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THE IMPACTS OF ANXIETY AND SELF-EFFICACY BELIEFS OF STUDENTS ON THE ACHIEVEMENT LEVELS ABOUT READING AND INTERPRETATION OF GRAPHS

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ABSTRACT: The aim of this study was to examine the effects of anxiety and self-efficacy beliefs of the eighth grade students on the achievement levels about the reading and interpretation of the frequency polygon and histogram. There were a total of 388 eighth grade students involved in this study. They attended to the study from four different middle schools. The researchers used three different instruments in the collection of the data. One of the instruments was a multiple choice statistics test that included 22 questions about the reading and interpretation of graphs and finding of the measures of both central tendency and dispersion. This test was developed by the researchers who piloted it and found its reliability of *Cronbach's alpha* value as 0.80. The researchers also used a math anxiety scale developed by Şentürk (2010) and a math self-efficacy beliefs scale developed by Umay (2002) in the study. After the collection of the data, the researchers employed the paired samples t-test, independent samples t-test and two-way ANOVA in the analysis of the data. The study demonstrated that the anxiety and self-efficacy levels of the 8th grade students in mathematics had considerable effects on the students' achievement levels about the reading and interpretation of the frequency polygon and histogram. The study also indicated that there were positive relationships between the students' self-efficacy levels and the overall test scores. Furthermore, when their achievement levels were examined according to their anxiety levels, the achievement levels of the students on the test were found successively medium, low and high. The interaction of students' anxiety and self-efficacy levels did not influence the accomplishment levels of the students about the reading and interpretation of the graphs.

Key words: Statistics, graphs, anxiety, self-efficacy beliefs

INTRODUCTION

There are many factors, such as anxiety, gender, curricula, peer-interaction, self-confidence, parental support, self-efficacy, use of technology, knowledge of teacher, and so forth that play important roles on the achievements of students in mathematics (e.g., Baloğlu, 2001; Ashcraft, 2002; Forgasız, 2005; Halat, Jakubowski & Aydın, 2008). For instance, anxiety is one of most influential factors on student's learning. Because of the math anxiety, many students do not like mathematics and escape from studying mathematics to other subject areas. According to Baloğlu (2001), although math anxiety was a prominent factor on students learning, it did not take much attention of math educators until 1970s. There can be found many definitions for math anxiety in the literature (i.e., Richardson & Suinn, 1972; Tobias, 1993; Ashcraft & Faust, 1994; Tooke & Leonard, 1998; Ashcraft, 2002; McAnallen, 2010). For instance, Richardson and Suinn (1972) defined mathematical anxiety as feelings of tension, nervousness, or fear that constrains success in math. Ashcraft (2002) stated "Math anxiety is commonly defined as a feeling of tension, apprehension, or fear that interferes with math performance." (p.181). Moreover, several researchers (i.e., Tooke & Leonard, 1998) claim that math anxiety, an important emotional factor, negatively affect students' learning and causes negative attitudes toward mathematics. Baloğlu (2001) states that there might be different factors, such as gender, age, socioeconomic statuses, teaching style, personality, and so on that may cause math anxiety.

Furthermore, self-efficacy is also very important factor on the students' achievement in mathematics. Self-efficacy can be defined as the belief of an individual in his or her ability to show necessary behaviors to reach or

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complete specific achievements (Bandura, 1977, 1986, 1997). Moreover, it reflects confidence in the capacity to use the motivation, knowledge and skills. According to the several research findings (Bandura, 1995; Schunk, 1996; Aşkar ve Umay, 2001), self-efficacy beliefs affect people's thoughts, behaviors, activities, choices, and efforts. Research findings support the claims of Bandura. For example, Aşkar & Umay (2001) expressed that individuals with high self-efficacy perception of any situation were persistent and patient, they made great efforts to accomplish a task and they did not easily return back when they faced with difficulties. In this study, the researchers focused on the impacts of the math anxiety and self-efficacy beliefs of the eighth grade students on their achievements in graph reading and interoperations.

Purpose of the Study

The aim of this study was to examine the effects of anxiety and self-efficacy beliefs of the eighth grade students on the achievement levels about the reading and interpretation of the Frequency Polygon and Histogram.

