Gender Differences in Mathematics Achievement:

Evidence from Latest Regional and International Student Assessments

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This paper aims to provide an assessment of current status of gender differences in mathematics achievement or competence based on the most recent data from regional and international student assessments, including

1. Latino Americano Laboratorio de Evaluacion de La Calidad de La Educacion (LAB) (focusing on Latin America, 1997)
2. Programme d'Analyse des Systèmes Educatifs des Pays de la CONFEMEN (PASEC) (focusing on Francophone Africa, 2004)
3. Southern Africa Consortium for Monitoring Educational Quality (SACMEQ) (focusing on Southern and Eastern Africa, 2002)
4. Programme for International Student Assessment (PISA, 2003)
5. Third International Mathematics and Science Study (TIMSS, 2003).

In synthesizing gender differences across results from these student assessments, this paper attempts to identify where the greatest challenges are in reducing gender differences in mathematics achievement by comparing gender differences across different grade levels, in different geographic regions, and between developed and developing countries.

Gender Differences in LAB

LAB measured mathematics achievement among the 3rd and 4th graders. Mathematics achievement was standardized scores with a mean of 250 points and a standard deviation of 50 points. Table 1 presents gender differences in mathematics achievement. At the 3rd grade, 4 out of 12 participating countries demonstrated gender differences, all in favor of boys. These gender differences were all small in magnitude (5 points in Argentina and Peru and 7 points in Brazil and Paraguay).

The male advantage in mathematics achievement did not advance much at the 4th grade: 4 out 12 participating countries demonstrated gender differences in favor of boys as in the case of the 3rd grade. Gender differences did reach the moderate level in 2 countries (8 points in Argentina and Brazil), and these 2 countries happened to show gender differences at both grade levels. Although Bolivia and Chile showed small gender differences at the 4th grade only (6 and 5 points respectively), Paraguay and Peru with small gender differences at the 3rd grade did not carry the male advantage over to the 4th grade. On the other hand, girls appeared to begin to catch up with boys, with Cuba showing a small female advantage (6 points).

Insert Table 1 about here

Overall, the emerging pattern from the participating Latin American countries about gender differences in mathematics achievement portrayed a picture in which the male advantage in (middle-grade) primary school was limited to a small number of participating countries (one-third) but half of these countries widened gender differences as students progressed through the middle grades of primary school. Argentina and Brazil appeared to be the gravity center for this male advantage among the participating Latin American countries. Meanwhile, girls began to catch up with boys in mathematics as early as the 4th grade with Cuba breaking through with a small female advantage, even though gender differences in favor of girls were still a rather isolated phenomenon at this early stage among the participating Latin American countries.

Gender Differences in PASEC

PASEC administered mathematics test to the 2nd and 4th graders in the participating Francophone African countries. The PASEC mathematics scale was from 0 to 100 points. At the

2nd grade, there were gender differences in mathematics achievement in 5 out of 8 participating countries, 4 of which were in favor of boys (see Table 2). Nevertheless, all gender differences ranged from 2 to 5 points (within a scale of 0 to 100). Such a magnitude is not a major concern in any practical sense. It is reasonable to conclude that there were no appreciable gender differences in mathematics achievement among the 2nd graders in the participating Francophone African countries.

Insert Table 2 about here

At the 5th grade, there were gender differences in mathematics achievement in 4 out of 8 participating countries, all in favor of boys. However, ranging from 2 to 4 points, such a male advantage, again, is not a cause for concern practically. Only 2 out of 8 participating countries, Mali and Senegal, had gender differences at both grade levels. Overall, there is no immediate concern about gender differences in mathematics achievement at the primary school level among the participating Francophone African countries. The magnitude of gender differences is so small that the slight male advantage in some participating countries requires nothing but continuous monitoring.

Gender Differences in SACMEQ

The SACMEQ mathematics achievement was standardized scores with a mean of 500 points and a standard deviation of 100 points. Table 3 shows differences in mean mathematics achievement between boys and girls. Gender differences were present in 6 out of 14 participating countries. Five out of these 6 countries showed gender differences in favor of boys. A moderate male advantage was found in Tanzania (33 points). Other male advantages (in Kenya, Mozambique, Zambia, and Zanzibar) were small, ranging from 10 to 22 points.

Insert Table 3 about here

The phenomenon of girls beginning to catch up with boys in mathematics achievement observed in PASEC is also observed in SACMEQ, with Seychelles breaking through with, as a matter of fact, moderate gender differences in favor of girls (38 points). Overall, SACMEQ indicates that there were no gender differences in mathematics achievement at the upper primary school level (the 6th grade) in the majority of the participating Southern and Eastern African countries. Although the few gender differences were almost all in favor of boys, the female advantage was the largest among all gender differences. Therefore, among the participating Southern and Eastern African countries, an interesting balance appeared to be at work in which the male advantage outnumbered the female advantage but in a much smaller magnitude in most cases whereas the female advantage claimed the largest magnitude.

