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Trends in Students' Science Achievement across TIMSS Studies with Emphasis on Gender Differences in 18 Countries

روندهای موجود در موفقیت‌های علمی دانش‌آموزان در مطالعات تیمز در ۱۸ کشور با تأکید بر تفاوت-های جنسیتی

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This article focuses on the trends in eighth graders' science achievement as well as several students' indicators and science teachers' indicators among Muslim countries (and Armenia) which are located in the Middle East and North Africa and participated in TIMSS 1999, 2003 and 2007. In the present study, the mean of plausible values represents students' science achievement and Jackknife Repeated Replication method was used for the estimation of sampling error. There was a significant correlation between the average science performance of eighth graders in 12 countries and science self-concept, attitudes towards science, school connectedness, and school climate. In many of the countries under study, the correlation between science self-concept and science achievement for girls was higher than that of their male counterparts. Considering the trends across the countries which participated in two or three of TIMSS studies, the students' average science performance showed a trend towards improvement. The extent of improvement observed in Iranian students' achievement from 1999 to 2007 was less than that of four countries. Improvement in girls' and boys' average performance indicates that improvement in girls' achievement was higher than that of boys. Trends in students' indicators showed that science self-concept has decreased, attitude towards science has increased and the two indexes of school connectedness and school climate have remained unchanged. Trends in teachers' indicators showed a trend toward improvement. If the trend in Iran's performance is compared with that of some more successful countries in the region, it becomes evident that improvement in Iranian students' achievement is less than that of their counterparts in several more successful countries in the region.

Key words: TIMSS, Muslim countries, Science achievement, teachers' indicators, students' indicators

علیرضا کیامنش

مقاله‌ی حاضر به بررسی روندهای موجود در موفقیت‌های علمی دانش‌آموزان پایه‌ی هشتم و همچنین شاخص‌های مختلف دانش‌آموزان و معلمان علوم در کشورهای مسلمان (و ارمنستان) می‌پردازد که در خاورمیانه و آفریقای جنوبی واقع شده و در مطالعات تیمز سال‌های ۱۹۹۹، ۲۰۰۳، و ۲۰۰۷ شرکت داشتند. در این مقاله، برای بررسی دستیابی‌های علمی دانش‌آموزان از میانگین ارزش‌های قابل پذیرش برای تخمین خطای نمونه‌گیری از روش جایگزین تکراری جک نایف استفاده شده است. طبق نتایج این بررسی همبستگی معناداری میان میانگین عملکرد علمی دانش‌آموزان مقطع هشتم در ۱۲ کشور از یک سو و خودپنداره‌ی علمی، دیدگاه نسبت به علوم، حس تعلق نسبت به مدرسه، و جو مدرسه از سوی دیگر وجود دارد. در بسیاری از کشورهای تحت بررسی، همبستگی میان خودپنداره‌ی علمی و موفقیت علمی دختران بیشتر از پسران بود. با توجه به روند موجود در کشورهایی که در دو یا سه مطالعه‌ی تیمز شرکت داشتند، میانگین عملکرد علمی دانش‌آموزان روندی رو به بهبود را نشان می‌داد. میزان پیشرفت مشاهده شده در میان دانش‌آموزان ایرانی از سال ۱۹۹۹ تا ۲۰۰۷ از چهار کشور دیگر کمتر بود. پیشرفت میانگین عملکرد دختران و پسران حاکی از آن است که موفقیت‌های دختران نسبت به پسران روند افزایشی بیشتری داشته است. روندهای شاخص‌های دانش‌آموزان نشان داد که خودپنداره‌ی علمی دانش‌آموزان کاهش و دیدگاه نسبت به علوم ارتقاء یافته و دو شاخص حس تعلق به مدرسه و جو مدرسه نیز ثابت و بدون تغییر مانده است. روندهای مشاهده شده برای شاخص-های معلمان روندی رو به بهبودی را نشان داد. با مقایسه‌ی روند عملکرد در ایران با کشورهای موفق‌تر در منطقه به وضوح می‌توان دریافت که پیشرفت در عملکرد دانش‌آموزان ایرانی کمتر از دانش-آموزان در دیگر کشورهای موفق‌تر منطقه است.

کلیدواژه‌ها: تیمز، کشورهای مسلمان، موفقیت علمی، شاخص‌های معلمان، شاخص‌های دانش‌آموزان

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Introduction

Muslims comprise over one fifth of the world's population. In addition, more than one fourth of the world's countries are Muslim ones. The vast majority of Muslim countries are geographically distributed in Asia and Africa. These countries have numerous commonalities, whereas they differ greatly in different aspects including cultural, economic and political growth. In 2008, the literacy rate for the population of over 15 in 57 countries which are the members of the Organization of the Islamic Conference (OIC) was 87% for men, 62.5% for women and 70.2% for both genders and the gender equity index was reported to be 0.802. On the other hand, these indexes were respectively 85.6%, 73.74%, 79.6% and 0.862 for the whole countries of the world. In 2008, the literacy rate for the young population aged between 15 and 25 in OIC member countries was 85.8% for men, 78.7% for women, and 82.2% for both genders and the gender equity index was reported to be 0.918. Meanwhile, these indexes were respectively 91.7%, 86.6%, 91.7% and 0.944 for the whole countries of the world.

