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Türkiye'de Az ve Çok Başarılı Okullardaki Öğrencilerin ve Kız-Erkek Öğrencilerin Duyuşsal ve Bilişsel Değişkenler Açısından Farklarının İncelenmesi

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Öz

Bu çalışmada çok başarılı ve az başarılı okullarda okuyan öğrenciler; fene karşı olan tutumları, epistemolojik inançları, üst-bilişsel becerileri ve fen öğretimiyle ilgili görüşleri açısından karşılaştırılmışlardır. Ayrıca kız ve erkek öğrenciler, hem çok başarılı hem de az başarılı okullarda bu değişkenler açısından karşılaştırılmıştır. Çalışmanın sonuçları, çok başarılı okullarda okuyan öğrencilerin bu değişkenlerin hepsinde az başarılı okullarda okuyan akranlarına göre daha yüksek puan elde ettiğini göstermiştir. Ayrıca çok başarılı okullarda kız öğrenciler erkek öğrencilerden daha olumlu epistemolojik inanç ve fen öğretimiyle ilgili görüş belirtmiş ve yüksek fen başarısı elde etmiştir. Diğer taraftan az başarılı okullarda kız öğrencilerin erkek öğrencilere göre daha olumlu üst-bilişsel becerilerinin olduğu bulunmuştur. Bu sonuçlar çerçevesinde fen eğitimiyle ilgili gerekli tavsiyeler yapılmıştır.

Anahtar Kelimler: Fen Eğitimi, Başarı Farkı, Cinsiyet Farkı, Sosyo-Ekonomik Statü, Epistemolojik İnanç, Üst-Bilişsel Beceriler.

An Investigation of the Differences between Students in Low and High Achieving Schools and between Female and Male Students based on Motivational and Cognitive Variables in Turkey

Abstract

Students in low achieving and students in high achieving schools were compared based on attitudes towards science, epistemological beliefs, metacognition, and views on science teaching in the present study. Besides girls and boys were compared both in high and low achieving schools based on these variables. Results of this study showed that students in high achieving schools outperformed their peers in low achieving schools on all of these measures. In addition girls stated more positive epistemological beliefs and views on science teaching and had higher science achievement than boys in high achieving schools. On the other hand, it was found that girls had more positive metacognitive skills than boys in low achieving schools. Implications regarding science education were discussed according to these findings.

Keywords: Science Education, Achievement Gap, Gender Gap, Socio-Economic Status, Epistemological Beliefs, Metacognition.

Introduction

Turkish students' science achievement is not at the desired level according to the findings reported for both national and international assessments (Bulunuz, Bulunuz, Karagöz, & Tavşanlı, 2016; Eğitimi Araştırma ve Geliştirme Dairesi Başkanlığı [EARGED], 2009; The Organisation for Economic Co-operation and Development [OECD], 2014; OECD, 2016). For instance, comparing PISA 2012 science achievement results with that of 2015 results, Turkish students' rank seems to go backwards from 43 in 65 to 52 in 70 countries (OECD, 2014;OECD, 2016). These results should alert caution among policy makers.

Science educators examined the factors that contribute to Turkish students' science achievement in international assessments, i.e., Programme for İnternational Student Assessment [PISA], the Trends in International Mathematics and Science Study [TIMSS]. More specifically, studies investigated the effect of student, teacher and school related variables on student science achievement. Student-level variables that affect to science achievement was found to be student self-esteem in their science performance (Berberoğlu, Çelebi, Özdemir, Uysal, & Yayan, 2003; Kalender & Berberoglu, 2009; Özdemir, 2003; Topçu, Erbilgin, & Arıkan, 2016), their readiness to learn science, attitudes towards science (Yetişir, 2014) and enjoyment and value of science (Ozel, Caglak, & Erdogan, 2013). Teacher-level factors include teacher-centered instruction (Ceylan & Berberoglu, 2007; Özdemir, 2003), teacher's gender (Atar, 2014), attendance of professional developmental programs, and collaboration among peers (Atar, 2014). At the school-level, school emphasis on academic success (Atar, 2014), class student size (Milli Eğitim Bakanlığı [MEB], 2016), and student-teacher ratio (MEB, 2016; Türk Eğitim Derneği [TED], 2014) were stated the variables that influence student science achievement in Turkey.