METHOD

Participants

There were a total of three hundred eighty-eight 8th grade students involved in this current study. The participants were from four different middle schools located in the city center of Aydın. The researchers used the convenience sampling procedure in the selection of the participants. This sampling procedure was the most commonly used one in today's educational research studies (McMillan, 2000; Wiersma, 2000). The participants were classified into three groups, low SES, middle SES and high SES, based on their schools.

Data Collection & Analysis Procedures

The researchers used a multiple choice statistics test that included 22 questions, 9 questions about Frequency Polygon that was drawn based on the test scores of students taken from a math test, 9 questions about the Histogram that was drawn based on the time spent on the social media, and 4 questions about the standard deviation. These questions were about the reading and interpretation of the graphs and finding of the measures of both central tendency and dispersion. Both Frequency Polygon and Histogram had similar questions. For instance, "How many students got 50 points on the Math test?," "How many students got 60 or below 60 points on the Math test?," and so on. This statistics test was developed by the researchers who piloted it and found its reliability of *Cronbach's alpha* value as 0.80.

The researchers also used a math anxiety scale developed by Şentürk (2010) and a math self-efficacy beliefs scale developed by Umay (2002) in the study. After the collection of the quantitative data, the researchers used the paired samples t-test, independent samples t-test and two-way ANOVA in the analysis of the data.

Table 1. Rubric For The Assessment Of The Levels

Self-Efficacy Levels			Anxiety Levels		
14-32	1	Low	22-51	1	Low
33-51	2	Medium	52-81	2	Medium
52-70	3	High	82-110	3	High

RESULTS AND FINDINGS

Types of Graphs & Gender Issue

Table 2. Paired Samples T-Test Results For The Graph Reading And Interpretation

Achievement levels	N	\bar{X}	SD	df	t	p
Frequency Polygon - Reading & Interpretation	388	4,14	0,71	387	3,475	0,001
Histogram- Reading & Interpretation	388	3,95	0,95			

According to the paired samples t-test results shown on Table 2, the mean score of the eighth grade students was numerically lower on the Histogram than the Frequency Polygon. This numerical difference was statistically significant [$t_{(387)}=3.475$ and $p=0.001 < \alpha=0.05$]. In other words, the 8th grade students in this study showed greater performance in reading and interpretation of the questions on the Frequency Polygon than the Histogram. Furthermore, Table 3 demonstrated that even though the mean scores of girls in regard to total test scores was numerically higher than that of boys, this numerical difference was not statistically significant [$t_{(387)}= -1.462$ and $p=0.145 > \alpha=0.05$]. That is, both 8th grade boys and girls performed equally on the graphs based on their total test scores.

Table 3. Independent Samples T-Test Results About The Total Test Scores For Gender

Variable	Gender	N	\bar{X}	SD	df	t	p
Total Test	Boys	155	67,06	16,16	386	-1,462	0,145
Score	Girls	233	69,27	13,39			

The Effects Of Anxiety And Self-Efficacy Levels On The Students Achievements In Graphs

According to descriptive statistics shown on Table 4; when the students had low anxiety level, their mean scores on the test increased from low self-efficacy level to high self-efficacy level. There can be seen the similar results for the medium and high anxiety levels, too. But, when the students had high self-efficacy level and low anxiety level, they had the highest mean score on the statistic test. When the students had high self-efficacy level and high anxiety level, their mean score on the test were higher than they had high self-efficacy level and medium anxiety level. This is interesting. In reality, it should be vise-versa.

Table 4. Descriptive Statistics About The Anxiety And Self-Efficacy Levels Based On The Test Scores

		Anxiety											
		Low			Medium			High			Total		
		N	\bar{X}	SD	N	\bar{X}	SD	N	\bar{X}	SD	N	\bar{X}	SD
Self- efficacy	Low	22	68,18	13,30	16	63,06	15,01	5	64,54	15,54	43	65,85	14,07
	Medium	50	66,90	15,28	171	66,26	14,22	35	65,58	14,84	256	66,29	14,46
	High	13	84,96	11,49	18	70,45	12,59	58	75,15	12,31	89	75,63	12,86
	Total	85	70	15,51	205	66,38	14,17	98	71,19	14,11	388	68,39	14,58

Table 5. Two-Way ANOVA Results About the Anxiety and Self-Efficacy Levels Based On the Test Scores

