Education and Science tedmem

Vol 40 (2015) No 179 133-145

Science and Mathematics Course Success of Elementary Students in Low Socio-Economic Status among 4th-8th Grades: Gender Perspective

Murat Bursal [1], Serkan Buldur [2], Yüksel Dede [3]

Abstract

This study has investigated the change of the 4th-8th grades science and mathematics course success of 2142 elementary students in low socio-economic status by their grade level and gender via cross-sectional and longitudinal research approaches. Based on the findings of the study, consistent with the recent national and international studies, girls were found to have higher academic success than boys both in science and mathematics. When the changes in the annual science and mathematics course scores are investigated by the grade level, the mean scores of boys were found to decrease with the increasing grade level, whereas no significant change in any direction was observed for the mean scores of girls. Due to this difference, it has been observed that the achievement gap between girls and boys increases as the grade level increases, in favor of girls. Based on the related literature and the results of this study, it has been concluded that the traditional expectations about the gender gap, suggesting the male superiority in elementary science and mathematics courses, are no longer valid in today's classrooms, even in a sample of students in low socio-economic level.

Keywords

Longitudinal study
Science success
Cross-sectional study
Mathematics success
Socio-economic status

Article Info

Received: 09.08.2013
Accepted: 02.03.2013
Online Published: 05.20.2013

DOI: 10.15390/EB.2015.2913

Introduction

Gender has always been one of the most widely used variable in studies about students' academic achievement levels and the results of the gender comparisons are usually one of the most wondered outcomes of these studies. Devoting specific chapters for gender in the most comprehensive studies around the world, such as in Trends in International Mathematics and Science Study (TIMSS) and in Programme for International Student Assessment (PISA), indicates the attention paid on this topic. Up to the recent years, a majority of the literature about the relationship between the gender and the academic achievement areas, concluded that girls were more successful in verbal areas, whereas boys were more successful in science (Bacharach, Baumeister & Furr, 2003; Evans, Schweingruber & Stevenson, 2002; Hedges & Nowell, 1995; Nosek et al., 2009) and mathematics (Cohen, Manion & Morrison, 1998; Hallinan & Sorensen, 1987; Hilton & Berglund, 1974; Levin, Mohamed & Platek, 2005; Stone, 1999). However, it is also often reported in recent years both in

[1] Cumhuriyet University, Faculty of Education, Department of Elementary Education, Turkey, mbursal@cumhuriyet.edu.tr
[2] Cumhuriyet University, Faculty of Education, Department of Elementary Education, Turkey, serkan.buldur@gmail.com
[3] Gazi University, Faculty of Education, Department of Elementary Education, Turkey, ydede@gazi.edu.tr

science (Cole, 1997; Keeves, 1992; Martin, Mullis, Gonzales & Chrostowski, 2004; Martin & et al., 2008; Spelke, 2005) and mathematics (Beller & Gafni, 1996; Hall, Davis, Bolen & Chia, 1999; Hyde, Fennema & Lamon, 1990; Mullis, Martin, Gonzales & Chrostowski,, 2004; Mullis & et al., 2008; Sakız, 2012) research literature that, not only the ability levels, but also the achievement levels do not significantly differ between girls and boys. Furthermore, there has been an increasing number of studies that report differences in the science and mathematics success levels, in favoring of girls (Bulut, Gür & Sriraman, 2010; Bursal, 2013; Educational Research and Development Agency [ERDA], 2007a; 2010; Koca, 2011; Martin, Mullis, Foy & Stanco, 2012; Mullis, Martin, Foy & Arora, 2012; Özay, Ocak & Ocak, 2003; Yıldırım, Yıldırım, Yetişir & Ceylan, 2013). These discrepant findings indicate that the conventional acceptations and expectations about the gender differences in educational achievement levels may change by the changing conditions with years.

The TIMSS and PISA results are maybe the most important indicators of the change of the gender gap in different grade levels with time. The project started by The International Association for the Evaluation of Educational Achievement (IEA), with First International Mathematics Study (FIMS) in 1964 and with First International Science Study (FISS) in 1970-71, was then continued in separate studies in 1980's with the Second International Mathematics Study (SIMS) and the Second International Science Study (SISS). The common conclusion in these studies was that boys had a higher success levels both in science and mathematics and the gap between boys and girls widened as the grade level increased (Çakıroğlu, 1999; Keeves, 1992). By comparing the results of SIMS and SISS with the previous FIMS and FISS, Keeves (1992) pointed out that the gender gap was smaller in the SIMS and SISS, and therefore concluded that the narrowing of the achievement gap between girls and boys with time indicated that this gap depend not on biological factors, but on social factors.

The Third International Mathematics Science Study (TIMSS), which was conducted in 1995 in 41 countries, where the science and mathematics achievement levels of the 4th and 8th graders were investigated, was repeated as Trends in International Mathematics and Science Study within four years of periods in 1999 (in 38 countries), in 2003 (in 49 countries), in 2007 (in 59 countries) and in 2011 (in 63 countries). When TIMSS reports from different years are compared, it can be seen that while there has been a significant achievement gap in favor of 4th grader boys in 1995 and 1999 studies in science, the achievement gaps, in favor of boys, were found for both in science and mathematics among the 8th graders (Martin & et al., 2000; Mullis & et al., 2000). In 2003 TIMSS, the science achievement gap between genders was found to disappear in 4th graders; however, though the gap is decreased, 8th grader boys still were found to have a higher science success than girls (Martin & et al., 2004). On the other hand, in 2007 study, girls were found to have higher science (Martin & et al., 2008) and mathematics (Mullis & et al., 2008) success than boys in many countries, including Turkey. In the last 2011 TIMSS project, no significant difference in science and mathematics success, due to gender, was found among 4th graders, whereas it has been reported that the achievement gap is widened both in science and mathematics in favor of girls at 8th grade level (Martin & et al., 2012; Mullis & et al., 2012).

