project-based learning in statistics teaching. These studies which were on the investigation of project-based learning were carried out in middle school level by comparing project-based learning with traditional methods. However, this study focuses on the effects of project-based learning with comparison to the traditional teaching. From this perspective, this research can be stated to have a significant value. By carrying out this study, the researcher hopes that project-based learning can receive more attention and enjoy more popularity amongst mathematics teachers at all grade levels.

There is general consensus in the mathematics education community that students need a deep and meaningful understanding of any mathematical content. Consequently, project based learning approach would be useful for teachers to consider the appropriate formative experiences that will foster the students' capacity for ongoing statistical learning, help them reflect on the nature of statistics, and help them value statistical knowledge and literacy in improving the education of all the citizens.

Teachers should be more informed about students' thoughts and attitudes towards statistics (Mvududu, 2003). Defining attitudes towards statistics of the students and planning the instruction process to improve their statistical literacy in a positive direction will contribute to increase the students' succes in maths. Teachers raise awareness to students about the practical applications of statistical research. Thus teachers can help improve students' attitudes.

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