SACMEQ defined a low level of mathematics competence. Percents of boys and girls at this low level in each participating country are presented also in Table 3. For countries that did not report gender differences, it is still possible to observe gender differences at this low level in a couple of them. For example, 55% of girls were at the low level of mathematics competence in contrast to 43% of boys in Lesotho, whereas 47% of boys were at the low level of mathematics competence in contrast to 36% of girls in Uganda. On the other hand, countries that reported gender differences in favor of boys might actually have a female advantage at the low level of mathematics competence. The most typical case is Mozambique. Even though, on average, there was a male advantage, 53% of boys were actually at the low level of mathematics competence in contrast to 35% of girls, an obvious female advantage at this low level.

Gender Differences in PISA

PISA defines mathematics achievement as mathematics literacy: the ability to formulate and solve mathematical problems in situations encountered in life (see OECD, 2001). The PISA mathematics literacy was standardized scores with a mean of 500 points and a standard deviation of 100 points. Table 4 shows gender differences in mathematics literacy at the 8th grade in PISA. In the case of PISA 2003, 28 out of 40 participating countries reported gender differences (this represents 70% of all participating countries), all but one in favor of boys. The small female advantage (15 points) in Iceland adds to the phenomenon of girls beginning to catch up with boys in mathematics (see also the cases in PASEC and SACMEQ as discussed above). The remaining gender differences (in favor of boys) were all small, ranging from 6 to 29 points.

Insert Table 4 about here

Regionally, the 3 countries with the largest gender differences came from Western Europe (Liechtenstein with 29 points) and East Asia (Korea with 23 points and Macao with 21 points). Obviously, participating developing countries (Korea and Macao) were the majority in this category. Overall, gender differences were found in 70% of the participating developing countries and 69% of the participating developed countries. The only participating transition country, Russia, also reported gender differences.

Six performance levels were developed based on scores on mathematics literacy in PISA 2003. A comparison of performance by boys and girls at the lowest and highest levels is shown in Table 4. At the top end of the performance spectrum, all participating countries indicated that the male percent was larger than (at least as large as) the female percent at the highest level of performance. Therefore, participating countries that did not report gender differences could still have "local" gender disparities. At the bottom end, 22 out of the 27 participating countries with gender differences in favor of boys indicated that the female percent was larger than (at least as large as) the male percent at the lowest level of performance, and Iceland with gender differences in favor of girls had a higher percent of boys at this level. Therefore, the vast majority of participating countries with gender differences in favor of boys (girls in the case of Iceland) commonly had a smaller percent of boys (girls in the case of Iceland) at the lowest level of performance—this might be a necessary (but not sufficient) condition for gender differences to occur.

Change in Gender Differences in Mathematics Achievement in PISA

A comparison between PISA 2000 and 2003 results indicates that the male advantage in mathematics literacy was on the rise in proportion (from 47% of the participating countries in 2000 to 70% of the participating countries in 2003). All but 2 participating countries with gender differences in 2000 continued to have gender differences in 2003. However, the male advantage remained small from 2000 to 2003. Compared with 2000, 2003 witnessed the first case of a female advantage that signaled that girls began to catch up with boys in mathematics literacy even though at this stage it was a rather isolated phenomenon. During this 3-year period, Iceland experienced the rise of a small female advantage in 2003 from a status of no gender differences in 2000.

East Asia and Western Europe consistently "produced" participating countries with the largest gender differences in favor of boys among all participating countries. Interestingly, the break-through female advantage came also from Western Europe (i.e., Iceland). Participating developing countries were the majority in the category of countries with the largest gender differences in both 2000 and 2003. In general, the percent of the participating developing countries with gender differences increased from 67% to 70%, and that of the participating developed countries increased from 46% to 69% between 2000 and 2003.

Some specific comparisons are made for the 31 participating countries with data from both 2000 and 2003. Among the 27 participating developed countries, from 2000 to 2003, 6 countries experienced increased gender differences in mathematics literacy with Liechtenstein reporting an increase larger than 10 points (17 points), and 5 countries experienced decreased gender differences with no country reporting a decrease larger than 10 points. During the same period, 6 countries remained free of gender differences, 8 countries witnessed the appearance of gender differences (all but one in favor of boys), and 2 countries (Austria and Norway) witnessed the disappearance of gender differences. Countries with the appearance of gender differences larger than 10 points include New Zealand (14 points), Iceland (15 points in favor of girls), Italy (18 points), and Greece (19 points).

Russia was the only transition country in PISA. From 2000 to 2003, Russia witnessed the appearance of gender differences in mathematics literacy (10 points). Brazil, Korea, and Mexico were the only developing countries in PISA with data from both 2000 and 2003. During this period, Brazil and Korea experienced decreased gender differences with the former reporting a decrease larger than 10 points (11 points). Mexico, on the other hand, witnessed the appearance of gender differences larger than 10 points (11 points).