As in the case of most countries, Turkish students' science achievement is affected by their families' socio-economic status (SES) (EARGED, 2009; OECD, 2014; OECD, 2016). Besides Turkish students cluster in schools according to their families' SES (Alacacı & Erbaş, 2010; Dinçer & Uysal, 2010; TED, 2014). Taken together, students who have families with high SES seem to cluster in high achieving schools (HAS) and students who have families with low SES seem to cluster in low achieving schools (LAS). This dissociation is so severe that Turkey is one of the countries which participate to Pisa 2012 that has one of the lowest in school achievement variance (TED, 2014).

Although there is a clear distinction regarding science achievement between LAS and HAS in Turkey, limited number of studies examined student profile in each setting. For instance, Engin-Demir (2009) investigated the effect of family, student, and school variables on student academic achievement which was measured by weighing 6th, 7th, and 8th grade students' previous Science, Math, and Turkish grades in Turkish urban poor schools. The author found that family related variables such as father education level and family income, student related variables such as time spent on studying, teacher treatment, and gender; school related variables such as student-teacher ratio and teacher's educational degree level had significant contribution to students' academic achievement. In another study, Aypay, Erdoğan and Sözer (2007) selected 20 LAS and 20 HAS based on schools' science performances at TIMSS-99 data. Two discriminant function analyses were performed to determine characteristics of LAS and HAS. Result of the first discriminant function analysis showed that activities that are seen as student-centered are characteristics of LAS science instruction and activities that are viewed as teacher-centered are characteristics of HAS science instruction. The other discriminant analysis yielded that SES, teacher-centered classroom activities, and students' attitudes towards science are characteristics of HAS and student-centered classroom activities, technology usage in classroom, and doing well in science were the characteristics of LAS.

In addition to school type, another factor that explains the variance in student science achievement in Turkey is gender. According to the results of international assessments, Turkey is one the countries which gender science achievement gap exists in favor of girls (Atalmis, Avgin, Demir, & Yildirim, 2016; Gevrek & Seiberlich, 2014; OECD, 2014; OECD, 2016, Önal, 2015). This result is also consisted with the result of national standardized exams (EARGED, 2009) and in class exams (Acar, Büber, & Tola, 2015a; Acar, Türkmen, & Bilgin, 2015b; Bursal, 2013; Engin-Demir, 2009). Gender gap alerts caution among policy makers because this gap widens as the grade level increases (Bursal, 2013).

Studies examined the difference of boys and girls on several variables such as attitudes towards science, epistemological beliefs, and metacognition. It is found that girls outperform boys on attitudes towards science (Önal, 2015), epistemological beliefs and metacognition (Özmusul, 2012; Topçu & Yılmaz-Tüzün, 2009). This is not a surprising picture in that attitudes towards science (Acar et al., 2015b; Yetişir, 2014), epistemological beliefs and metacognition significantly predict student science achievement in Turkey (Kizilgunes, Tekkaya, & Sungur, 2009; Topçu & Yılmaz-Tüzün, 2009).

As in the case of scarcity of studies which examined student profile according to the school types, there is paucity study exists in the literature which examined gender profile in HAS and LAS. In fact, if there is clear distinction in terms of student profiles between HAS and LAS, boys and girls should be examined separately. Only a study by Engin-Demir (2009) has been found in the literature which included gender variable in the weighted achievement model of Turkish urban poor schools. This study found that gender is a significant variable that contributes to the science achievement model in Turkish urban poor schools and girls outperformed boys on a weighted achievement which included previous semester Turkish, math, and science courses' grades. Another issue that has been neglected in the literature is the classroom activities' perception difference between boys and girls especially in LAS and HAS settings. If there is a science achievement difference between boys and girls, investigation of their perception of class science teaching would give valuable insight on the possible class environmental factors that can contribute to this gap. With an aim to focus on these issues, the present study investigated the following research questions:

R.Q.1: Is there any difference on attitudes towards science, epistemological beliefs, metacognition, and views on science teaching between students in LAS and students in HAS?