Among the TIMSS projects that Turkey has participated, no significant difference due to gender was found in science and mathematics success among Turkish students in the 1999 and 2007 studies (ERDA, 2003; Martin & et al., 2008; Mullis & et al., 2008). In 2011 TIMSS project, the findings for the Turkish sample were similar to those in general international findings that, girls have slightly higher success levels in science and mathematics at 4th grade level, and they have significantly higher science success than boys at 8th grade level (Martin & et al., 2012; Mullis & et al., 2012).

The PISA project, which was initiated in 2000 by the Organisation for Economic Co-operation and Development (OECD) and has been conducted in three years cycles, investigates the literacy levels of 15 years old students in science, mathematics and reading. Similar to the TIMSS results, while the achievement gap in favor of boys were reported in 2000 and 2003 PISA reports both in science and mathematics (OECD, 2004), the gap is reported to diminish in 2006 and 2009 PISA studies (OECD, 2007; 2010). In 2012 PISA study, although gender achievement gaps were still observed in some countries, it has been concluded that performance differences within the genders are significantly larger than those between them (OECD, 2013). The average score of Turkey in the four PISA studies between 2000-2012 were significantly lower than the OECD average (500 points) (ERDA, 2005; 2007a; 2010; Yıldırım & et al., 2013). Also, while the scores of Turkish girls and boys were almost equal in 2003 study, an achievement gap in favor of girls was reported to be seen in subsequent studies. This change by time was expresses in the national PISA 2006 report as "In general of Turkey, when students' mean science performance scores were considered, female students are more successful than male students." (ERDA, 2007a: 31-32). In 2012 PISA study, while no significant difference was found in mathematics literacy of girls and boys, a difference was reported in science literacy in favor of girls and this finding was stated as "Turkey is one of the countries, where the gender performance gap is high in science." (Yıldırım & et al., 2013: 33).

The most comprehensive study at the national level in Turkey is the Student Success Determination Exam (SSDE) run by the Ministry of National Education (MNE). The SSDE was started in 2002 for investigating the 4th-8th grade students' academic success in the Turkish, Mathematics, Science and Social Science courses around Turkey. The SSDE exam was repeated in 2005 and 2008, and although no statistically significant difference due to gender was found in students' science and mathematics' success, some patterns were observed with time. For example, when the science success is examined, 4th grader girls and boys had almost the same mean score in 2002 and 2005 SSDE, however girls were found to have slightly higher scores than boys at other grade levels (ERDA, 2002; 2007b). After the 2008 SSDE exam, it has been reported that the science achievement gap in favor of girls was seen in all grade levels including the 4th grade (ERDA, 2009).

The teaching program handbooks of MNE for science and mathematics courses, which were initiated in the 2006-2007 academic year and were renewed at several times with the latest reform in 2013, underlines the topic of achievement gap between genders. For example, the one of the main objectives of the science and technology course program, which was printed in 2006 by the MNE, was defined by "During the application of this program with different teaching tools and in different learning environments, an equal chance of gaining science experience should be provided to girls and boys in order to eliminate the achievement gap in favor of boys …" (MNE, 2006: 56). This new teaching programs based on constructive learning approach, aim to enhance the scientific literacy of students by student-centered learning activities, and the main principles of these programs were defined in the science course program as "preparing all students as scientifically literate individuals" (MNE, 2013: 1) and in the mathematics course program as "Every child can learn mathematics." (MNE, 2009: 7). Based on these goals, in order to determine the success levels of these new science and mathematics teaching programs, an important indicator would be investigating the academic success levels of students with different social profiles.

The Significance and Purpose of the Study

The past studies about students' academic success almost always focused on certain grades via cross-sectional studies, thus these studies do not allow understanding the longitudinal change of students' course success levels during elementary school years. To be able to explore the impact of the science and mathematics teaching programs on students' achievement levels, panel type longitudinal studies are needed, where the data on students' academic success collected from the same sample between 4th and 8th grades.

Socio-economic status (SES) has been reported to have a significant effect on students' academic achievement levels in various studies (Çakır, Şahin & Şahin, 2000; Dursun & Dede, 2004; Fennema & Sherman; 1977; OECD, 2007; 2010; Sirin, 2005), therefore it is crucial to statistically control the SES variable in longitudinal studies. For example, according to PISA 2009 Turkey report, the achievement gap between Turkish students with low and high-SES is larger than 20% (ERDA, 2010). In another study, which has studied the relationship between academic success and SES, Çakır et al. (2000), concluded that academic success in the science course was significantly differed by SES. Since SES level seems to impact the academic acahievement gap between genders, in order to control the SES variable, it is important that researchers in this area should focus on students with the same SES. In this study, researchers studied with a homogenious sample of students with low SES because the achievement gap in favor of boys is usually expected to be large in the low-SES group.