Gender Differences in TIMSS

TIMSS was a four-year cycle of assessments of international trends in mathematics and science achievement. TIMSS 1995 was the first cycle of data collection. TIMSS 1995 targeted 3 populations of students in the 4th, 8th, and 12th grades. TIMSS 1999 was the second cycle, measuring the progress of students in mathematics and science achievement at the 8th grade. TIMSS 2003 was the latest cycle, assessing mathematics and science achievement of students at the 4th and 8th grades. The TIMSS mathematics achievement was standardized scores with a mean of 500 points and a standard deviation of 100 points.

TIMSS 2003 has seen major historical changes in gender differences in mathematics achievement. Table 5 indicates that, at the 4th grade, gender differences in favor of girls began to appear, with 3 participating countries (Armenia, Moldova, and Philippines) showing small female advantages ranging from 11 to 12 points (equivalent to 12% of all participating countries). Though small in magnitude, these gender differences are the first occurrence of a female advantage in mathematics achievement at the 4th grade in the entire IEA history. Gender differences in favor of boys occurred in 6 participating countries (equivalent to 24% of all participating countries). The male advantage (ranging from 6 to 11 points) was quite similar in magnitude to the female advantage. As a matter of fact, gender differences in favor of girls balanced off gender differences in favor of boys, resulting in the lack of gender differences at the 4th grade in TIMSS 2003 (i.e., the overall average gender differences were negligible).

Insert Table 5 about here

Regionally, 3 out of the 4 countries with the largest gender differences (Armenia from Central Asia and Philippines from East Asia with 12 points as well as Moldova from Central and Eastern Europe and Scotland from Western Europe with 11 points) reported female advantages. Half of these countries are transition countries (and both showed female advantages). Overall, 38% of the participating developing countries, 67% of the participating transition countries, and 29% of the participating developed countries reported gender differences.

Two phenomena appeared at the 8th grade regarding gender differences in mathematics achievement (see Table 5). First, for the first time in the entire IEA history, gender differences in favor of girls are observed. In fact, among all participating countries, countries showing gender differences in favor of girls were the same in number as countries showing gender differences in favor of boys (9 versus 9 or 20% each). The female advantage was mostly small, ranging from 7 to 27 points, with the exception of Bahrain that demonstrated a moderate female advantage (33 points). On the other hand, the male advantage was small, ranging from 6 to 24 points.

The second phenomenon quite noticeable in Table 5 is that among the 3 countries (Bahrain, Jordan, and Tunisia) with the largest gender differences, 2 (Bahrain and Jordan) showed gender differences in favor of girls. All 3 countries in this category are developing Arab countries. Such gender differences indicate that when girls in Arab countries are provided with equal opportunity to learn, they tend to achieve far better in mathematics achievement than their male counterparts who traditionally have privileged access to formal education. Among all participating developing countries, 45% reported gender differences. Two out of the 3 participating transition countries reported gender differences (67%). Among all participating developed countries, 29% reported gender differences.

The two phenomena as discussed above also highlight the cross-sectional comparison between the 4th and 8th grades in TIMSS 2003. Two things are worthy of emphasizing: both grades witnessed the occurrence of the female advantage in mathematics achievement in the history of IEA and the participating transition and developing countries stood out at both grades. The largest gender differences did not display any regional pattern between the 4th and 8th grades, but the overall impression is that the participating transition and developing countries began to crowd this category. Indeed, the participating transition and developing countries are unique in TIMSS 2003 on at least two counts. First, these countries tended to show the largest gender differences in both grades, and in most cases, these gender differences were in favor of girls. Second, the participating transition and developing worlds kept having a higher proportion of their countries showing gender differences than the participating developed world across both grades.

Change in Gender Differences in Mathematics Achievement in TIMSS

With 3 cycles of assessments, TIMSS has a good opportunity to examine the trend of gender differences in mathematics achievement. Comparisons can be made at the 4th grade with TIMSS 1995 and 2003 as well as at the 8th grade with TIMSS 1995, 1999, and 2003. Table 6 presents a comparison on gender differences at the 4th grade between TIMSS 1995 and 2003. Clearly, gender differences have gone through dramatic change over time among participating countries in TIMSS. At the 4th grade, if gender differences ever occurred in 1995, they occurred in favor of boys. This pattern disappeared at the 4th grade in 2003. Gender differences in favor of girls have matched up in magnitude (not in number yet) with gender differences in favor of boys. In less than a decade, the male advantage in mathematics achievement has partially disappeared from the 4th grade among participating countries in TIMSS.

Insert Table 6 about here

Some specific analyses on change over time in gender differences in mathematics achievement are possible at the 4th grade because 15 countries took part in both TIMSS 1995 and 2003. Four of them are developing countries: Cyprus, Hong Kong, Iran, and Singapore. All 4 countries reported no gender differences in 1995. Hong Kong and Iran remained free of gender differences in 2003. Cyprus and Singapore witnessed the appearance of gender differences in favor of boys in 2003. The male advantage was small in both countries (9 points in Cyprus and 8 points in Singapore). Therefore, among the participating developing countries with data from both 1995 and 2003, the overall trend is the appearance of a small male advantage at the 4th grade.

