8

Student-Related Inequity Factors

This chapter focuses on identifying and investigating student-related inequity factors in mathematics achievement, based on *TIMSS 2003 Student Background Questionnaire* and TIMSS 2003 assessment data. According to our definition, a student-related inequity factor is one that accounts for a significant percentage of between student-variance in mathematics achievement. For each of the 18 countries in the sample, two runs of stepwise multiple regression were done, one with the student indices as predictors, and another with the student single-item variables as predictors (will henceforth be referred to as practices). In both cases, the Average Mathematics Plausible Score (AMPS) was used as a dependent variable (Section 7.5).

The stepwise multiple regression results are presented in a uniform pattern. An inequity factor, whether index or practice, is included in the discussion in this chapter, if it satisfies two conditions. First, the inequity factor should be significant, i.e. it should account for a significant (> 0) percentage of variance in (AMPS). Second, the inequity factor should be significant in at least six of the 18 countries in the sample. For each inequity factor that satisfies the two conditions, we present a figure consisting of a two-part bar graph:

1. Sub-figure (a) represents the the inequity factor's strength (percentage of variance in the math achievement score accounted for by the inequity factor) for each country. It is used to identify the pattern of the inequity factor's strength across countries.
2. Sub-figure (b) represents the country's math average by inequity factor level for each country. It is used to identify the pattern of math mean differences associated with the levels of the inequity factor, across countries.

The theoretical framework of the activity system at the classroom/school level, whose center (subject) is the student, will be used to interpret the significant inequity factors as interactions between the nodes of the system (Chapter 3). For easy reference we reproduce here the figure representing mathematics education as an activity system at the classroom/school level, with factors and their attributes identified. The rest of this chapter will be

M. Jurdak, *Toward Equity in Quality in Mathematics Education*, DOI 10.1007/978-1-4419-0558-1_8,

divided into two sections, one on indices and the other on practices. In each section, a subsection will be allotted to each index or practice.

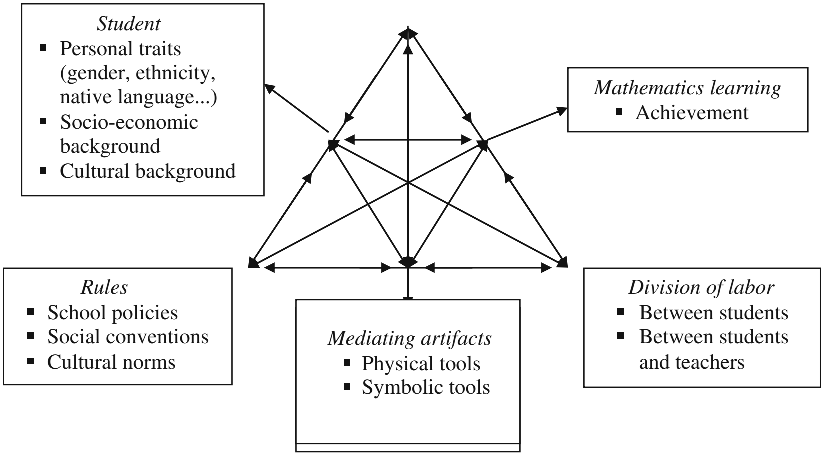


Fig. 8.1. Factors and their attributes in the activity system of mathematics education at the school level

8.1 Student Indices

For each of the 18 countries, the seven student indices were entered in a stepwise multiple regression model using student's math score as a dependent variable (see Chapter 7). The two indices, namely Index of Time Student Spends Doing Mathematics Homework and Index of Student Valuing Math, did not meet the inclusion criterion (significant in at least six countries) and hence were not presented in this chapter.

It is to be noted that all five student indices that were inequity factors are not math specific, except for student self-confidence in learning mathematics. This indicates that student attributes that impact equity in math achievement are, in general, not directly related to math, but rather to the socioeconomic-cultural background of student.

8.1.1 Index of Student Educational Aspiration Relative to Parents' Education

This index measures the level of student educational aspiration relative to parents' education. Figure 8.2 (a) shows that this index was an inequity factor in all countries in the sample, except in Egypt and the United States of America.