R.Q.2: Is there any difference between boys and girls on attitudes towards science, epistemological beliefs, metacognition, views on science teaching, and science achievement in LAS and HAS?

Research Context

This research carried out during 2015 spring semester in an industrial city in Turkey. Two schools were selected as representing advantaged schools based upon their student mean performance scores on a nationwide exam in the previous year (TEOG), i.e., one of them was the 6th and the other was the 7th among total of 56 schools that is used to place students in high schools. Another two schools were selected as representing disadvantaged schools based upon their student performance on TEOG, i.e., one of them was the 44th and the other was 53rd among total of 56 schools. We performed an independent samples t test on the present's year students' TEOG science scores to confirm that science achievement between the students in the two groups of schools is statistically different from each other. Result showed that students in HAS ($M = 78.69$) scored higher than students in LAS ($M = 48.22$, $t(559) = 14.95$, $p < .001$). Former schools were located in an area where mostly people with higher SES were living. On the other hand, school district of the latter schools was known as an area where people with lower SES were living. 320 8th grade students participated to the study in the advantaged schools and 241 8th grade students participated in the disadvantaged schools. Among these students, 150 girls and 170 boys were in the advantaged school and 122 girls and 119 boys were in the disadvantaged school. We selected 8th graders for our study because students in that grade had to take TEOG that is used to place students in high schools as explained above. TEOG was administered at the last week of April. We administered our instruments one week before the administration of TEOG. Students completed each instrument in their school science classes. We administered the questionnaires related to student attitudes towards science and views on science teaching during one class time and questionnaires related to student epistemological beliefs and metacognition on another class time at each school.

Study Variables

Attitudes Towards Science

This questionnaire was developed by Kind, Jones and Barmby (2007) by the examination of science attitude measures developed previously. There were 37 items in the questionnaire. Authors performed principal component analysis on the data and found 6 sub scales. These were Learning science in school (6 items), self-concept in science (7 items), practical work in science (8 items), science outside school (6 items), future participation in science (5 items), and importance of science (5 items). Each of these subscales had internal consistency estimates of over .75. Kind and Barmby (2010) did Rasch Analysis and reduced items to 29 items. We used this shorter version in our study. We performed principal component analysis on these 29 items. When we examined eigen values of the factors, we noticed 5 factors whose eigen values were bigger than 1. Furthermore we noticed that the slope of the scree plot was getting smoother after the component number 5. Therefore did an additional principal component analysis with fixed 5 factors. In this analysis, we used varimax rotation and suppressed item loadings to .40. Result showed one item did not contribute to any of the subscales. Besides 5 factor solution explained 56.11% variance. Inspired by the findings of Kind and Barmby (2010), we named the subscales as learning science in school (9 items, Cronbach α = .85, n = 561), self-concept in science (6 items, Cronbach α = .82, n = 561), science outside school (4 items, Cronbach α = .83, n = 561), future participation in science (5 items, Cronbach α = .82, n = 561), and importance of science (4 items, Cronbach α = .69, n = 561). Example items for each subscale can be seen in Table 1.

Table 1. Example Subscale Items in Attitudes Towards Science Questionnaire

Name of the Subscale	Example Items
Learning Science in School	We learn interesting things in science lessons
Self-Concept in Science	Science is boring
Science Outside School	I like to visit science museums
Future Participation in Science	I would like to study more science in the future
Importance of Science	Science and technology make our lives easier and more comfortable