Among the 15 countries with data from both 1995 and 2003, 11 are developed countries. Seven countries (Australia, England, Hungary, Latvia, New Zealand, Norway, and Slovenia) remained free of gender differences in both 1995 and 2003. Netherlands and United States saw gender differences in favor of boys in both 1995 and 2003. While the male advantage decreased 9 points in Netherlands, it increased 6 points in United States. During the same period, the male advantage disappeared in Japan (8 points in 1995) but appeared in Scotland (11 points in 2003). Therefore, among the participating developed countries with data from both 1995 and 2003, the overall trend can best be described as a stable maintenance, with 9 out of 11 countries keeping their status of gender differences (either present or absent).

Table 7 presents a comparison on gender differences at the 8th grade among TIMSS 1995, 1999, and 2003. Similar to the case of the 4th grade, gender differences in mathematics achievement have experienced dramatic change over time at the 8th grade among participating countries in TIMSS. In 1995, if gender differences ever occurred at the 8th grade, they occurred in favor of boys. In 1999, this pattern remained at the 8th grade. In 2003, this pattern disappeared at the 8th grade. From a global aspect, girls have closed the gap with boys in mathematics achievement at this grade level. In both number and magnitude, gender differences in favor of girls are matching up with gender differences in favor of boys. In less than a decade, the male advantage in mathematics achievement has disappeared at the 8th grade.

Insert Table 7 about here

Similar to the case of the 4th grade, some specific analyses on change over time in gender differences in mathematics achievement are also possible at the 8th grade. Twenty one participating countries took part in all 3 cycles of student assessments at this grade level (TIMSS 1995, 1999, and 2003). Seven of them are developing countries. Hong Kong and South Africa remained free of gender differences across 1995, 1999, and 2003. Korea, Iran, and Israel come into one category. All of them experienced gender differences in favor of boys in 1995 but saw the disappearance of gender differences in 2003 (gender differences disappeared in Korea even earlier in 1999). Cyprus and Singapore witnessed the appearance of gender difference in favor of girls in 2003 although neither experienced gender differences in either 1995 or 1999. The female advantage was small in both countries (16 points in Cyprus and 10 points in Singapore). Therefore, based on analysis of the participating developing countries with data from all 3 cycles, the overall trend can be characterized as the disappearance of the male advantage and the emergence of the female advantage at the 8th grade.

Russia is the only transition country in TIMSS with data from all 3 cycles. It remained free of gender differences in mathematics achievement at the 8th grade across 1995, 1999, and 2003. Among the remaining 13 participating developed countries, the majority (9 of them) remained free of gender differences across 1995, 1999, and 2003. Japan witnessed the disappearance of gender differences in favor of boys as early as in 1999 and remained free of gender differences in 2003. Belgium (Flemish-speaking), Hungary, and United States witnessed the appearance of gender differences in favor of boys after being free of gender differences in both 1995 and 1999. The male advantage was small in all 3 countries (11 points in Belgium, 7 points in Hungary, and 6 points in United States). Therefore, based on analysis of the participating developed countries with data from all 3 cycles, the overall trend can be described as a continuing absence of gender differences, with 9 out of 13 countries free of gender differences throughout and with 1 more country joining them in 2003.

Countries of Challenge

Table 8 presents the top 3 countries with the largest gender differences in mathematics achievement as reported in the latest regional and international student assessments (LAB is omitted in all subsequent discussion because it was conducted in 1997). Selecting such a small number of countries allows this synthesis to concentrate on countries that face the greatest challenges in a concise and manageable manner. To inform the current educational policy and practice, only the most recent regional and international student assessments are chosen for this analysis, and if a student assessment has multiple cycles, only the most recent cycle is used.

Insert Table 8 about here

Among the participating Francophone African countries examined in PASEC 2004, Mali and Senegal shows gender differences across grade levels. These countries have relatively greater challenges than other participating Francophone African countries in PASEC. As reported earlier, however, these gender differences are fairly small. Periodical monitoring is all that is recommended at the current stage for gender differences in these countries. Seychelles, Tanzania, and Kenya face the greatest challenges among the participating Southern and Eastern African countries in SACMEQ 2002. Gender differences in Seychelles are particularly substantial. The extent to which Seychelles stands far out from other participating Southern and Eastern African countries in terms of gender differences requires a careful further examination.