Among longitudinal research designs, panel design is rarely conducted in educational studies due to its limitations with the sample and time (Fraenkel & Wallen, 2003). The large scale projects, such as TIMSS, PISA and SSDE, do not study with the same sample over years but use cross-sectional research design, where students from different grade levels are investigated. Therefore, even these projects do not fulfill the longitudinal panel study conditions. For the above reasons, this study would be a significant contribution to the literature by longitudinally investigating the science and mathematics course success of same studemts from 4th grade to 8th grade. The research problems and related sub-problems investigated in this study are:

- How do elementary students science and mathematics course scores change between the 4th-8th grades by the grade level and their gender?
  1. Is there any significant difference by gender in elementary students' 4th-8th grades (i) Science, (ii) Mathematics course scores at any grade level?
  2. Is there any significant difference due to gender in the change of elementary students' (i) Science, (ii) Mathematics course scores from 4th to 8th grades?

Methodology

Research Design

This study was designed as a survey study (Fraenkel & Wallen, 2003), where elementary students' annual course scores in science and mathematics courses are compared by their grade levels and gender, via cross-sectional and longitudinal research designs. This study was conducted as a part of the project "An Investigation of the Academic Development of Elementary 4-8th Grade Students in the Context of Student and Teacher Profiles", which has been completed in Hani County, Diyarbakır.

Sample

The sample of the study consisted of 2141 elementary students, enrolled in 10 different elementary schools in Hani Country, Diyarbakır. The distribution of the participants by their grade levels and gender is given in Table 1.

Table 1. The Distribution of the Study Sample by Grade Level and Gender

	Girl		Boy		Total
	n	%	n	%	n
Grade 4	166	%50	165	%50	**331**
Grade 5	152	%41	219	%59	**371**
Grade 6	192	%39	295	%61	**487**
Grade 7	201	%44	255	%56	**456**
Grade 8	205	%41	292	%59	**497**
Total	**916**	%43	**1226**	%57	**2142**

When the montly income of the participants are considered, it was seen that the majority of students came from families with a 900 TL or lower monthly income (Girls: 91%, Boys: 89%), which is lower than the hunger limit announced by the Turkey Workers Union Confederation for a family of 4 people. Also, it has been found that the majority of students' mothers (Girls: 94%, Boys: 93%) and fathers (Girls: 70%, Boys: 73%) had educational background of elementary school level or lower. Therefore, when students are grouped by their gender, both groups were concluded to be in the low-SES level. Among the participants, 16% had pre-school education, 29% were in the transportative education program and 36% were educated in integrated schools. Since the majority of the participants of this study lived under low-SES level, the findings of this study would be generalized to other low-SES level students in similar regions of Turkey

For the longitudinal part of the study, the sample was determined via purposeful sampling method. The longitudinal sample consisted of a total of 133 eighth graders, 72 girls and 61 boys, of whom were selected with criterion sampling technique. The presence of the annual science and mathematics course scores for the 4th-8th grades data in the MNE database was used as the criterion for being included the sample.

Data Sources

The data collection process was started after providing the official permissions from the Hani county officials and County National Education Management office. The science and mathematics course scores of the 8th graders' from 4th to 8th grades between 2008-2012, were collected electronically. The data for the other participants were collected with the same procedure and their course scores for their grade levels were collected. To gather demographic information about the students, "Student Demographic Information Form" was prepared and administered by counseling teachers working at those schools. The names of participants were not revealed in any way and they were used only for matching the longitudinal data.

Data Analysis

This study has employed two different types of survey research designs, cross-sectional and longitudinal designs, for investigating the research problems. Among the longitudinal research designs, panel design is chosen for this study, since it is based on gathering data from the same participants over years (Fraenkel & Wallen, 2003). Cross-sectional and longitudinal designs are used together for investigating the consistency of findings for the research problem 1, and due to its limitations, longitudinal analysis has been done for the research problem 2 only. In order to prevent the dependency of the results from the cross-sectional and longitudinal analyses, the longitudinal data sample was defined separately and these participants are not included in the anayses for the cross-sectional design.

For investigating the research problem 1, cross-sectional design was used to compare the 4th-8th grade course scores of participants by their gender. In the cross-sectional analysis, the data of all students, except the ones in longitudinal sample, are used and students' course scores are compared by their gender with independent samples t-tests. The data from the longitudinal sample are analzed with multivariate ANOVA (MANOVA) tests, which allow comparing multiple dependent variable scores by gender at the same time. The MANOVA results for all grade levels and the independent samples t-test results for the cross-sectional analysis are compared together for their consistency.

Multi-variate tests are used for investigating the research problem 2 because these tests fit the factorial design, where the effects of grade level and gender independent variables on the longitudinal change of the course scores were tested at the same time. Altough repeated-measures ANOVA would provide more statistical power for these comparisons, since the sphericity assumtion crucial for repeated-measures ANOVA was not satisfied, multi-variate tests, which do not require sphericity assumption, have been used. (Pallant, 2007).

Significance alpha level was chosen α=,05 for all statistical tests. When MANOVA tests were used, Bonferroni alpha correction was used for controlling the total statistical error limit by 5% and the corrected significance level was determined by dividing ,05 to the number of dependent variables (Pallant, 2007). Cohen's d and partial eta-squared effect size values were calculated for comparisons that provided statistically significant results in order to explore the practical significance of the differences.