Epistemological Beliefs

Schommer-Aikins, Duell, & Hutter (2005) developed a questionnaire for assessing middle school students' epistemological beliefs. Schommer et al. (2005) examined the factor structure of this questionnaire and found 4 factors. Authors named these factors as quick/fixed learning, studying aimlessly, omniscient authority, and certain knowledge. Cronbach's α found for these factors were .77, .55, .55, and .36 respectively. Topcu and Yilmaz-Tuzun (2007) adapted this questionnaire to Turkish and found 4 factors for 4^{th}, 5^{th}, 6^{th} and 8^{th} graders after confirmatory factor analysis. However some of the internal consistencies of the subscales were relatively low such as .44. In our study, first we examined items' internal consistency. We found Cronbach' α = .43 for 30 items. We noticed that several items were not contributing to overall internal consistency. After removing these items one by one, Cronbach's α increased to .64. 20 items remained at this process. We performed principal factor analysis for the remaining items. After examination of the scree plot, eigen values, and total variance explained by the factors, we decided to extract two factors for the next principal factor analysis. We used varimax rotation and fixed the subtracted factors to two. Two factor model explained 27.81% variance. Factor loadings of these two factors ranged between .20 to .70. 12 of the items loaded on the first subscale and 8 of the items loaded on the other subscale. We also computed Cronbach α values for these two subscales. We found .70 for the first subscale and .67 for the second subscale (n = 561). We examined the items in each subscale for the identification of the factors. Inspired by previous research on this questionnaire, we named the first subscale as quick learning and the second subscale as studying. Example three items which had the highest factor loadings for each subscale can be seen in Table 2.

Table 2. Example Subscale Items in Epistemological Beliefs Questionnaire

Name of the Subscale	Example Items
Gradual Learning*	- Successful students understand things quickly. - Working hard on a difficult problem only pays off for the really smart students. - An expert is someone who is really born smart in something.
Studying	- Getting ahead takes a lot of work. - If I can't understand something right away, I will keep on trying. - To me studying means getting the big ideas from the textbook, rather than the details.

* These items were reverse coded.

Metacognition

Sperling, Howard, Miller, and Murphy (2002) developed two inventories to measure metacognition, one for grades 3 through 5 and the other for grades 6 through 9. The first one included 12 items with three-choice response and the other included 18 items with 5 point Likert scale. Authors examined factor structure for both inventories and found 5 factors within each inventory. However authors argued that two factor solution can also interpret the variance. Authors named these factors as knowledge of cognition and regulation of cognition. Topçu and Yılmaz-Tüzün (2009) used the translated version of the second inventory to Turkish and also found knowledge of cognition and regulation of cognition constructs. In this study, we performed principal factor analysis on the second version containing 18 items. Examination of the scree plot, eigen values of the factors and the variance explained by the factors led us to conclude that there were two factors. After examination of each item loading to the factors, we also named these factors as knowledge of cognition and regulation of cognition. There were 8 items in the knowledge of cognition subscale and 10 items in the regulation of cognition subscale. Sample items for each factor can be seen in Table 3. Cronbach's α value for knowledge of cognition subscale was .76 (n = 561) and regulation of cognition subscale was .79 (n = 561). Factor loadings were utilized to compute a composite score for each factor.

Table 3. Sample Items for each Subscale in Metacognition Questionnaire

Name of the Subscale	Example Items
Knowledge of Cognition	- I know when I understand something. - I learn more when I am interested in the topic. - I really pay attention to important information.
Regulation of Cognition	- I ask myself if there was an easier way to do things after I finish a task. - I ask myself how well I am doing while I am learning something new. - When I am done with my schoolwork, I ask myself if I learned what I wanted to learn.

Views on Science Teaching

17 items were selected from EOCD (2006) student questionnaire to investigate student views on science teaching in their science classes. We performed principal factor analysis on these 17 items to examine if there is any subscale existed. After the examination of the scree plot, eigen values

and total variance explained by the factors, we decided to extract 3 factors. Then we fixed 3 factors for extraction. We used varimax rotation this time

and suppressed the factor loadings to .30. Result showed 6 items loaded to the first factor, 7 items loaded on the second factor, and 4 items loaded on the third factor. Cronbach α values were .75, .71, and .68 respectively (n = 561). After the examination of the items in each subscale, we named the first subscale as views on laboratory work, the second subscale as views on classroom discourse, and the third subscale as views on science application. Example items can be seen in Table 4.

Table 4. Example Subscale Items in Views on Science Teaching Questionnaire

Name of the Subscale	Example Items
Views on Laboratory Work	- Students do experiments by following the instructions of the teacher. - Experiments are done by the teacher as demonstrations. - Students spend time in the laboratory doing practical experiments.
Views on Classroom Discourse	- The lessons involve students' opinions about the topics. - Students have discussions about the topics. - Students are given opportunities to explain their ideas.
Views on Science Application	- The teacher explains how a school science idea can be applied to a number of different phenomena. - The teacher uses school science to help students understand the world outside school. - The teacher uses examples of technological application to show how school science is relevant to society.