In the case of PISA 2003, Liechtenstein, Korea, and Macao face greater challenges of reducing gender differences in mathematics than other participating countries in PISA 2003. Regionally, major concerns of gender differences come from East Asia and, in particular, Western Europe. As far as TIMSS 2003 is concerned, Armenia, Philippines, Moldova, and Scotland in the 4th grade as well as Bahrain, Jordan, and Tunisia in the 8th grade represent the gravity center of gender differences in mathematics education. They face the greatest challenges of reducing gender differences among all participating countries in TIMSS 2003. Regionally, major concerns of gender differences come across several regions.

It is worth of mentioning that North America is the single region that has never appeared on any top 3 list. This is a real credit given that Canada and United States are regular participants in all major international student assessments. With a clean record across all major international student assessments, North America appears to be a region of minor concerns of gender differences. The other regions that are rarely indicated in international student assessments are Latin America and Sub-Saharan Africa. Given that few countries from these regions are regular participants in international student assessments, this lack of indication on major concerns of gender differences needs to be confirmed at a later time when an increasing number of countries from these regions take part regularly in international student assessments.

Developing and Developed Countries

International student assessments cover a wide range of regions with countries from both developing and developed world. Participating developing countries can be compared with participating developed countries in terms of gender differences in mathematics achievement. From the earlier section on countries of challenge, it is evident that almost all countries showing largest gender differences are developing countries. A specific examination of PISA and TIMSS confirms this interesting trend related to the socioeconomic background of countries.

PISA 2003 reports that the participating developing countries are the majority in the category of countries with the largest gender differences in mathematics achievement at the 8th grade. In addition, the percent of the participating developing countries with gender differences is slightly higher than the percent of the participating developed countries with gender differences (70% versus 69%). In the case of the 8th grade in TIMMS 2003, the participating developing countries occupy the category of countries with the largest gender differences in mathematics achievement. In addition, the participating developing world keeps a higher proportion of its countries showing gender differences than the participating developed world (45% versus 29%).

Results on the 4th grade in TIMSS 2003 indicate that 38% of the participating developing countries report gender differences in mathematics achievement, compared with 29% of the participating developed countries. One developing country is also in the category of countries with the largest gender differences. Overall, PISA 2003 and TIMSS 2003 appear to suggest that gender differences in mathematics achievement are a bigger concern in the participating developing than developed countries across the 4th and 8th grades, especially at the secondary school level (the 8th grade).

Grade Levels of Challenge

Table 9 presents research syntheses across grade levels in terms of gender differences in mathematics achievement based on the most recent regional and international student assessments. Such syntheses are not rigid estimates but convenient analyses to integrate research findings. Each value in the table is an index for boys or girls calculated for each assessment (regional or international) as the percent of participating countries with gender differences in favor of boys and girls. For example, at the 2nd grade, boys have an index of 0.50. Percents in the table can be interpreted as simple probabilities indicating how likely gender differences would appear in favor of boys and girls. Adding male and female percents yields an overall probability that gender differences would appear.

Insert Table 9 about here

The probability that gender differences would appear (adding male and female percents) is 51% in mathematics. With a probability above 50%, gender differences are likely to occur in mathematics in favor of boys than girls in mathematics. Gender differences in favor of boys are more likely to occur than gender differences in favor of girls across grade levels. On average, the male advantage is more than 4 times as likely to occur as the female advantage (42% versus 9%). The probability that gender differences would appear (adding male and female percents) is 63% in the 2nd grade, 36% in the 4th grade, 50% in the 5th grade, 43% in the 6th grade, and 57% in the 8th grade. Obviously, the 2nd and 8th grades are where gender differences are most likely to occur, both with probabilities above 50%.

Complexity of Gender Differences as Another Challenge

As presented earlier, some regional and international student assessments have developed indices as additional ways to investigate outcomes of student learning. These indices have also provided additional ways to examine gender differences in learning outcomes. In fact, these indices have served to expose the complexity of gender differences. In PISA 2003, all participating countries reported that the male percent was larger than (at least as large as) the female percent at the highest level of performance, indicating that participating countries that did not report gender differences could still have “local” gender disparities (the 3 countries with gender differences in favor of girls could still have “local” male advantages).

These scenarios suggest that the complexity of gender differences in mathematics achievement constitutes by itself a challenge. Countries without gender differences may not be entirely free of gender inequality, and countries with gender differences may still have some gender equality to celebrate. Overall, they call for a detailed analysis of gender differences, layer by layer, level by level. In other words, there ought to be different “analytical units” of gender differences. In this paper, all existing indices provide opportunity to use competence level or ability level as a unit. Other units, such as attitudinal attribute (level) and socioeconomic background (level) can all become units for analysis of gender differences. The macro perspective of gender differences calls for, say, school district, geographic region, type of community, and type of school as units of analysis. Fortunately, regional and international student assessments are in a good position to provide meaningful units to address the complexity of gender differences.