According to UNESCO datasets, 8 out of 10 countries which are the members of OIC and have the literacy rate of over 94% are the ones that have recently gained independence from the eastern bloc (only Brunei 95% and Kuwait 94.5%). In addition, 7 out of 10 countries which are the members of OIC and have the literacy rate of over 94% for the young population aged between 15 and 25 are the ones that have newly gained independence from the eastern bloc (only Bahrain, Lybia, and Kuwait). In 2008, the amount of national net income allocated for education was 4.1% in the world, 2.9% in Muslim countries, and 2.6% in Iran (Education and Scientific Development in OIC Member Countries, 2010).

Carrying out research on education and its quality such as that of Coleman Report (1966) and the evaluation of students' achievement and educational systems have a long history. Many countries evaluate their education systems periodically but continuously. Nevertheless, the evaluation of education systems in OIC member countries has so far attracted little attention. Participation of several regional countries in the

TIMSS studies (Trends in International Mathematics and Science Study), which are conducted under the auspices of the International Association for the Evaluation of Educational Achievement (IEA), can be considered the most valid and prominent educational evaluation in these countries.

The regional countries which participated in TIMSS 2007 are Jordan, Armenia, Algeria, Iran, Bahrain, Turkey, Tunisia, Dubai (United Arab Emirates), Syria, Saudi Arabia, Oman, Palestinian National Authority, Qatar, Kuwait, Georgia, Lebanon, Morocco, and Egypt. It is worth mentioning that 11 out of 18 countries under study (Jordan, Armenia, Iran, Bahrain, Tunisia, Syria, Saudi Arabia, Palestinian National Authority, Lebanon, Morocco, and Egypt) participated in TIMSS 2003 and 5 countries (Jordan, Iran, Turkey, Tunisia, and Morocco) took part in TIMSS 1999. As a result, in the present article trends in students' average science achievement have been investigated in the four countries of Jordan, Iran, Tunisia, and Morocco using TIMSS 1999, 2003 and 2007 datasets. In addition, trends in students' average science achievement have been studied in Armenia, Bahrain, Syria, Saudi Arabia, Palestinian National Authority, Lebanon, and Egypt based on TIMSS 2003 and 2007 database and finally this trend has been examined in Turkey on the basis of TIMSS 1999 and 2007 results.

The countries under study, which are all Muslim ones except 1 country, approximately share a common Islamic culture and majority of them are Arabic-speaking countries (13 out of 18); however, they have significant differences as well. Indicators of human resources development (life expectancy at birth, expected years of schooling, gross national income per capita), literacy rate, gender equality in access to primary, middle school and secondary education, transition rate from primary to middle school by gender, and grade repetition in primary school by gender are among these differences.

According to the United Nations report in 2010, 3 out of 18 countries under study ranked among 42 countries with "very high" human development status considering HDI indicator (which is a combination of Health, Knowledge, and Income). Nevertheless, the Muslim country

which comes in first regarding this indicator (United Arab Emirates) ranked 32nd among the countries with very high human development status. Nine of the countries under study ranked among countries with "high" human development indicator. In this group, Kuwait with the rank of 47 comes in first and Tunisia, Jordan, Turkey and Algeria with the ranks of 81 to 84 respectively come in last. Iran with the rank of 70 comes in the middle of the Table.

School-entry age is six in all the countries under study; however, the time allocated to general education is different to some extent. Turkey with 8 and Kazakhstan with 12 years have respectively allocated the least and most time to general education. In general, the average time for general education is 9 years. In spite of the fact that no exact information is available on the exact amount of time spent on teaching science in the eighth grade, the available data indicate that 13 percent of the class time in Jordan, Algeria, and Tunisia is allocated to teaching science in the eighth grade. This figure is 10 percent for Turkey, 15 percent for Palestinian National Authority, 26 percent for Kazakhstan and 11 percent for Iran (based on the reports on the education systems).

These countries are not similar regarding the literacy age for the population of over fifteen. This rate varies from 100 percent in the two countries of Armenia and Georgia to 66 percent in Morocco, 71 percent in Egypt, and 73 percent in Algeria. A cross-comparison of the literacy rate among men and women within and between the countries show a lower literacy rate among women compared to men. With the exception of Armenia and Georgia in which 100 percent of men and women are literate, Kuwait (93%), Palestinian National Authority (91%), and Dubai (91%) have the highest literacy rates for woman and Morocco (44%), Egypt (59%), and Algeria (64%) have the lowest rates for women. The largest gap between men and women is observed in Egypt (59% for women vs. 83% for men) and Morocco (44% for women vs. 69% for men). In Iran, 77 percent of women and 88 percent of men are literate.

In many countries the transition rate from primary to middle school is higher for girls than boys. The average transition rates for girls and boys are 97.5% and 95.4%, respectively. In Iran, the transition rate for boys (92.8%) is higher than that of girls (83.4%). In addition, the grade repetition rate for girls at primary school is lower than for boys. The average rate of grade repetition in the 18 countries under study is 3.4% and 4.8% for girls and boys, respectively. The grade repetition rate at primary school is 1.4% and 2.8% for Iranian girls and boys, respectively.