Science Achievement

8th graders science achievement composite scores from TEOG that is used to place students to high schools were used as science achievement measure. There were 20 items related to science in TEOG. Items were about fall and spring semester 8th grade science content such as genetics, pressure, matter states and its properties, sound, phases of matter and heat, living things and energy relation. We had permission for using composite but not individual item scores. Therefore we used only science composite scores for the analysis.

Results

School Type on Attitudes Towards Science

Table 5. Descriptive Statistics for Attitudes Towards Science

School Type	Variable	M	SD
HAS School*	Learning Science in School	17.98	4.63
	Self-Concept in Science	13.82	3.50
	Science Outside School	7.89	2.46
	Future Participation in Science	9.97	3.54
	Importance of Science	9.17	2.21
LAS School**	Learning Science in School	17.94	3.29
	Self-Concept in Science	12.32	2.87
	Science Outside School	7.66	2.12
	Future Participation in Science	9.73	3.09
	Importance of Science	8.54	2.12

* n = 320, ** n = 241.

We did a Multivariate Analysis of Variance (MANOVA) for the examination of the effect of school type on overall subscales of attitudes towards science. The result showed there is an overall attitudes towards science difference between students in LAS and students in HAS ($F(5, 555) = 12.43$; $p < .001$; $\eta^2 = .10$). Follow-up Analysis of Variance (ANOVA) results showed there is a significant difference between students in HAS and students in LAS on self-concept in science ($F(1, 559) = 29.27$; $p < .001$; $\eta^2 = .05$) and importance of science ($F(1, 559) = 11.69$; $p < .01$; $\eta^2 = .02$) subscales. As can be seen in Table 5, this difference is in favor of students in HAS. However students in HAS and students in LAS did not differ on learning science in school ($F(1, 559) = 0.01$; $p > .05$), science outside school ($F(1, 559) = 1.40$; $p > .05$), and future participation in science ($F(1, 559) = 0.70$; $p > .05$) subscales.

School Type on Epistemological Beliefs

Table 6. Descriptive Statistics for Epistemological Beliefs Subscales

School Type	Variable	M	SD
HAS School*	Gradual Learning	19.07	3.82
	Studying	15.47	2.90
LAS School**	Gradual Learning	16.75	3.42
	Studying	14.74	3.08

* n = 320, ** n = 241.

We performed MANOVA for the examination of the effect of school type on overall student epistemological beliefs subscales. In this analysis, school type was the independent variable and students' scores on epistemological belief subscales, i.e., gradual learning and studying, were the dependent variables.

Result showed school type had an overall effect on epistemological beliefs ($F(2, 558) = 33.61$; $p < .001$; $\eta^2 = .11$). Follow-up ANOVA results also showed school type had an effect on both gradual learning ($F(1, 559) = 55.57$; $p < .001$; $\eta^2 = .09$) and studying ($F(1, 559) = 8.29$; $p < .01$; $\eta^2 = .02$). As can be seen in Table 6, these differences were in favor of students in HAS.

School Type on Metacognition

Table 7. Descriptive Statistics for Metacognition Subscales

School Type	Variable	M	SD
HAS School*	Knowledge of Cognition	19.70	2.80
	Regulation of Cognition	19.17	3.85
LAS School**	Knowledge of Cognition	18.54	3.33
	Regulation of Cognition	18.37	3.64

Another MANOVA was performed to analyze the effect of school type on overall metacognition subscales. MANOVA result showed school type had a significant effect on the set of dependent variables ($F(2, 558) = 10.00$; $p < .001$; $\eta^2 = .04$). Follow-up ANOVA results also showed schools' performances were different on knowledge of cognition ($F(1, 559) = 20.04$; $p < .001$; $\eta^2 = .04$) and regulation of cognition subscales ($F(1, 559) = 6.25$; $p < .05$; $\eta^2 = .01$). As can be seen from Table 7, both differences were in favor of students in HAS.