Major Theme and Potential Explanation

A major theme has emerged as the reviews of gender differences progress from regional to international student assessments. Girls are catching up with boys in mathematics achievement. This traditionally male domain has experienced in the past decade historical breakthroughs (i.e., first occurrences in history) where girls have begun to outperform boys in mathematics in some participating countries in both regional and international student assessments. These breakthroughs are also reflected in Table 9. Girls have a chance of 9 to 42 (out of 100) to outperform boys in mathematics achievement. As discussed earlier, the current trend as shown in TIMSS 2003 suggests that a gender balance in mathematics achievement is progressing well. Such themes (or patterns) fit well into the research literature. Education Testing Service (ETS) in United States conducted a longitudinal review to synthesize gender differences in learning outcomes. *The ETS Gender Study* involves more than 400 tests from more than 1,500 databases. Cole (1997, p. 3) concluded that "the familiar math … advantage for males was found to be quite small, significantly smaller than 30 years ago."

Interestingly, female breakthroughs in mathematics achievement come from developing countries. What accounts for this trend? Gender stereotypes are based on the proposition that self-perceptions of students on their abilities correspond to beliefs of their significant others (teachers, parents, and peers) (Sadker & Sadker, 1994). The theoretical framework of gender stereotypes is developed to explain engendered academic differences. Gender stereotypes can transmit into culture by means of mass media, toys, and books, and can be reinforced by significant others. Gender stereotypes are likely to make their way into school policy in which administrators limit access to one gender and into classroom practice in which teachers discourage one gender, both because of their stereotyped gender notions. Gender stereotypes do influence behaviors, expectations, and beliefs of administrators and teachers, and do filter through them to students.

A concise review of this issue from the perspectives of both developed and developing countries shows that gender stereotypes take on different forms between the two worlds. In the developed world, traditional gender stereotypes typically emphasize that one gender is better than the other at certain area of learning. For example, language is portrayed as a female domain where girls excel, whereas mathematics and science as male domains where boys excel. Swetman (1995) showed that initially girls have more positive attitude toward mathematics than boys, but as they continue their education in school under mathematics as a male domain, female attitude declines substantially and becomes much more negative than male attitude, with many girls intentionally avoiding studies in mathematics (and science) to pursue programs at which girls are good.

In the developing world, traditional gender stereotypes typically emphasize social role rather than academic ability. According to El-Sanabary (1993) and Hyde (1993), for example, gender stereotypes in Middle East and Africa stress desirable feminine traits such as weakness, sensitivity, submissiveness, dependency, and self-sacrifice. Women in general are seen to derive their identity and status from conformity to gender-based role expectations as caring mother and dutiful wife. Under such widely expected social roles, administrators, teachers, parents, and even girls themselves see no reason or need to pursue an intensive study of mathematics and science. Instead, girls in Ghana and Kenya pursue a curriculum leading to “woman’s work,” namely a study of domestic science, handcrafts, and biology (King & Hill, 1993). Rather than, say, considering mathematics negative and themselves incapable as girls do in the developed world, girls in the developing world are likely to consider mathematics irrelevant to their life.

This distinction in gender stereotypes between developed and developing countries may in fact explain why most female breakthroughs in mathematics where girls begin to outperform boys come from the developing world (see TIMSS 2003 results). Philippines reports female breakthroughs in mathematics at both 4th and 8th grades. Bahrain, Jordan, and Singapore show female breakthroughs in mathematics at the 8th grade. In contrast, very few female breakthroughs are observed in mathematics from the developed world.

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Table 1

Gender Differences in Mathematics Achievement: Results from LAB

	Grade 3		Grade 4	
	Boys Better	Girls Better	Boys Better	Girls Better
Argentina	**5**		**8**	
Bolivia	1		**6**	
Brazil	**7**		**8**	
Chile	3		**5**	
Colombia	1		4	
Cuba		2		**6**
Honduras		2		2
Mexico	1			2
Paraguay	**7**		1	
Peru	**5**		2	
Dominican Republic		4	1	
Venezuela	1		2	

Note. Gender differences statistically significant at the 95% confidence level are bold.

Table 2

Gender Differences in Mathematics Achievement: Results from PASEC

	Grade 2		Grade 5	
	Boys Better	Girls Better	Boys Better	Girls Better
Burkina Faso	0.3		**3.0**	
Cameroon	1.0		0.8	
Chad	**4.0**		0.5	
Côte d'Ivoire	**2.1**		0.9	
Madagascar		**2.5**	0.3	
Mali	**2.9**		**3.6**	
Niger	1.5		**2.0**	
Senegal	**5.2**		**2.0**	

Note. Gender differences statistically significant at the 95% confidence level are bold.

Source: Bernard (2006).

Table 3

Gender Differences in Mathematics Achievement: Results from SACMEQ

	Difference in Average Achievement		Percent at Low Level	
	Boys Better	Girls Better	Boys	Girls
Botswana		9	42	43
Kenya	**22**		32	34
Lesotho		3	43	55
Malawi	10		52	48
Mauritius		11	33	28
Mozambique	**18**		53	35
Namibia	5		45	49
Seychelles		**38**	37	29
South Africa		8	43	44
Swaziland	5		43	45
Tanzania	**33**		38	46
Uganda	4		47	36
Zambia	**10**		51	48
Zanzibar	**14**		46	49

Note. Gender differences statistically significant at the 95% confidence level are bold.