In addition to the differences observed in quantitative indicators, there are differences among the countries under study regarding the qualitative indicators of education. In TIMSS 2007, the difference between the average science achievement of Armenian eighth graders (with the highest achievement, i.e., 488) and that of Qatari students (with the lowest achievement, i.e., 319) is 169 points. In TIMSS 2007 and from among 49 participating countries, Armenia, Jordan, Bahrain, Iran, and Qatar had the ranks of 17, 20, 26, 29, and 47, respectively. It is worth mentioning that students from Dubai had a better performance than their Armenian counterparts; however, this has not been taken into account.

Research conducted into the role of gender in students' mathematics and science achievement has not been conclusive. According to some research, females have demonstrated that they are equally capable as their male counterparts of learning and mastering science and math concepts and knowledge. Nevertheless, views that females hold in relation to science and its application to solve real-world problems; courses that females are advised to enroll in during high school; support from parents, teachers, and other role models related to pursuing a career in science-related disciplines (most science experts are men); school climate; teachers' attitudes, behaviors, and pedagogical strategies; cognitive abilities; attitudes; and prevailing stereotypes in society that science is a male-oriented field are among the factors that provide additional insight into gender differences in science achievement and girls' being less interested in science-related fields (Green, 2009; Sandler, Silverberg, & Hall, 1996; Lauzon, 2001).

Different theories have different explanations for the gender gap in mathematics and science. These theories have paid special attention to math achievement. For instance, the biological theories argue that innate differences in spatial ability, higher order thinking, or brain development produce a gap in achievement. Societal explanations focus on how girls are socialized into believing that math and science are not important, useful, doable, or part of the identity of a girl (Wilder & Powell, 1989). The gender stratification hypothesis proposes that in a society with more societal stratification based on gender, and more inequality of opportunity, girls will report less positive attitudes and more negative affect and will perform less well on mathematics achievement tests than will their boy peers (Penner, 2008). On the other hand, gender similarities hypothesis argues that boys and girls are similar in most, but not all, psychological variables (Hyde, 2005).

Penner (2008) analyzed TIMSS 1995 data and showed that the proportion of girls scoring above the 95th percentile was linked to the national gender equity (cited in Else-Quest, Hyde, and Linn, 2010). Gender stratification hypothesis is consistent with Eccles's expectancy-value theoretical model (1994). According to this model, cultural inequities in educational or career opportunities have an adverse impact on girls' performance. Fryer and Levitt (2009) found a high correlation between the gender gap in mathematics and gender equality in 17 countries participated in PISA (Program for International Student Assessment) and TIMSS. They argued that gender equality is sensitive to the inclusion of Muslim countries because in spite of women's low status in Muslim countries (mentioning Iran and Bahrain) girls outscored boys in mathematics. Considering gender stratification hypothesis and Eccles's expectancy-value theoretical model (1994), they argued that the controversy observed in Iran and Bahrain's findings is due to the relatively strong performance by the girls, not an unusually bad showing among the boys. This interpretation might be acceptable and logical based on the findings of a single study; nevertheless, trends in girls and boys'

achievement should be examined across such countries for the widespread acceptance of this conclusion.

In 2008 and based on TIMSS 1999 and 2003 data, a study was conducted by the IEA in eight Arab countries (Bahrain, Egypt, Jordan, Lebanon, Morocco, Saudi Arabia, and Palestinian National Authority) which are located in the Middle East and North Africa Region (MENA). Each country's performance was independently examined in this study. Furthermore, the similarities and differences in influential factors in students' achievement have also been focused on. The findings of the study showed that students' age is one the influential factors in their math and science achievement. In other words, the math and science performance of the students who enter schools with a delay (students living in remote areas and those from a deprived economic or cultural background) is weaker than those who enter schools at an appropriate age (at the age of 6). Even though students' school-entry age is correlated to the families' economic status and the place where they live, some other factors including grade repetition and students' capabilities can also play a significant role. This study has also referred to the factors contributing to the low achievement of students such as inappropriate usage of the allocated time to teaching (homework), inappropriate utilization of public resources allotted to education, families' socio-economic status, and students' attitudes towards math and science.

Gender differences in science achievement have been given some attention; however, this issue has been less investigated compared to the role of gender in math achievement. Evidence shows that the overall science performance of boys is better than that of girls. Young and Fraser (1993) reported significant gender differences in science achievement even after adjusting for individual characteristics, family background, and school context. The statistics indicate that gender differences became more stable over time. In addition, these differences became bigger in earth science and physics content areas compared to life science and general science.

Chang (2008) carried out a study based on TIMSS 1999 and 2003 database for Taiwanese eighth graders. All statistics showed that gender differences became smaller over time. In both studies (TIMSS 1999 and 2003), boys always had higher self-concept of ability and attitude. In addition, in both years, there were significant gender differences at upper quarter (scores above the 75 percentile) and boys significantly outperformed girls. Gender difference was also significant in 2003 and girls outperformed boys at lower quarter (scores below the 25 percentile).