Findings

Findings from Cross-Sectional Design Analysis for the First Research Problem

The science and mathematics course scores of girls and boys, who were included in the cross-sectional analysis, are summarized by their grade levels in Tables 2 and 3. Independent samples t-test results and test statistics (t values and degrees of freedom levels) for the comparisons of the course scores of girls and boys at each grade level are also given in these tables. The common pattern in both samples is that, girls have significantly higher course scores than boys at all grade levels. Also, except some instances, it can be seen that the course scores decrease as the grade level increases. Mathematics course scores seems to be low for both girls and boys, especially for boys since their scores are lower than 50 over 100 between the 6th-8th grades.

Table 2. Science Course Scores of the Cross-Sectional Sample for 4th-8th Grades

Science Course		**Girl**			**Boy**		**Comparison Statistics**	
Grade	**Mean**	**s**	**n**	**Mean**	**s**	**n**	***t* (d.f.)**	***p***
Grade 4	**63,2**	15,33	591	**57,8**	15,89	706	6,19 (1295)	<,001
Grade 5	**66,7**	14,40	533	**60,5**	15,53	678	7,10 (1209)	<,001
Grade 6	**61,3**	15,43	493	**53,7**	16,80	642	7,85 (1133)	<,001
Grade 7	**61,5**	16,01	314	**51,8**	17,14	390	7,74 (702)	<,001
Grade 8	**61,6**	16,43	124	**52,7**	18,46	168	4,23 (290)	<,001

Table 3. Mathematics Course Scores of the Cross-Sectional Sample for 4th-8th Grades

Mathematics		**Girl**			**Boy**		**Comparison Statistics**	
Course Grade	**Mean**	**s**	**n**	**Mean**	**s**	**n**	***t* (d.f.)**	***p***
Grade 4	**57,5**	17,05	591	**55,0**	18,26	706	2,48 (1295)	,013
Grade 5	**60,7**	16,98	533	**57,0**	18,36	678	3,56 (1209)	<,001
Grade 6	**53,5**	17,61	493	**46,8**	18,20	642	6,26 (1133)	<,001
Grade 7	**53,6**	17,57	313	**46,2**	18,42	390	5,39 (701)	<,001
Grade 8	**50,1**	16,89	124	**45,0**	18,62	168	2,40 (290)	,017

Another important point in Tables 2-3 is that while the gender achievement gap is relatively small in early grades, it widens in favor of girls as the grade level increases. For example, the smallest gender gap (Δ) is detected at 4th grade level (ΔScience=5,4; ΔMath=2,5), but the gender gap is much wider at 8th grade level (ΔScience=8,9; ΔMath=5,1). When Cohen's d effect sizes are calculated for exploring the practical significance of these differences, effects sizes are found as d=0,35 for the science course and d=0,14 for the mathematics course scores at 4th grade level, whereas same effect sizes were d=0,51 for the science course and d=0,29 for the mathematics course scores at 8th grade level. All of the effect sizes indicate very large effects (Pallant, 2007) and the effect size values increase as the grade level increases.

Findings from Longitudinal Design Analysis for the First Research Problem

The science and mathematics course scores of participants, who were included in the longitudinal analysis, are summarized by their gender and grade levels in Tables 4 and 5. By crosschecking the data in Tables 4-5 with the data in Tables 2-3, it can be seen that the data from the longitudinal sample has similar patterns to the cross-sectional sample. For example, in both cases, girls have higher course scores than boys in science and mathematics courses at all grade levels.

MANOVA test results, which yield data from the comparions of longitudinal sample's course scores at all grade levels at the same time, indicate that there is a statistically significant difference by gender variable in at least two grade levels between 4th-8th grades, in both science [Wilks' Lambda=0,78; $F(5; 127)=7,16$, $p<,001$; eta-squared=,22] and mathematics [Wilks' Lambda=0,71; $F(5; 127)=10,22$, $p<,001$; eta-squared =,29] course scores. To be able to detect the grade levels that include a gender gap, the results of MANOVA within-group comparison tests, which yield data for the comparison of the course scores of girls and boys at all grade levels, and partial effect size values (η2) calculated for these comparisons are given in the final columns of Tables 4-5. The corrected Bonferroni alpha level was used as ,05/5=,01 in the analysis of these results since five dependent variables (five grade levels) were used in the model (Pallant, 2007).

Table 4. Science Course Scores of the Longitudinal Sample for 4^{th}-8^{th} Grades and MANOVA Comparison Results

Science	Girl (n = 61)		Boy (n = 72)		MANOVA	
Course Grade	**Mean**	**s**	**Mean**	**s**	***p***	**η^2**
Grade 4	**64,7**	13,76	**60,7**	15,14	,111	,02
Grade 5	**68,3**	14,74	**60,8**	13,83	,003	,06
Grade 6	**65,1**	14,08	**54,7**	12,97	<,001	,13
Grade 7	**70,9**	13,47	**57,1**	15,09	<,001	,19
Grade 8	**67,0**	15,32	**55,3**	12,08	<,001	,16

Table 5. Mathematics Course Scores of the Longitudinal Sample for 4^{th}-8^{th} Grades and MANOVA Comparison Results

Mathematics	Girl (n = 61)		Boy (n = 72)		MANOVA	
Course Grade	**Mean**	**s**	**Mean**	**s**	***p***	**η^2**
Grade 4	**60,9**	15,06	**58,0**	15,52	,267	,01
Grade 5	**64,2**	16,57	**58,1**	14,69	,027	,04
Grade 6	**58,7**	15,10	**49,5**	14,21	<,001	,09
Grade 7	**58,2**	18,56	**45,1**	15,56	<,001	,13
Grade 8	**60,1**	19,01	**41,0**	15,18	<,001	,24

The MANOVA within-group comparison test results in Tables 4 and 5 show that while there is no statistically significant difference in course scores of girls and boys at 4^{th} grade, a statistically significant difference in the science course scores is seen at 5^{th} grade. Also, starting from the 6^{th} grade, signicant differences in favor of girls are observed in both course scores. As was detected in the cross-sectional sample analysis, as the grade level increases, the achievement gap widens in favor of girls. The score gap between girls and boys are 4 for science and 2,9 for mathematics course at the 4^{th} grade level, however by the end of the 8^{th} grade, the differences are 11,7 for science and 19,1 for mathematics scores. The partial eta-squared effect sizes for the comparisons of two genders indicate that gender has a large effect (Pallant, 2007) on students' course scores, especially at 7^{th} and 8^{th} grades.