Source: Ross, Saito, Dolata, & Ikeda (2004).

Table 4

Gender Differences in Mathematics Achievement: Results from PISA 2003 and 2000

	Difference in Average Achievement				Percent in Performance Level (PISA 2003)			
	PISA 2003		PISA 2000		≤ Level 1		≥ Level 6	
	Boys Better	Girls Better	Boys Better	Girls Better	Boys	Girls	Boys	Girls
East Asia and the Pacific								
Australia	5		12		5	4	7	5
Hong Kong	4				5	3	13	8
Indonesia	3				49	52	0	0
Japan	8		8		5	4	11	6
Korea	**23**		**27**		2	3	10	6
Macao	**21**				2	2	7	3
New Zealand	**14**			3	5	5	8	5
Thailand		4			25	23	0	0
Central and Eastern Europe								
Czech Republic	**15**		**12**		4	6	7	4
Hungary	**8**		7		8	8	3	2
Latvia	3		6		8	7	2	1
Poland	6		5		8	6	3	2
Russia	**10**			2	11	11	2	1
Serbia	1				19	16	0	0
Slovak Republic	**19**				6	7	4	2
Turkey	**15**				26	29	3	2

North America and Western Europe

Austria	8		**27**		6	5	5	3
Belgium	8		6		7	7	11	7
Canada	**11**		**10**		3	2	8	4
Demark	**17**		**15**		4	6	5	3
Finland	**7**		1		2	1	8	5
France	**9**		**14**		6	5	5	3
Germany	**9**		**15**		9	9	5	3
Greece	**19**		7		16	19	1	0
Iceland		**15**		5	6	3	4	4
Ireland	**15**		**13**		4	5	3	2
Italy	**18**		8		13	14	3	1
Liechtenstein	**29**		**12**		5	5	11	4
Luxembourg	**17**		**15**		7	8	3	1
Netherlands	5		11		2	3	8	7
Norway	6		**11**		7	7	4	2
Portugal	**12**		**19**		12	11	1	0
Spain	**9**		**18**		8	8	2	1
Sweden	**7**		7		6	6	5	3
Switzerland	**17**		**14**		4	6	9	5
United Kingdom			8					
United States	**6**		10		11	10	3	1

Latin America						
Brazil	**16**	**27**	51	55	1	0
Mexico	**11**	11	36	39	0	0
Uruguay	**12**		24	28	1	0
Arab States						
Tunisia	**12**		48	54	0	0

Note. Gender differences statistically significant at the 95% confidence level are bold.

Source: Organisation for Economic Co-operation and Development (2001, 2004).

Table 5

Gender Differences in Mathematics Achievement: Results from TIMSS 2003

	Grade 4		Grade 8	
	Boys Better	Girls Better	Boys Better	Girls Better
East Asia and the Pacific				
Australia	3		13	
Hong Kong	0			2
Indonesia				1
Japan	4		3	
Korea			5	
Malaysia				8
New Zealand	0			3
Philippines		**12**		**13**
Singapore	**8**			**10**
Taiwan		1		7
South and West Asia				
Iran		8		9
Central Asia				
Armenia		**12**		**10**
Central and Eastern Europe				
Bulgaria				1
Estonia				2
Hungary	3		**7**	
Latvia		1		6
Lithuania	1			5
Macedonia				**9**
Moldova		**11**		**10**
Romania				4
Russia	4			3
Serbia				**7**
Slovak Republic			0	

Slovenia	5			3
North America and Western Europe				
Belgium (Flemish)	2		**11**	
Cyprus	**9**			**16**
England		2	0	
Israel			8	
Italy	**9**		**6**	
Netherlands	**6**		7	
Norway	5			3
Scotland	**11**			5
Sweden			1	
United States	**8**		**6**	
Latin America				
Chile			**15**	
Sub-Saharan Africa				
Botswana			2	
Ghana			**17**	
South Africa			3	
Arab States				
Bahrain				**33**
Egypt				1
Jordan				**27**
Lebanon			**10**	
Morocco	6		**12**	
Palestinian A. T.				8
Saudi Arabia			10	
Tunisia		5	**24**	

Note. Gender differences statistically significant at the 95% confidence level are bold.

Source: Mullis, Martin, Gonzalez, & Chrostowski (2004).