Thomson (2008) conducted a study using TIMSS 2003 database in Australia. The findings of the research showed that there was no significant gender difference in science achievement at primary school level, nor were there gender differences in attitudes to science at this level in Australia. By early in their secondary schooling, however, boys outscored girls in all of the science content areas. Gender differences are more notable in physics and science content areas (d=0.31 and d=0.43) and less significant in life science and environmental science domains (d=0.15 and d=0.22). Despite that fact that the average science self-concept and attitudes towards science is higher for boys than for girls, the effect sizes were small (d=0.14 and d=0.18). Lee and Burkam (1996) (cited in Lee, 1998) found out that in the eighth grade boys outscored girls in physical science content area, whilst girls outperformed boys in life science domain. The findings of the National Assessment of Educational Progress (NAEP, 2006) demonstrated that males outperformed females in science and the difference was significant from the fourth grade through the end of high school. However, the effect sizes indicated that the there was little difference in all grades.

Due to the fact that regular and objective educational evaluations are not conducted in OIC member countries, participation of 18 countries from among OIC member countries in the consecutive studies of TIMSS (Trends in International Mathematics and Science Study) has paved the way for a comprehensive evaluation of students' performance, education quality as well as trends in achievement.

Purpose of the Study

Considering Vision of the Islamic Republic of Iran's Document in 2025, the present article focuses on the comparison of eighth graders' science achievement by gender in regional countries. More specifically, it aims to investigate the following issues:

- Trends in the average science achievement of eighth graders by gender in Muslim countries (as well as Armenia) which participated in TIMSS 1999, 2003 and 2007
- Trends in several students' indicators in regional countries by gender: (a) science self-concept, (b) attitudes towards science, (c) school connectedness, and (d) school climate
- Trends in some science teacher's indicators by gender: (a) Teachers' perception of school security, (b) teachers' job satisfaction, understanding and achievement, and (c) parents and students support for and involvement in school activities)
- A comparison of trends in the average science achievement of Iranian eighth graders with the students of other regional countries by gender and identifying Iranian students' status in science achievement.

Data Analysis

IDB software was used for the purpose of analyzing the achievement data. This software has the capacity to merge files, omit missing data from analysis, observe sample sizes, utilize the appropriate method for estimating the sampling error of variance, and calculate plausible values for the estimation of each student's score. In the present study, the mean of plausible values represents students' science achievement (total achievement and achievement by different science domains). Jackknife Repeated Replication method was used for the estimation of sampling error.

The Student Questionnaire data were analyzed using factor analysis, principal component analysis, and direct Oblimin rotation and as a result the following four factors were identified. *Science self-concept* factor; *attitudes towards science* factor; *school connectedness* factor; and *school climate* factor.

The Science Teacher Questionnaire data were analyzed using factor analysis, principal component analysis, and direct Oblimin rotation and as a result the following three factors were identified. *Teachers' perception of school security* factor; *teachers' job satisfaction, understanding and achievement* factor; and *parents and students support for and involvement in school activities* factor.

Results

The scale average computed for the eighth graders of 38 countries which participated in TIMSS 1999 was 488. This index was 474 for 46 countries which took part in TIMSS 2003 and 500 for 49 countries participating in 2007. The average science score for the students of 5 countries under study which participated in TIMSS 1999 was by 71 points lower than the TIMSS scale average. Jordan with the average of 450 (38 points below the TIMSS scale average) and Morocco with the average of 323 (165 points below the TIMSS scale average) had the highest and lowest performances, respectively. Iran which was outperformed by one country (from among 5 countries) had the average of 448 that was 40 points below the TIMSS scale average.

The average science score for the students of 11 countries under study which took part in TIMSS 2003 was 426 and by 48 points lower than the TIMSS scale average. Jordan with the average of 475 (1 point above the TIMSS scale average) and Lebanon with the average of 393 (81 points below the TIMSS scale average) had the highest and lowest performances, respectively. Iran which was outperformed by two countries (from among 11 countries) had the average of 453 that was 21 points below the TIMSS scale average.

The average science score for the students of 18 countries under study which participated in TIMSS 2007 was 431 and by 69 points lower than the TIMSS scale average. Dubai and Armenia with the averages of 489 and 488 (11 and 12 points below the TIMSS scale average) had the highest performances. In addition, Morocco and Qatar with the averages of 401 and 319 (99 and 181 points below the TIMSS scale average) had

the lowest performances. Iran which was outperformed by four countries (from among 18 countries) had the average of 459 that was 41 points below the TIMSS scale average. In TIMSS 2007, the average science score for the students of Qatar (319) and Saudi Arabia (403) (2 countries with "very high" or "high" human development indicator) was lower than the average performance of Syria (452), Egypt (408) and Oman (423) (3 countries with "low" human development indicator).

Looking at trends across the regional countries, 5 countries had higher average achievement in 2007 than in TIMSS 1999. More specifically, Morocco showed improvement by 79 points, Jordan by 31 points, Turkey by 21 points, Tunisia by 15 points, and Iran by 10 points. The performance of 11 countries which participated in TIMSS 2003 and 2007 indicated that Tunisia and Syria's average achievement increased by 41 points. This increase in average achievement was 29 points for Bahrain, 27 for Armenia, 20 for Lebanon, 7 for Jordan and 6 for Saudi Arabia. This improvement is 5 points in Iran .