Findings from Longitudinal Design Analysis for the Second Research Problem

When the changes of science and mathematics course scores by gender are explored in Tables 4 and 5, there seems an evident decrease in both course scores of boys as the grade level increases. On the other hand, the course scores of girls do not show an obvious increment or decrement. The multi-variate test results, which yield data for the comparisons of the changes in course scores by gender, showed that the changes by gender in both science [Wilks' Lambda=0,90; $F(4;128)=3,75$; $p=,006$; eta-squared=,10] and mathematics [Wilks' Lambda=0,75; $F(4;128)=10,42$; $p<,001$; eta-squared=,25] course scores between 4th-8th grades are statistically different. When the overall mean course scores of girls and boys for 4th-8th grades are compared, girls are found to have higher scores than boys (9,5 in science scores and 10,1 in mathematics scores) and these differences were found to be statistically significant ($p<.001$). The partial eta-squared effect size values calculated for the longitudinal analysis between the 4th-8th grades indicate that gender has a medium effect (Pallant, 2007) on the science score change and a high effect (Pallant, 2007) on the mathematics score change between these grade levels.

Results and Discussion

The first research problem in this study, investigated the change of elementary students' science and mathematics course scores by gender between the 4th and 8th grades via cross-sectional and longitudinal research designs. The findings from both designs were consistent with each other and showed that girls had higher science and mathematics course scores than boys. The independent samples t-tests run for the cross-sectional design sample, found statistically significant differences in favor of girls at all grade levels. The MANOVA run for a smaller longitudinal sample, found significant differences in science course scores starting from the 5th grade and in mathematics course scores starting from the 6th grade, which were all in favor of girls.

When the findings from the cross-sectional design in Tables 2-3 and the results of the independent samples t-tests were analyzed together, not only girls have significantly higher course scores in all grade levels, but also the gap widens as the grade level increases. The Cohen's d effect size values calculated for these differences also show that the practical significance of the gender achievement gap gets larger in higher grade levels. The same phenomenon was checked in the longitudinal sample and it is concluded that as the grade level increases, the partial eta-squared values, calculated for each grade level comparisons in MANOVA, increase as well. These findings documented that the changes in the science and mathematics course scores of girls and boys did not have the same change patterns with the increasing grade levels. Therefore, this difference in change patterns were studied in detail with the second research problem.

The second research problem in this study used a longitudinal panel research design to investigate whether there is any difference due to gender in the change of elementary students' science and mathematics course scores between the 4th and 8th grades. Data from Tables 4-5 show that there is not any specific change in any direction in girls' science and mathematics course scores between the 4th-8th grades, however boys experienced noticeworthy decreases between the same grade levels. The multi-variate tests, comparing the changes in course scores by gender, showed that the changes in girls' and boys' course scores between the 4th-8th grades significantly differ for both science and mathematics courses. Moreover, it is detected that the achievement gap widens in favor of girls at higher grades.

These results are consistent with the other personal research studies (Bulut, Gür & Sriraman, 2010; Bursal, 2013; Koca, 2011; Özay, Ocak & Ocak, 2003), nation-wide exams such as SSDE (ERDA, 2009) and international studies such as TIMSS and PISA (Martin & et al., 2012; Mullis & et al., 2012; Yıldırım & et al., 2013) that have reported higher science and mathematics achievement of girls than boys. Similar conclusions are made in studies that have examined the Level Determination Exam (LDE), which is administered by the MNE to 6th-8th grade students for determining their high school types. The researchers, who had compared the LDE scores by gender, concluded that girls are more successful than boys in terms of the the number of correct responses in science and mathematics tests (Dede, Bursal & Aydoğdu, 2011) and the total LDE scores (Altun & Canca, 2011; Gündevür, 2011; Ötken, 2012). In light of all these studies, it can be concluded that boys do not hold the more advantegious spot in terms of higher achievement in the science and mathematics courses any longer.

Furthermore, it can be concluded that in today's classrooms girls started to have higher science and mathematics achievement than boys.