School Type on Views on Science Teaching

Table 8. Descriptive Statistics for Views on Science Teaching Subscales

School Type	Variable	M	SD
HAS School*	Views on Laboratory Work	8.80	2.79
	Views on Classroom Discourse	11.01	2.08
	Views on Science Application	6.91	1.75
LAS School**	Views on Laboratory Work	7.92	2.40
	Views on Classroom Discourse	10.42	2.25
	Views on Science Application	6.05	1.71

We performed another MANOVA on subscales of views on science teaching, i.e., views on laboratory work, views on classroom discourse, views on science application, where school type was the independent and the mentioned subscales were the dependent variables. Result showed school type had an effect on overall subscales of views on science teaching ($F(3, 557) = 12.12$; $p < .001$; $\eta^2 = .06$). Follow-up ANOVA results also showed schools differed sıgnificantly on views on laboratory work ($F(1, 559) = 15.37$; $p < .001$; $\eta^2 = .03$), views on classroom discourse ($F(1, 559) = 10.25$; $p < .01$; $\eta^2 = .02$), and views on science application ($F(1, 559) = 33.62$; $p < .001$; $\eta^2 = .06$). Each difference was in favor of students in HAS (see Table 8).

Gender on Attitudes Towards Science

Table 9. Descriptive Statistics Related to Gender for Attitudes Towards Science Subscales

	School Type	Girls		Boys	
		M	SD	M	SD
Learning Science in School	HAS	18.37	4.58	17.63	4.67
	LAS	17.97	3.41	17.90	3.18
Self-Concept in Science	HAS	14.05	3.27	13.62	3.69
	LAS	12.19	2.99	12.46	2.75
Science Outside School	HAS	8.16	2.36	7.66	2.53
	LAS	7.76	2.14	7.56	2.11
Future Participation in Science	HAS	10.13	3.58	9.83	3.52
	LAS	9.63	3.14	9.83	3.04
Importance of Science	HAS	9.50	1.95	8.88	2.38
	LAS	8.85	1.91	8.22	2.27

Descriptive statistics for gender variable in both HAS and LAS related to attitudes towards science subscales can be seen in Table 9. First we performed a MANOVA on the set of student attitudes towards science subscale scores in HAS. Gender was the independent variable and subscale scores were the dependent variables in this analysis. Result showed that boys and girls did not differ on the set of dependent variables in HAS ($F(5, 314) = 1.46$; $p > .05$). Since we did not find any difference on the set of dependent variables, we did not perform follow-up ANOVAs.

Another MANOVA was performed on student attitudes towards science subscale scores in LAS. Result showed that gender did not make a difference on the set of dependent variables ($F(5, 235) = 1.81$; $p > .05$). Similar to the approach taken for HAS, we did not perform follow-up ANOVAs for LAS.

Gender on Epistemological Beliefs

The result of the MANOVA showed gender made a difference on the set of dependent variables in HAS ($F(2, 317) = 10.21$; $p < .001$; $\eta^2 = .06$). Results of the follow-up ANOVAs showed girls and boys differed on gradual learning ($F(1, 318) = 7.17$; $p < .01$; $\eta^2 = .02$) and studying ($F(1, 318) = 13.89$; $p < .001$; $\eta^2 = .04$). As can be seen from Table 10, both differences were in favor of girls.

Second MANOVA showed boys and girls did not differ on the set of dependent variables in LAS ($F(2, 238) = 2.08$; $p < .05$). Therefore we did not perform follow-up ANOVAs.

Table 10. Descriptive Statistics Related to Gender for Epistemological Beliefs Subscales

	School Type	Girls		Boys	
		M	SD	M	SD
Gradual Learning	HAS	19.67	3.71	18.54	3.84
	LAS	16.90	3.60	16.59	3.24
Studying	HAS	16.10	2.68	14.91	2.98
	LAS	15.06	2.99	14.40	3.16

Gender on Metacognition

Table 11. Descriptive Statistics Related to Gender for Metacognition Subscales

	School Type	Girls		Boys	
		M	SD	M	SD
Knowledge of Cognition	HAS	20.05	2.55	19.39	2.98
	LAS	19.06	2.95	18.01	3.61
Regulation of Cognition	HAS	19.49	3.59	18.89	4.05
	LAS	19.05	3.45	17.68	3.70

We did a MANOVA to examine any gender differences on the set of dependent variables in HAS. Result showed no gender differences on the set of metacognition subscales in HAS ($F(2, 317) = 2.35$; $p > .05$). Thus we did not perform follow-up ANOVAs.