The percentage of between-student variance of mathematics achievement accounted for by this index ranged between 28 (Hungary) and 1.3% (Australia). An examination of the bars reveals that there is no apparent pattern in the relationship between the strength of this index and the developmental factors of the countries. For example, the group of the three countries in which this index had the highest strength (Hungary, Romania, Botswana) and the group in which the index had the least strength (Australia, Saudi Arabia, Lebanon) both include countries belonging to different regions and having different developmental indicators. What is remarkable, however, is that this index was an inequity factor in mathematics achievement in all but two countries and that its impact cuts across cultural, social, economic, and regional boundaries.

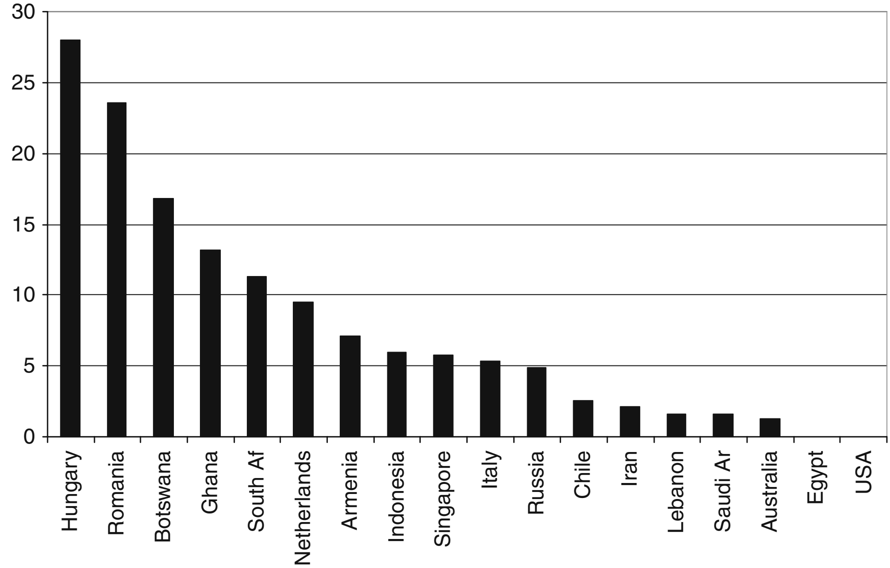
Figure 8.2 (b) shows that the higher the student educational aspiration relative to parents' education, the higher the mathematics achievement in each of the 16 countries in which this index was an inequity factor. The mean difference in mathematics achievement was most pronounced between the highest and lowest levels of educational aspiration (in favor of the former). This difference reached about 140 points (equivalent to 1.4 standard deviations of TIMSS standardized score) in countries such as in Hungary, South Africa, and Chile. It seems that the student's educational aspiration relative to parents' education is a strong inequity factor that makes a difference in math achievement.

How does student's aspiration relative to parents' educational level relate to the activity system at the classroom/school level? Referring to Figure 8.1, this index seems to belong to student personal traits, since it is a personal belief. However, a student's educational aspiration is socially constituted as a result of the interaction of the student with the home environment, on one hand, and with the classroom community, on the other. These results confirm the research trends in Chapter 3, regarding the effect of interactions of student socioeconomic-cultural home habitus and of classroom community on equity in math education.