Conclusion and Comments

This study found that in a sample of low-SES students, girls have higher science and mathematics course scores than boys, though the expectations were conventionally the opposite for similar samples in Turkey. The longitudinal part of the study also documented that gender variable plays an important role in the changes of science and mathematics course scores between the 4^{th}-8^{th} grades. Although noticeworthy decreases were observed in the science and mathematics course scores of boys, girls did not experience similar decreases in their course scores. In light of the findings of this study and the related studies in the literature, it can be concluded that the conventional statement of boys having higher science and mathematics achievement, which even had entered into the official teaching programs of the MNE, is no longer valid. This conclusion is actually not surprising because although male dominance had been declared for a long time, the official reports of national exams in Turkey supports the higher level of female success in science and mathematics. For example, when the Higher-Education Transition Exam (HTE), administered by the Measurement, Selection and Placement Center (MSPC), results are examined for the 2010-2014 years, the percentage of girls who scored higher than 180 point (2010: 87%; 2011: 84%; 2012: 77%; 2013: 72%; 2014: 77%) are consistently higher the percentages of boys who scored at the same level (2010: 79%; 2011: 76%; 2012: 68%; 2013: 65%; 2014: 69%). Additionally, as another indicator of the achievement gap in science and mathematics, which are the main topics of this study, females are reported to have higher mean scores than males about 6 points in the Undergraduate Placement Exam (UPE) in 2012 and 2013 (MSPC, 2012b; MSPC, 2013b). The point difference, in favor of females, is reported to be higher than 7 points in the 2014 MSPC media announcement (MSPC, 2014b).

Although the major finding of this study, the conclusion that the conventional male superiority idea is no longer valid in a low-SES sample living in a relatively under-developed region of Turkey, seems to be a positive sign, it also points out that focusing on the gender difference would mask many other problems in education. Firstly, it should be underlined that both gender groups in this study have low success in science and mathematics. The low achievement level in science and mathematics is also documented in other nation wide exams in Turkey (ERDA, 2002; 2007b; 2009). For this reason, instead of focusing on the gender achievement gap, the priority should be given on enhancing the success level of both genders. This point is also supported by the 2012 PISA international report that the science and mathematics achievement differences within the same gender group are found to be significantly larger than those between the genders (OECD, 2013). Since many different factors would impact the academic achievement of students, specifically designed studies are needed for developing scientific conclusions. For this reason, this study does not claim explaining the factors that had affected the achievement levels of students in the sample. However, it reveals important data that beyond focusing on the studies on the gender achievement gap, specific precautions are needed for each gender in order to enhance their success levels. Based on the findings of this study, it should be studied in detail that why the students achievement levels in science and mathematics decrease —especially the achievement levels of boys— as the grade level increases via qualitative studies. Also, similar studies to this present study, which included a low-SES sample, can be designed and conducted in different regions of Turkey with students in different SES levels in order to investigate their science and mathematics achievement longitudinally. Instead of finding general solutions for all Turkish students, the results of these studies would allow developing suggestions for each student profile, living in various social, economic and regional contexts.

One of the major limitation of this study is using the annual course scores for measuring the academic success levels of students. However, since the main objective of this study was studying the longitudinal change of the academic achievement, it can be assumed that the extraneous variables on their success levels would be homogenious in a sample, which is consisted of merely low-SES level girls and boys living in the same county. On the other hand, the difficulty of collecting data from the same sample in a longitudinal panel study, spanning a five years period, is obvious. In order to overcome the limitation stated above and explain the changes in students' academic achievement levels in detail, large-scale projects can be conducted in some pilot regions of Turkey, by using TIMSS and PISA type questions which had been examined for their validity and reliability by the researchers.

Acknowledgement

We would like to thank the governer of Hani county of Diyarbakır, İsmail Şanlı, the Hani county national education office personal and all elementary school personals and students that had contributed to this study.

References

Altun, S., & Canca, D. (2011). İlköğretim öğrencilerinin seviye belirleme sınavından aldıkları puanlar öğrenme stiline, okul türüne ve cinsiyete göre farklılaşmakta mıdır? *E-Journal of New World Sciences Academy*, *6*(1), 793-800.

Bacharach, V. R., Baumeister, A. A., & Furr, M. (2003). Racial and gender science achievement gaps in secondary education. *The Journal of Genetic Psychology: Research and Theory on Human Development*, *164*(1), 115-126.

Beller, M., & Gafni, N. (1986). The 1991 International assessment of educational progress in mathematics and sciences: The gender differences perspective. *Journal of Educational Psycholology, 88*, 365-377.

Bulut, S., Gür, B. S., & Sriraman, B. (2010). Commentary 2 on feminist pedagogy and mathematics. In B. Sriraman and L. English (Eds.), Theories of Mathematics Education: Seeking New Frontiers (pp. 455-466). New York: Springer.

Bursal, M. (2013). İlköğretim öğrencilerinin 4-8. sınıf fen akademik başarılarının boylamsal incelenmesi: Sınıf düzeyi ve cinsiyet farklılıkları. *Kuram ve Uygulamada Eğitim Bilimleri (KUYEB), 13*(2), 1141-1156.

Cohen, L, Manion, L., & Morrison, K. (1998). *A guide to teaching practice.* Fourth Edition. New York.: Routledge.

Cole, N. S. (1997). *The ets gender study: how females and males perform in educational settings*. Princeton, NJ: Educational Testing Service.

Çakır Ö. S., Şahin, T., & Şahin B. (2000*).* İlköğretim 6. sınıf fen bilgisi dersine ilişkin bazı değişkenlerin öğrencilerin duyuşsal özelliklerini açıklama gücü. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 19*, 43-49.

Çakıroğlu, J. (1999). Gender difference in the science classroom. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 16-17*, 127-133.

Dede, Y., Bursal, M., & Aydoğdu, B. (2011). *İlköğretim öğrencilerinin 6. ve 7. sınıf Seviye Belirleme Sınavındaki (SBS) matematik ve fen netlerinin değişimi: Cinsiyet farklılıkları,* 11th International Educational Technology Conference (IETC), İstanbul.