Table 6

Gender Differences in Mathematics Achievement: 4th Grade Results from TIMSS 2003 and 1995

	TIMSS 2003		TIMSS 1995	
	Boys Better	Girls Better	Boys Better	Girls Better
East Asia and the Pacific				
Australia	3		2	
Hong Kong	0			1
Japan	4		**8**	
Korea			**15**	
New Zealand	0			10
Philippines		**12**		
Singapore	**8**			10
Taiwan		1		
Thailand				11
South and West Asia				
Iran		8	9	
Central Asia				
Armenia		**12**		
Central and Eastern Europe				
Czech Republic			3	
Hungary	3		5	
Latvia		1		9
Lithuania	1			
Moldova		**11**		
Russia	4			
Slovenia	5			3
North America and Western Europe				
Austria			8	
Belgium (Flemish)	2			
Canada			3	
Cyprus	**9**		8	

England		2	5	
Greece				2
Iceland			1	
Ireland				3
Israel				9
Italy	**9**			
Netherlands	**6**		**15**	
Norway	5		5	
Portugal			4	
Scotland	**11**		0	
United States	**8**		2	
Arab States				
Morocco	6			
Tunisia		5		

Note. Gender differences statistically significant at the 95% confidence level are bold.

Source: Mullis, Martin, Fierros, Goldberg, & Stemler (2000). Mullis, Martin, Gonzalez, & Chrostowski (2004).

Table 7

Gender Differences in Mathematics Achievement: 8th Grade Results from TIMSS 2003, 1999, and 1995

	TIMSS 2003		TIMSS 1999		TIMSS 1995	
	Boys Better	Girls Better	Boys Better	Girls Better	Boys Better	Girls Better
East Asia and the Pacific						
Australia	13		2			5
Hong Kong		2		2	20	
Indonesia		1	5			
Japan	3			8	**9**	
Korea	5		5		**17**	
Malaysia		8		5		
New Zealand		3		7	9	
Philippines		**13**		15		
Singapore		**10**	2			2
Taiwan		7	4			
Thailand				4		9
South and West Asia						
Iran		9	**24**		**13**	
Central Asia						
Armenia		**10**				
Central and Eastern Europe						
Bulgaria		1	0			

Czech Republic			**17**		11	
Estonia		2				
Hungary	**7**		6		0	
Latvia		6	5		4	
Lithuania		5	3			1
Macedonia		**9**	0			
Moldova		**10**	3			
Romania		4		5	3	
Russia		3	1			1
Serbia		**7**				
Slovak Republic	0		5			4
Slovenia		3	1		8	
Turkey			2			
North America and Western Europe						
Austria					8	
Belgium (Flemish)	**11**			4		4
Belgium (French)					6	
Canada			3			4
Cyprus		**16**		4		3
Demark					**17**	
England	0		19		4	
Finland			3			
France					5	

Germany				3	
Greece				**12**	
Iceland				2	
Ireland				14	
Israel	8		**16**	**29**	
Italy	**6**		9		
Netherlands	7		5	8	
Norway		3			4
Portugal				**11**	
Scotland		5		16	
Spain				**10**	
Sweden	1			2	
Switzerland				5	
United States	**6**		7	5	
Latin and South America					
Chile	**15**		9		
Colombia				2	
Sub-Saharan Africa					
Botswana	2				
Ghana	**17**				
South Africa	3		16	11	
Arab States					
Bahrain		**33**			

Egypt		1		
Jordan		**27**		7
Lebanon	**10**			
Morocco	**12**		17	
Palestinian A. T.		8		
Saudi Arabia	10			
Tunisia	**24**		**25**	

Note. Gender differences statistically significant at the 95% confidence level are bold.

Source: Mullis, Martin, Fierros, Goldberg, & Stemler (2000). Mullis, Martin, Gonzalez, & Chrostowski (2004). Mullis, Martin, Gonzalez, Gregory, Garden, O'Connor, Chrostowski, & Smith (2000).

Table 8

Top 3 Countries with Largest Gender Differences in the Latest Regional and International Student Assessments

	Mathematics
PASEC	
2nd Grade	Senegal
	Chad
	Mali
5th Grade	Mali
	Burkina Faso
	Niger
	Senegal
SACMEQ	
6th Grade	Seychelles
	Tanzania
	Kenya
PISA 2003	
8th Grade	Liechtenstein
	Korea
	Macao
TIMSS 2003	
4th Grade	Armenia
	Philippines
	Moldova
	Scotland
8th Grade	Bahrain
	Jordan
	Tunisia

Note. Countries within each category are ranked in a descending order in gender differences.

Table 9

Gender Differences Across Grade Levels as Reported in Regional and International Student Assessments

	Mathematics		Average by Grade	
	Boys	Girls	Boys	Girls
2nd Grade			0.50	0.13
PASEC	0.50	0.13		
4th Grade			0.24	0.12
TIMSS 2003	0.24	0.12		
5th Grade			0.50	0.00
PASEC	0.50	0.00		
6th Grade			0.36	0.07
SACMEQ	0.36	0.07		
8th Grade			0.45	0.12
PISA 2003	0.70	0.03		
TIMSS 2003	0.20	0.20		
Average by Subject	0.42	0.09		

Note. An index is calculated for each assessment (both regional and international) as percent of countries with gender differences.