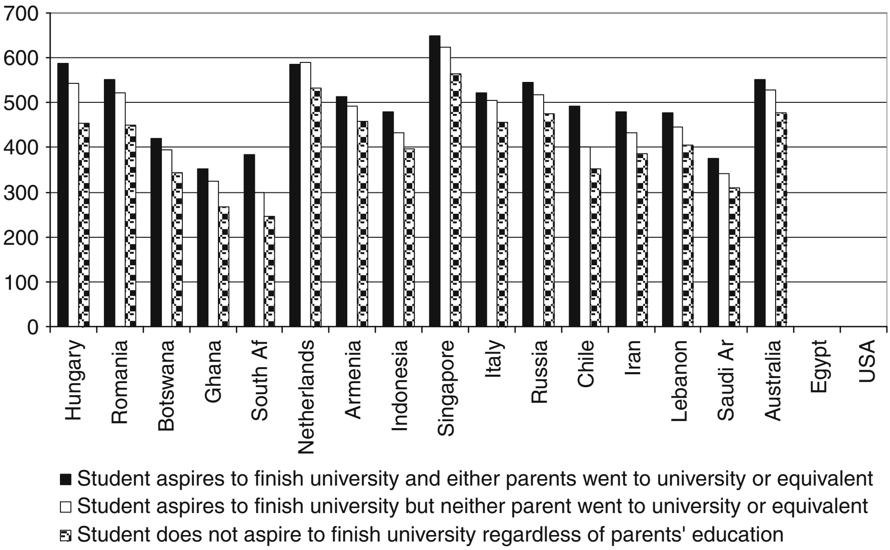
Is student's educational aspiration amenable to change by changing classroom practices or school policies? There is little that can be done regarding the home environment in this regard. However, classroom practices may contribute to enhancing students' educational aspirations. This is because students' valuation of their education, and hence their educational aspirations, are partially formed as a result of their interaction with teacher and peers. Making the learning of math more meaningful and relevant to students may enhance students' educational aspirations.

8.1.2 Index of Student Self-confidence in Learning Mathematics

The Index of 'Self Confidence in Learning Mathematics' measures student's perception of how well he/she usually does in mathematics, whether mathematics is easier for the student than for many of classmates, whether mathematics is one of her/his strengths, and whether he/she learns things quickly in



(a) Percentage of between-student variance in student math score accounted for by the index of student educational aspiration relative to parents' education, by country



(b) National math average score by level of the index of student educational aspiration relative to parents' education, by country.

Fig. 8.2. The impact of student educational aspiration relative to parents' education on math achievement

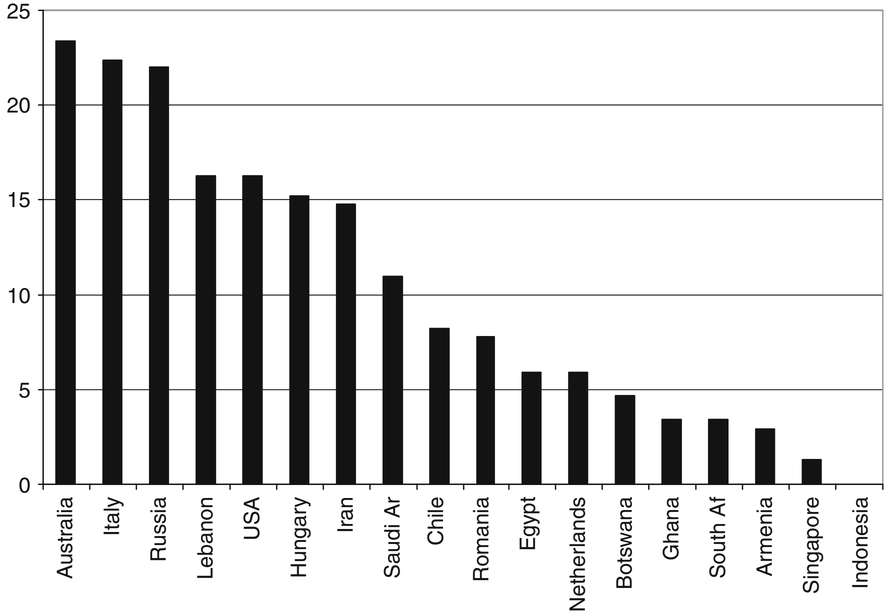
mathematics. The higher the index the higher the self-confidence in learning mathematics.