Result of the other MANOVA showed a gender effect on metacognition subscales in LAS ($F(2, 238) = 4.77$; $p < .01$; $\eta^2 = .04$). Follow-up ANOVA results also confirmed this result for knowledge of cognition ($F(1, 239) = 6.18$; $p < .05$; $\eta^2 = .03$) and regulation of cognition subscales ($F(1, 239) = 8.73$; $p < .01$; $\eta^2 = .04$). As can be seen in Table 11, both differences were in favor of girls.

Gender on Views on Science Teaching

Result of the MANOVA showed that gender made a difference on the set of views on science teaching subscales in HAS ($F(3, 316) = 4.95$; $p < .01$; $\eta^2 = .05$). Results of the Follow-up ANOVAs' results also confirmed this result for views on classroom discourse ($F(1, 318) = 7.78$; $p < .01$; $\eta^2 = .02$), and views on science application ($F(1, 318) = 11.34$; $p < .01$; $\eta^2 = .03$) but not for views on laboratory work ($F(1, 318) = 0.07$; $p > .05$). As can be seen in Table 12, both differences were in favor of girls in HAS.

Other MANOVA for LAS showed that gender did not make a difference on the set of dependent variables ($F(3, 237) = 2.35$; $p > .05$). Therefore we did not perform follow-up ANOVAs.

Table 12. Descriptive Statistics Related to Gender for Views on Science Teaching Subscales

	School Type	Girls		Boys	
		M	SD	M	SD
Views on Laboratory Work	HAS	8.84	2.87	8.76	2.72
	LAS	7.89	2.41	7.95	2.39
Views on Classroom Discourse	HAS	11.35	2.08	10.71	2.04
	LAS	10.74	2.31	10.09	2.16
Views on Science Application	HAS	7.26	1.79	6.61	1.66
	LAS	6.11	1.82	6.00	1.60

Gender on Science Achievement

Table 13. Descriptive Statistics Related to Gender for Science Achievement

	School Type	Girls		Boys	
		M	SD	M	SD
Science Achievement	HAS	81.63	19.43	76.09	25.72
	LAS	49.02	24.25	47.39	25.66

We performed two ANOVAs for science achievement, i.e., one for HAS and the other for LAS. Result of the first ANOVA demonstrated that boys and girls differed on achievement in HAS ($F(1, 318) = 4.64$; $p < .05$; $\eta^2 = .01$). As can be seen in Table 13, this difference was in favor of girls in HAS. However no gender difference was found in LAS according to the second ANOVA ($F(1, 239) = 0.25$; $p > .05$).

Discussion

First we investigated school type, i.e., HAS and LAS, differences on students' attitudes towards science, epistemological beliefs, metacognition, and views on science teaching. Next we examined gender differences on these variables and science achievement both in HAS and LAS. For the first inquiry, we found that students in HAS performed better than students in LAS on each of the composite scores. Particularly, students in HAS scored higher than students in LAS on each of the subscales of epistemological beliefs, metacognition, and views on science teaching, i.e., gradual learning and studying for epistemological beliefs, knowledge of cognition and regulation of cognition for metacognition, views on laboratory work, views on classroom discourse, and views on science application for views on science teaching. On the other hand, students in HAS got higher scores specifically on self-concept in science and importance of science subscales of attitudes towards science measure but not on the other subscales.

For the second inquiry, we found no gender difference on attitude towards science both in HAS and LAS. On the other hand, girls performed better than boys on epistemological beliefs, views on science teaching, and science achievement in HAS. Particularly, girls scored higher than boys on gradual learning and studying which were epistemological beliefs subscales, and views on classroom discourse and views on science application which were views on science teaching subscales. Besides, girls performed better than boys in LAS on only metacognition subscales, i.e., knowledge of cognition and regulation of cognition. On the other hand, we found no gender difference on epistemological beliefs, views on science teaching, and science achievement in LAS.