Dursun, Ş., & Dede, Y. (2004). Öğrencilerin matematikte başarisini etkileyen faktörler: matematik öğretmenlerinin görüşleri bakimindan. *Gazi Üniversitesi, Gazi Eğitim Fakültesi Dergisi, 24*(2), 217-230.

ERDA (2002). *ÖBBS 2002: İlköğretim öğrencilerinin başarılarının belirlenmesi durum belirleme raporu*. MEB Eğitimi Araştırma ve Geliştirme Dairesi (EARGED) Başkanlığı, Ankara.

ERDA (2003). *TIMSS 1999: Üçüncü uluslar arası matematik ve fen bilgisi çalışması: Ulusal rapor*. MEB Eğitimi Araştırma ve Geliştirme Dairesi (EARGED) Başkanlığı.

ERDA (2005). *PISA 2003 projesi ulusal nihai rapor*. MEB Eğitimi Araştırma ve Geliştirme Dairesi (EARGED) Başkanlığı, Ankara.

ERDA (2007a). *PISA 2006: Uluslar arası öğrenci değerlendirme programı ulusal ön rapor*. MEB Eğitimi Araştırma ve Geliştirme Dairesi (EARGED) Başkanlığı, Ankara.

ERDA (2007b). *ÖBBS 2005: İlköğretim öğrencilerinin başarılarının belirlenmesi: Fen bilgisi raporu*. MEB Eğitimi Araştırma ve Geliştirme Dairesi (EARGED) Başkanlığı, Ankara.

ERDA (2009). *ÖBBS 2008: İlköğretim öğrencilerinin başarılarının belirlenmesi: Fen ve teknoloji raporu*. MEB Eğitimi Araştırma ve Geliştirme Dairesi (EARGED) Başkanlığı, Ankara.

ERDA (2010). *PISA 2009 projesi ulusal ön raporu*. MEB Eğitimi Araştırma ve Geliştirme Dairesi (EARGED) Başkanlığı, Ankara.

Evans, E. M., Schweingruber, H., & Stevenson, H. W. (2002) Gender differences in interest and knowledge acquisition: The United States, Taiwan, and Japan, *Sex Roles, 47*(3/4), 153-167.

Fennema, E., & Sherman, J. (1977). Sex-related differences in mathematics achievement, spatial visualization and affective factors. *American Educational Research Journal, 14*(1), 51-71.

Fraenkel, J. R., & Wallen, N. E. (2003). *How to design and evaluate research in education*, New York, NY: McGraw Hill.

Gündevür, A. (2011). *İlköğretim öğrencilerinin SBS başarılarının bazı değişkenlere göre incelenmesi.* Unpublished master thesis, Yüzüncü Yıl University, Van.

Hall, W., Davis, N., Bolen, L., & Chia, R. (1999). Gender and racial differences in mathematical performance. *The Journal of Social Psychology*, *139*(6), 677-689.

Hallinan, M. T., & Sørensen, A. (1987). Ability grouping and sex differences in mathematics achievement. *Sociology of Education, 60*(2), 63-72.

Hedges, L. V., & Nowell, A. (1995). Sex differences in mental test scores, variability, and numbers of high-scoring individuals. *Science*, *269*(5220), 41-45.

Hilton, T. L., & Berglund, G. W. (1974) Sex differences in mathematics achievement: A longitudinal study. *Journal of Educational Research, 67*, 231-237.

Hyde, J. S. Fennema, E., & Lamon, S. J. (1990) Gender differences in mathematics performance: A meta-analysis**.** *Psychological Bulletin, 107*(2), 139-155.

Keeves, J. P. (1992). *Learning science in a changing world: Cross-national studies of science achievement, 1970 to 1984*. The Hague: IEA.

Koca, S. (2011). *İlköğretim 8. Sınıf öğrencilerinin matematik başarı, tutum ve kaygılarının öğrenme stillerine göre farklılığının incelenmesi*. Unpublished master thesis, Kocatepe University, Afyon.

Levin, S. L., Mohamed, F. B., & Platek, S. M. (2005). Common ground for spatial cognition? A behavioral and fMRI study of sex differences in mental rotation and spatial working memory. *Evolutionary Psychology*, *3*, 227–254.

Martin, M. O., Mullis, I. V. S., Foy, P., & Stanco, G. M. (2012). *TIMSS 2011 international results in science*. International Study Center, Boston College, MA, USA.

Martin, M. O., Mullis, I. V. S., Foy, P., Olson, J. F., Erberger, E., Preuschoff, C., & Galia, J. (2008). *TIMSS 2007 international science report.* TIMSS & PIRLS International Study Center, Boston College, MA, USA.

Martin, M. O., Mullis, I. V. S., Gonzales, E. J., & Chrostowski, S. J. (2004). *TIMSS 2003 international science report.* TIMSS & PIRLS International Study Center, Boston College, MA, USA.

Martin, M. O., Mullis, I. V. S., Gonzales, E. J., Gregory, K. D., Smith, T. A., Chrostowski, S. J., Garden, R. A., & O'Connor, K. M. (2000). *TIMSS 1999 international science report.* International Study Center, Boston College, MA, USA.

MNE (2006). *İlköğretim fen ve teknoloji dersi (6, 7 ve 8. sınıflar) öğretim programı*. Ankara: MEB Talim ve Terbiye Kurulu Başkanlığı.

MNE (2009). *İlköğretim matematik dersi 6–8. sınıflar öğretim programı ve kılavuzu*. Ankara: MEB Talim ve Terbiye Kurulu Başkanlığı.