In TIMSS 1999, girls in Jordan had higher science achievement than girls in 4 countries. In addition, the average achievement for girls in Jordan was higher than for boys by 18 points. However, the average performance for Jordanian girls was lower than the average achievement for girls in all 38 participating countries in TIMSS 1999 (by 20 points). On the other hand, the average science achievement for girls in Iran was lower than for boys by 31 points and the average performance of boys in Iran was higher than for boys in Jordan by 19 points. As a result, although Iran was outperformed by Jordan, this is due to the acceptable performance of Jordanian girls and the relative poor performance of Iranian girls. On average, in TIMSS 1999 the average achievement of boys was higher than for girls in the 5 countries under study by 12 points. In TIMSS 1999 and across all participating countries boys had higher average science achievement than girls by 15 points (495 vs. 480).

In TIMSS 2003, average science achievement for girls was higher than for boys in Bahrain (by 30 points), Jordan (by 27 points), Saudi Arabia (by 16 points), Armenia and Palestinian National Authority (by 13

points), Iran and Egypt (by 1 point). Boys had higher achievement than girls in the other countries. In TIMSS 2003 the average achievement for girls was higher than for boys in the 11 countries under study by 4 points (428 vs. 424). Nevertheless, in TIMSS 2003 and across all participating countries boys had higher average science achievement than girls by 6 points (471 vs. 477). In fact, in TIMSS 2003 the direction of gender differences is different in Muslim countries and across all participating countries.

In TIMSS 2007, average science achievement for girls was higher than for boys by 22 points (442 vs. 420) in 14 out 18 countries under study. The average achievement for girls was higher than for boys in Qatar (by 70 points), Bahrain (by 62 points), Oman (by 61 points), Kuwait (by 50 points), Saudi Arabia (by 43 points), and Palestinian National Authority (by 36 points). Similarly, in TIMSS 2007 and across all participating countries girls had higher average science achievement than boys by 6 points (469 vs. 463). In fact, in TIMSS 2007 the direction of gender differences is identical in Muslim countries and across all participating countries; however, the extent of the difference between the two genders is different.

Morocco showed improvement in average achievement between its first cycle of participation (1999) and TIMSS 2007. More specifically, girls and boys had higher averages in 2007 by 91 and 71 points, respectively. This improvement is remarkable compared to the other 4 countries. The average improvement in girls' science achievement within this interval showed 32 points improvement and that of the boys decline 2 points. Iran is the only country among the 5 countries under study which showed improvement in girls' average achievement (by 36 points) and decline in boys' achievement (by 8 points).

Considering the trends across the 11 countries which participated in TIMSS 2003 and 2007, girls' average performance showed improvement by 14 points and that of boys showed decline by 4 points. Decline is observed in the average achievement of girls and boys in Egypt (by 5 and

81 points) and Palestinian National Authority (by 19 and 42 points). Improvement is shown in the average achievement of girls and boys in Syria (by 46 and 44 points), Tunisia (by 44 and 39 points), Bahrain (by 46 and 14 points), Armenia (by 24 and 29 points), and Lebanon (18 and 22 points). Saudi Arabia and Morocco showed improvement in girls' average achievement (by 19 and 11 points) and decline in boys' average achievement (by 8 and 2 points). In Iran improvement is observed in girls' average achievement (by 12 points); however, boys' performance has remained unchanged (Place Table ١ here).

Table 1. Average Science Achievement in three Different Studies By Countries and Gender

Country	2007			2003			1999		
	Both	**Boy**	**Girl**	**Both**	**Boy**	**Girl**	**Both**	**Boy**	**Girl**
Jordan	482	466	499	475	462	489	450	442	460
Armani	488	484	492	461	455	468	-	-	-
Algeria	408	408	408	-	-	-	-	-	-
Iran	459	453	466	453	453	454	448	461	430
Bahrain	467	437	499	438	423	453	-	-	-
Turkey	454	452	457	-	-	-	433	434	431
Tunisia	445	455	436	404	416	392	430	442	417
Dubai	489	483	495		-	-	-	-	-
Syria	452	457	448	411	413	402	-	-	-
Saudi Arabia	403	383	426	397	391	407	-	-	-
Oman	423	391	452	-	-	-	-	-	-
Plantain	404	386	422	435	428	441	-	-	-
Qatar	319	284	354	-	-	-	-	-	-
Kuwait	418	391	441	-	-	-	-	-	-
Georgia	421	410	432	-	-	-	-	-	-
Lebanon	414	417	410	393	395	392	-	-	-
Morocco	401	401	403	396	403	392	323	330	312
Egypt	408	340	417	421	421	422	-	-	-
All Countries Mean	431	420	442	426	424	428	417	422	410

Looking at trends in students' achievement in different science content areas (chemistry, physics and earth sciences), approximately similar performances to general science was observed. In all the three content areas, girls outperformed boys in 18 countries which participated in TIMSS 2007. In addition, girls had higher average science achievement than boys in Iran and Jordan. In the three science content areas, similar to general science, the average performance for Jordanian girls and boys was higher than the average achievement for their Iranian counterparts. There was an exception to this, i.e., only in physics domain Iranian boys had higher average achievement than Jordanian boys by 2 points.