Source	Sum of Squares	df	Mean Square	F	p
Self-efficacy	5334,999	2	2667,499	13,597	0,000
Anxiety	1591,871	2	795,936	4,057	0,018
Anxiety* Self- efficacy	1253,536	4	313,384	1,597	0,174
Error	74350,948	379	196,177		
Total	1897231,405	388			

Two-way ANOVA indicated that there were statistically significant differences found in reference to both the anxiety and self-efficacy beliefs among the groups, but the interaction of both variables anxiety and self-efficacy beliefs did not influence the students' achievements on the statistic test. Scheffe test results indicated that there was a statistically significant difference detected with regard to the anxiety level between the students who had medium anxiety level and the students who had high anxiety level, but there were no statistically significant differences found for the other levels (see Table 6). In fact, one would expect that anxiety has negative effects on the students' success in mathematics. In this case, the students who had high anxiety level had high test score on the statistics test. It might be because of the fact that the participants of this study took this statistics test before the TEOG Exam which may have affected these students.

Table 6. Post Hoc Scheffe Test Results Based On the Anxiety Levels

Anxiety	Anxiety	Mean Differences	SE	p
Low	Medium	3,6142	1,80	0,137
	High	-1,1967	2,07	0,847
Medium	Low	-3,6142	1,80	0,137
	High	-4,8109*	1,72	0,021
High	Low	1,1967	2,07	0,847
	Medium	4,8109*	1,72	0,021

*: $p < \alpha = 0.05$

Table 7. Post Hoc Scheffe Test Results Based On the Self-Efficacy Levels

Self- efficacy	Self- efficacy	Mean Differences	SE	p
Low	Medium	-0,7580	2,331	0,949
	High	-10,0540*	2,622	0,001
Low	Low	0,7580	2,331	0,949
	High	-9,2960*	1,722	0,000
Low	Low	10,0540*	2,622	0,001
	Medium	9,2960*	1,722	0,000

The Scheffe test results about the self-efficacy levels pointed out that there were statically significant differences found in regard to self-efficacy beliefs between the students who had low self-efficacy levels and the students who had high self-efficacy levels, and between the students who had medium self-efficacy levels and the students who had high self-efficacy levels on the test (see Table 7). In other words, this study showed that students' self-efficacy levels had positive effects on the students' test scores. One would say that there were positive relationships between the students' self-efficacy levels and achievements levels on the statistics test.

CONCLUSION

The findings of this current study showed that the anxiety and self-efficacy levels of the eighth grade students on the statistics test had considerable effects on the students' achievements about the reading and interpretation of the Frequency Polygon and Histogram. Furthermore, when their achievement levels were examined based on their anxiety levels, the achievement levels of the students on the statistics test were found successively medium, low, and high. One would expect that we could match low anxiety level with high math score and high anxiety level with low math score. There is a contradiction with the order of achievement levels based on the anxiety levels found in this study. In this study, the 8th grade students who had high anxiety levels got the highest test scores. It seems that these successful students had anxiety level because of the fact that they were supposed to take the TEOG Exam which may have caused to increase their anxiety levels.

The study also indicated that there were positive relationships between the students' self-efficacy levels and achievement levels on the statistics test. In other words, the students who had low self-efficacy levels had low test scores, or the students who had high self-efficacy levels got high achievement levels on the test. This supports the arguments of several researchers (i.e., Ryan & Pintrich, 1997; Dev, 1998) who stated that there were positive correlations between the student's achievements and motivational levels in mathematics. There were also positive relationships between self-efficacy levels and achievements in mathematics. But, the interaction of students' anxiety and self-efficacy levels did not influence the accomplishment levels of the students about the reading and interpretation of the graphs.

Moreover, this current study pointed out that the participants of this study performed better on the Frequency Polygon than Histogram. This result is not in contrast with finding of Kaynar & Halat (2012) who found similar results about the reading and interpretation of 8th graders on the statistics test included Frequency Polygon, Histogram, and Pie graph. Besides, gender was not a prominent factor on the students test scores. This finding is also lined up with the results of several research studies (e.g., Friedman, 1994; Fennema & Hart, 1994; Halat, 2011; Kaynar & Halat, 2012; Selamet & Halat, 2014).

In short, this current study indicated that both math anxiety and self-efficacy beliefs of the eighth grade students had significant impacts on the students' achievement levels on the statistics test. Gender was not a great factor on the students overall test scores.

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