MNE (2013). *Ortaokul matematik dersi (5, 6, 7 ve 8. sınıflar) öğretim programı.* Ankara: MEB Talim ve Terbiye Kurulu Başkanlığı.

MSPC (2012a). Measurement, Selection and Placement Center, 2012 HTE results [Ölçme, Seçme ve Yerleştirme Merkezi, 2012 YGS sonuçları]. Retrieved on July 24 2013 from, http://dokuman.osym.gov.tr/pdfdokuman/2012/OSYS/2012YGSSonuclari.pdf.

MSPC (2012b). Measurement, Selection and Placement Center, 2012 UPE results [Ölçme, Seçme ve Yerleştirme Merkezi, 2012-LYS sonuçları]. Retrieved on July 24 2013 from, http://www.osym.gov.tr/dosya/1-60607/h/2012-lyssayisalbilgiler23072012.pdf.

MSPC (2013a). Measurement, Selection and Placement Center, 2013 HTE results [Ölçme, Seçme ve Yerleştirme Merkezi, 2013 YGS sonuçları]. Retrieved on February 20 2015 from, http://dokuman.osym.gov.tr/pdfdokuman/2013/OSYS/2013-YGS-SonucAciklama_Sunum.pdf.

MSPC (2013b). Measurement, Selection and Placement Center, 2013 UPE results [Ölçme, Seçme ve Yerleştirme Merkezi, 2013-LYS sonuçları]. Retrieved on July 26 2013 from, http://www.osym.gov.tr/dosya/1-69292/h/2013-lyssayisalbilgilerbasin.pdf.

MSPC (2014a). Measurement, Selection and Placement Center, 2014 HTE results [Ölçme, Seçme ve Yerleştirme Merkezi, 2014 YGS sonuçları]. Retrieved on February 20 2015 from, http://dokuman.osym.gov.tr/pdfdokuman/2014/YGS/2014YGSSAYISALBiLGiLER03042014.pdf.

MSPC (2014b). Measurement, Selection and Placement Center, 2014 UPE results [Ölçme, Seçme ve Yerleştirme Merkezi, 2014-LYS sonuçları]. Retrieved on February 20 2015 from, http://dokuman.osym.gov.tr/pdfdokuman/2014/LYS/2014_LYS_SB.pdf.

Mullis, I. V. S., Martin, M. O., Foy, P., & Arora, A. (2012). *TIMSS 2011 International results in mathematics*. International Study Center, Boston College, MA, USA.

Mullis, I. V. S., Martin, M. O., Foy, P., Olson, J. F., Preuschoff, C., Erberger, E., Arora, A., & Galia, J. (2008). *TIMSS 2007 international mathematics report.* TIMSS & PIRLS International Study Center, Boston College, MA, USA.

Mullis, I. V. S., Martin, M. O., Gonzales, E. J., & Chrostowski, S. J. (2004). *TIMSS 2003 international mathematics report.* TIMSS & PIRLS International Study Center, Boston College, MA, USA.

Mullis, I. V. S., Martin, M. O., Gonzales, E. J. , Gregory, K. D., Garden, R. A., O'Connor, K. M., Chrostowski, S. J., & Smith, T. A. (2000). *TIMSS 1999 international mathematics report.* TIMSS & PIRLS International Study Center, Boston College, MA, USA.

Nosek et al., (2009). National differences in gender–science stereotypes predict national sex differences in science and math achievement. *Proceedings of the National Academy of Sciences of the United States of America (PNAS), 106*(26), 10593-10597.

OECD (2004). *Learning for tomorrow's world: First results from PISA 2003.* OECD Publications.

OECD (2007). *PISA 2006 science competencies for tomorrow's world: Executive summary*. OECD Publications.

OECD (2010). *PISA 2009 results: Executive summary.* OECD Publications.

OECD (2013). *PISA 2012 results in focus.* OECD Publications.

Ötken, Ş. (2012). *İlköğretim 7. Sınıf SBS başarısını yordayan değişkenlerin belirlenmesi*. Unpublished master thesis. Hacettepe University, Ankara.

Özay, E. T., Ocak, İ. T., & Ocak, G. T. (2003). Genel biyoloji uygulamalarında akademik başarı ve kalıcılığa cinsiyetin etkisi. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi, 14,* 63-67.

Pallant, J. (2007). *SPSS survival manual*. New York: Mc Graw Hill.

Sakız, G. (2012). *Akademik özyeterlik ve başarı arasındaki ilişkinin ilköğretim I. kademe fen derslerinde cinsiyet ve öğretmen değişkenlerine göre incelenmesi*. 21. Ulusal Eğitim Bilimleri Kongresi. İstanbul.

Sirin, S. R. (2005). Socioeconomic status and academic achievement: A meta-analytic review of research. *Review of Educational Research, 75*(3), 417-453.

Spelke, E. S. (2005). Sex differences in intrinsic aptitude for mathematics and science? A critical review. *American Psychologist, 60*(9), 950-958.

Stone, K. (1999). Girls' math scores could indicate success and aspirations. Retrieved on July 25 2013 from, http://teep.tamu.edu/reports/report014.pdf.

Yıldırım, H. H., Yıldırım, S., Yetişir, M. İ., & Ceylan, E. (2013). *PISA 2012 ulusal ön raporu*. MEB Yenilik ve Eğitim Teknolojileri Genel Müdürlüğü (YeğiTek), Ankara.