There was a significant correlation between the average science performance of eighth graders in 12 countries and science self-concept, attitudes towards science, school connectedness, and school climate. The correlation coefficient between science achievement and school climate was negative for girls (-0.161) and boys (-0.150). In other words, the more negative the school climate, the weaker the science performance. Furthermore, the correlation coefficient between science achievement and science self-concept was positive for girls (0.351) and boys (0.329). A study of the correlation coefficients between "science self-concept", "attitudes towards science", and "science achievement" in Iran, Jordan, Bahrain and Dubai revealed that in these countries the obtained indexes were higher than the average of the indexes for all the students of the 12 countries under study. Moreover, these indexes were higher in Jordan and Bahrain than in Iran for both genders. In many of the countries under study, the correlation coefficients between science self-concept and science achievement for girls were higher than those obtained for their male counterparts.

A study of the average of the above-mentioned four factors indicates that their average is higher in Jordan, Bahrain and Dubai compared to Iran. It is worth mentioning that these three countries have higher science performances than Iran. Considering trends across the regional countries in TIMSS 2003 and 2007, the average self-concept in countries with high

performance has roughly remained unchanged. Nevertheless, the average self-concept has decreased in countries with low performance. In TIMSS 2003 and across the regional countries, the average index for self-concept factor was 3.08 and it decreased by 0.07 points to 3.01 in TIMSS 2007. The average index for attitude towards science increased by 0.07 points within this interval and the trends in school connectedness factor and school climate factor have approximately remained unchanged.

Comparing the three indexes related to science teachers in TIMSS 2003 and 2007 demonstrates that teachers' perception of school security has increased within this interval (3.2 vs. 3.25). In both studies, the extent of Iranian teachers' perception of school security is less than that of their Egyptian and Syrian counterparts and the extent of the increase of this index in Iran (0.05) is less than in Syria (0.11) and Egypt (0.08). Palestinian National Authority and Tunisia had the highest improvement (0.22 and 0.18, respectively) and the highest decline was observed in Armenia (-0.63), Morocco (-0.24), and Saudi Arabia (-0.12). In both studies, male and female teachers approximately had identical averages for perception of school security (3.20 for women and 3.19 for men in TIMSS 2003 and 3.25 for women and 3.23 for men in TIMSS 2007). Nonetheless, there are trivial differences between male and female teachers among the participating countries.

"Teachers' job satisfaction, understanding and achievement" index has increased for male and female teachers between the two studies of TIMSS 2003 and 2007. The amount of this increase within this interval is significant (3.32 in TIMSS 2003 and 3.79 in TIMSS 2007). Armenia is the only country in which a decline was observed. Bahrain and Saudi Arabia had the highest increase and Tunisia and Lebanon experienced the lowest increase. In both studies, the average of this index for Iranian teachers was less than the average of all countries under study and the observed differences were significant (3.10 for Iranian teachers vs. 3.32 for teachers of participating countries in TIMSS 2003 and 3.64 vs. 3.79 in TIMSS 2007). In fact, in both studies the average of "Iranian teachers' job satisfaction, understanding and achievement" index was less than that of

their counterparts in Bahrain, Tunisia, Syria, Palestinian National Authority, Lebanon, and Egypt and the differences were significant. In both studies, the average of "female teachers' job satisfaction, understanding and achievement" index was higher than that of their male counterparts.

"Parents and students support for and involvement in school activities" index has increased for male and female teachers between the two studies of TIMSS 2003 and 2007. The amount of the increase within this interval was significant (2.66 in TIMSS 2003 and 2.72 in TIMSS 2007). There was no significant difference between the average of "parents and students support for and involvement in school activities" index for Iranian teachers and that of participating countries. In both studies, the average of this index was higher for female teachers than for their male counterparts (2.72 vs. 2.62 in TIMSS 2003 and 2.80 vs. 2.64 in TIMSS 2007). The extent of improvement between the two studies was higher in Saudi Arabia, Morocco and Armenian (0.28, 0.27 and 0.20, respectively) than in Iran (0.17). However, the observed improvement in Iran was significant.

If the distribution of students' scores is represented along a continuum and several points are identified on the scale as benchmarks, the percentage of students achieving at or above each benchmark point can be indentified and as a result students' achievement in different countries can be compared. The International Association for the Evaluation of Educational Achievement has identified four benchmark points with particular definitions: The Advanced International Benchmark is 625, the High International Benchmark is 550, the Intermediate International Benchmark is 475, and the Low International Benchmark is 400. In the present study and due to the wide gap between the performance of students in the countries under study and the students' achievement in all countries participating in TIMSS 2007 another benchmark point was defined, i.e., the Very Low Benchmark which is 325. As shown in Table 2 (Place table ۲ here), three percent of students in the 18 countries under

study could achieve at or above the advanced benchmark, i.e., 625. In addition, the percentage of students reaching the low international benchmark, i.e., 400, was 64 percent. In other words, 36 percent of students in these countries gained scores which were less than 400. Armenia had 12 percent, Dubai 11 percent, Jordan 10 percent, Turkey 6 percent, Bahrain 5 percent, and Iran 5 percent of their students reaching the advanced benchmark. The median percentage of Iranian students reaching the high international benchmark, i.e., 550, was 14 percent. On the other hand, the percentage of students achieving at high international benchmark was higher than 23 percent in Dubai, Armenia and Jordan.