Results related to the first inquiry add to the results of the previous research findings that in addition to science achievement there are other differences related to cognitive and motivational variables between students in HAS and LAS. More clearly, unlike Aypay et al. (2007) we found that students in HAS perceived their classroom environment more student-centered compared to students in LAS. On the other hand, our results are in alignment with Aypay et al. (2007) in that we found students in HAS had more positive attitudes towards science. However we found only self-concept in science and importance of science to be the attitudinal subscales that made the difference between students in HAS and LAS. These subscales may be more important for predicting student science achievement than the other subscales (e.g., Acar et al., 2015b). Besides our findings add to our knowledge base that students in HAS had more sophisticated epistemological beliefs and metacognition than their peers in LAS. This finding should not be surprising because metacognition and epistemological beliefs were found to predict achievement significantly (Schommer-Aikins & Duell, 2013; Schommer-Aikins et al., 2005; Topçu & Yılmaz-Tüzün, 2009).

Our results confirm to the research approach that gender differences should be examined separately for LAS and HAS. In fact most of the gender differences occurred in HAS in the present study. Girls outperformed boys on epistemological beliefs subscales, views on science teaching subscales and science achievement in HAS. On the other hand, only the gender difference occurred in LAS was metacognition and this difference was again in favor of girls. From these results, we can assume that both boys and girls have similar attitudes towards science both in LAS and HAS. This difference seems to contradict what Acar et al. (2015b) found that there was an importance of science difference between boys and girls and this difference was in favor of girls. However Acar et al. (2015b) did not find this result specifically either HAS or LAS. Girls' superiority over boys on epistemological beliefs and metacognition was also detected by Topçu and Yılmaz-Tüzün (2009). However Topçu and Yılmaz-Tüzün's (2009) finding was not school specific. Therefore our results are innovative in that girls outperform boys on epistemological beliefs in HAS and metacognition in LAS. Surprisingly, girls stated more positive views about their science teaching compared to boys in HAS although they were in the same classes as boys. From this result we assume that girls' perception of the same phenomenon, i.e., class science teaching, was different than that of boys. We interpret this mismatch as a result of different learning styles possessed by girls and boys in Turkey. More specifically, although student-centered instruction has been fostered in national science programs (Milli Eğitim Bakanlığı, 2006, 2013), still teacher dominates the science classes in Turkey because of the burden of high stakes tests, student population, and overloaded science curriculum. Girls may benefit this teacher-centered science instruction more than boys because of their different learning style than boys (Stark & Gray, 1999). Finally we found that gender achievement gap occurred in only HAS but not in LAS. Although previous research showed that gender achievement gap occurs in Turkey (Acar et al., 2015b; Atalmis et al., 2016; Bursal, 2013; Gevrek & Seiberlich, 2014), to our knowledge paucity of study examined the interaction of school type and gender on student science achievement. Therefore our result regarding gender science achievement gap in HAS should alert caution among policy makers to reduce gender gap in HAS.

Implications

More effort should be given to students in LAS to develop their attitudes towards science, epistemological beliefs, metacognition, and views on science teaching. Acar (2016) found that argumentation based science instruction may be used to reduce attitudes towards science and views on science teaching differences between students in HAS and LAS. Furthermore Zohar and Peled (2008) found that student metacognitive awareness can be developed by teaching metastrategic knowledge. Similarly, Sandoval and Morrison (2003) showed that student scientific epistemological beliefs can be enhanced by explicit teaching. Therefore explicit teaching of epistemological beliefs and metacognitive strategies may be used to assist students in LAS to develop these skills. Explicit teaching of epistemological beliefs may help to reduce gender gap in HAS. In addition, allocating more space to connecting science to real life situations and student discussion of ideas with their peers in science classes may help to reduce the science achievement and views on science teaching gender gaps in HAS by promoting credibility of science among boys (Jocz, Zhai, & Tan, 2014). Finally, we suggest also teaching metacognitive skills in LAS to reduce gender gaps. Moreover parents can also be educated on how to monitor and develop their children metacognitive skills.

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