Table 2: Performance at the Benchmarks of Science Achievement by Countries (2007 study)

Country	Very Low (325)	(400) Low	Intermediate (475)	High (550)	Advanced (625)
Jordan	93	79	56	26	10
Armani	95	83	55	23	12
Algeria	90	55	14	1	0
Iran	95	76	41	14	5
Bahrain	94	78	49	17	5
Turkey	92	71	40	16	6
Tunisia	98	77	31	4	0
Dubai	95	82	58	27	11
Syria	95	76	39	9	2
Saudi Arabia	84	52	18	2	0
Oman	84	61	32	8	2
Palestine	76	54	28	9	2
Qatar	51	29	11	2	0
Kuwait	84	60	28	6	1
Georgia	86	61	27	5	1
Lebanon	81	55	28	8	2
Morocco	83	51	18	3	0
Egypt	79	55	27	7	2
All Countries Mean	86	64	33	10	3

Conclusion

The average science score for the students of the countries under study was lower than the TIMSS scale averages for all the participating countries in the three consecutive TIMSS studies. In addition, the average achievement of the regional countries which had high performances (such as Jordan, Armenia and Dubai) was lower than the TIMSS average scales for all the countries participating in the three TIMSS studies.

Considering the trends across the countries which participated in 2 or three of TIMSS studies, the students' average science performance showed a trend towards improvement. More specifically, 5 countries had higher average achievement in 2007 than in TIMSS 1999 and the observed differences were significant. The extent of improvement observed in Iranian students' achievement within this interval was less than that of the other four countries. In fact, the 2-point difference between Iranian and Jordanian students in TIMSS 1999 has increased to a 33-point difference in TIMSS 2007. In addition, the 15-point difference between Iranian and Turkish students in TIMSS 1999 has decreased to a 5-point difference in TIMSS 2007.

Looking at trends across the countries which participated in TIMSS 2003 and 2007, the students' average science performance showed a trend towards improvement which was also significant. Within this interval, Bahraini students' average achievement increased by 29 points and they could compensate for the 15-point difference with Iranian students. In fact, they could outperform their Iranian counterparts by 8 points. In addition, Syrian and Tunisian students' average achievement increased by 41 points and as a result the gap between their performance and that of Iranian ones diminished to a great extent. Considering the existing trends, Iran's chance of achieving the first scientific rank in the region is remote, at least in science content areas for eighth graders.

A study of the average performance of girls and boys across different TIMSS studies shows an upward trend in girl students' average

achievement in general science and the three content areas of physics, chemistry and earth sciences. On the other hand, boy students' average achievement has shown a downward trend in general science and the three above-mentioned science domains. In TIMSS 1999, boys outperformed girls in general science and the two content areas of physics and chemistry by 12, 18, and 6 points, respectively. However, In TIMSS 2003 and TIMSS 2007 boys were outperformed by girls (by 4, 4, and 12 points in TIMSS 2003 and 22, 13 and 27 points in TIMSS 2007, respectively). Girls' average science achievement in general science and the three related domains showed a trend towards improvement in all the countries under study except Egypt, Palestinian National Authority, and Saudi Arabia. In Iran and in TIMSS 1999, boys outperformed girls in general science and the two content areas of physics and chemistry by 31, 45, and 20 points, respectively. Nevertheless, In TIMSS 2003 and TIMSS 2007 boys were outperformed by girls (by 1, 1, and 7 points in TIMSS 2003 and 36, 3 and 21 points in TIMSS 2007, respectively).

A comparison of the improvement in girls and boys' average performance indicates that in some countries (Jordan, Bahrain and Tunisia) the average performance of both genders has increased; however, the extent of improvement in girls' achievement was higher than that of boys. In some countries, improvement was observed in the average achievement of girls and decline was observed in that of boys (Iran, Saudi Arabia and Morocco). In some other countries decline was shown in the average achievement of both genders (Egypt and Palestinian National Authority); however, in these two countries boys' performance decreased more than that of girls. Improvement was shown in the average achievement of both genders in Armenia and Lebanon; however, the amount of improvement in boys' performance was higher than that of girls by 5 points in Armenia and by 4 points in Lebanon. In general, even though girls' average achievement shows improvement and gender differences have changed to the benefit of girls, there is no set pattern in the extent of improvement in both gender's achievement in the regional countries. At least in Iran, Egypt, Syria, Saudi Arabia and Bahrain the

improvement in girls' performance is accompanied by a slower improvement or decline in boys' achievement.

The higher average achievement of girls in general science and its content domains (except earth sciences) in TIMSS 2003 and TIMSS 2007 as well as the higher improvement in girls' achievement compared to that of boys in regional countries is not consistent with different theories of gender differences. In fact, the gender stratification hypothesis (Penner, 2008) and Eccles's expectancy-value theoretical model (1994) are inconsistent with what is observed in Muslim countries of the region. It appears that at least for general education the present perspective on the role which gender plays in math and science achievement must be changed. Up to present, the reasons for the poor performance of girls have been investigated. It's time that the existing theories were reconsidered and attempts were made in order to formulate theories for the reasons why boys performed weakly (at least in the regional countries).

Considering the trends in students' indexes, the science self-concept has decreased, attitude towards science has increased and the two indexes of school connectedness and school climate have remained unchanged. In addition, considering the trends in teachers' indexes, the three indexes showed a trend toward improvement which was significant. Looking at the findings from students' performance in general science and its different content areas, it can be concluded that in general the average achievement of students in regional countries showed an upward trend; however the extent of improvement is not the same in different countries. If the trend in Iran's performance is compared with that of some more successful countries in the region, it becomes evident that the objectives of Vision of the Islamic Republic of Iran's Document in 2025 cannot be achieved under present conditions. Iranian girl students' performance and that of girls in other countries shows a trend towards improvement compared to that of their male counterparts. However, the extent of improvement in Iranian girl students' achievement is less than that of their counterparts in several more successful countries in the region. The

higher performance of girls in the region compared to that of boys is a general trend and is not limited to one or several countries.

The findings of previous research into factors such as science self-concept, attitude towards science and school climate, the results of multi-faceted studies of the contributions that student, class and school factors make to achievement as well as investigation into the differences between male and female teachers' perspective on "job satisfaction" (such as the findings of Moran & Bar), teachers' self-efficacy (Parker, Hannah & Topping, 2006), teachers' expectations of students (Shin, Lee & Kim, 2009), teachers' emotional and educational support for students and the interaction between teachers and students (Kiamanesh, 2006), job satisfaction and female teachers' positive attitude towards teaching profession might help deepen our understanding of the influential factors in the boy and girl students' performance in regional countries. Nevertheless, such an interpretation would be valid if we have confidence in the validity of the findings from students and teachers' "self-expression".

Considering the high percentage of students' responses to self-assessment and self-expression items in the regional countries and the low performance of these students compared to that of their counterparts in successful countries such as Japan and Korea (For instance, 82, 88, 82, and 77 percent of students in Oman, Tunisia, Egypt and Turkey respectively reported high attitude towards science whilst these indexes were 38 and 47 percent in Korea and Japan, respectively. In addition, 52, 70, 60, and 51 percent of students in Oman, Tunisia, Egypt and Turkey respectively reported high science self-concept whilst these indexes were 24 and 20 percent in Korea and Japan, respectively; Source: TIMSS 2007 International Science Report), several key questions arise: Do the respondents have the same interpretation of the concepts underlying the items of the questionnaires? Are the respondents well aware of what is asked in each item? For instance, are they well aware of their attitude towards the subject under question? And finally, do they provide appropriate responses or do they consider some other factors while

responding? More specifically, do they avoid providing truthful responses for the benefit of convenience? The reply to these three questions may indicate that: 1) Cultural factors play a role in replying to the questionnaires and the obtained results. In fact, a westerner's or South Asian's interpretation of phrases like "I learn things quickly in science" and "This school is located in a safe neighborhood" is different from individuals who are in the regional countries. 2) In the regional countries and again due to cultural factors, individuals either are alienated from themselves or avoid "self-assertiveness" for the benefit of convenience.

In the political and economic culture, societies can be classified into two types: "developed" and "developing". Developing countries which the author prefers to classify them as countries "kept back" are dominated by politics. Under such circumstances, all life aspects including the expressed views on education and its functions are influenced by political views. In such societies in which politics has absolute power, the most appropriate view to adopt by individuals, irrespective of their age, education and profession is that they carry out actions and utter things in light of expediency. More specifically, individual's express views in line with the norm making sure what is said is not a reflection of their true thoughts and ideas.

Under these circumstances, we should not expect that the "self-expression" and "self-assessment" instrumentation used in open societies can identify the influential educational factors or the reasons for gender differences in closed societies. This does not imply that the questionnaires and methods of "self-assessment" and "self-expression" should be invalidated. It is advisable to use observations and interviews and to continuously join educational researchers with the education process over a long period of time in trying to gain a more real picture of what occurs in classrooms and schools. It is evident that qualitative approaches are a lot more complex and more time-consuming than quantitative ones and in many cases a combination of the two in a research project yields more acceptable findings. And finally it is worth mentioning that the principles

underlying these two approaches must be taken into account while utilizing a qualitative approach or a mixed one. Otherwise, these approaches can be as misleading and dangerous as a quantitative approach.

In summing up and closing the article the following points are worth stressing:

- Slower trend in the progress of Iranian students' performance makes the realization of the development set in the National Development Forecast, specially ranking first in the region as far as science and technological development in concerned, more unlikely.
- Faster trend in the progress of girls' compared to boys' performance in all participating countries makes the gender gap a resilient phenomenon.
- The factors affecting the gender difference needs to be studied and the findings should be used in formulating policies to close the gap. Methodologically, quantitative studies alone are not going to adequately account for the factors involved. Mixed method, in which both quantitative and qualitative data are produced and the findings are based on both types of data, is the recommended approach.

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