Figure 8.3 (a) shows that this index was an inequity factor in all countries in the sample except Indonesia. The percentage of variance in mathematics achievement accounted for by this index ranged between 23.4 percentage (Australia) and 1.3% (Singapore). An examination of the bars in Figure 8.3 (a), reveals that there is no apparent pattern in the relationship between the strength of this index and the developmental factors of the countries. For example, the three countries in which this index had the highest impact (Australia, Italy, Russian Federation) are countries that are developed countries; whereas, those in which the index had the least impact (Singapore, Armenia, South Africa) had the highest TIMSS scoring country (Singapore) and the lowest scoring country (South Africa) and those two countries belong to different regions and have different developmental indicators. What is remarkable, however, is that this index was an inequity factor in all but one country, and that its impact cut across cultural, social, economic, and regional boundaries.

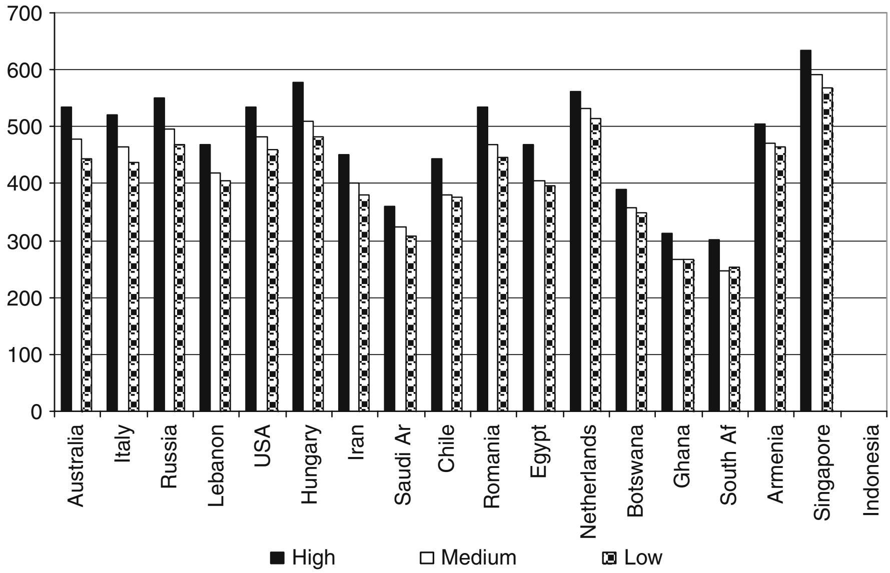
In each of the 17 countries in which this variable had a significant impact on mathematics achievement, Figure 8.3 (b) shows that the higher the student self confidence in learning mathematics, the higher the mathematics achievement. The mean difference in mathematics achievement was most pronounced between the highest and lowest levels of student self-confidence in learning mathematics (in favor of the former). This difference reached about 90 points (equivalent to 0.9 standard deviation of TIMSS standardized score) in Australia, for example. It seems that student self confidence in learning mathematics is a strong inequity factor that makes a difference in math achievement.

How does student self confidence in learning mathematics relate to the activity system at the classroom/school level? Referring to Figure 8.1, on the surface, this index seems to belong to student personal traits, since it is a personal belief. However, student self confidence in learning mathematics is primarily formed as a result of student's interactions with the math teacher and with classroom peers during math instruction. To a lesser degree, student self-confidence in learning mathematics is influenced by the home environment, especially parents' perceptions of value of mathematics and of their child's capacity for learning mathematics. It is highly likely that student self confidence in learning mathematics is primarily influenced by the interaction of the students with math mediating artifacts (math teacher) and to a lesser degree by social and cultural factors in the classroom and at home.

Is student self confidence in learning mathematics amenable to change by changing classroom practices or school policies? This index is math-specific, and hence the math teacher's practices are critical in enhancing student's math self-concept, and hence self-confidence in learning math. Later in this chapter, we provide evidence that practices such as giving opportunities to students to explain their answers and to solve problems on their own impact math



(a) Percentage of between-student variance in student math score accounted for by the index of student self-confidence in learning math, by country



(b) National math average by level of the index of students' self-confidence in learning math, by country

Fig. 8.3. The impact of students' self-confidence in learning math on math achievement

achievement. Consequently, building students' autonomy and responsibility for learning math may enhance their confidence in learning the subject.

8.1.3 Index of Parents Highest Education Level

This index measures the highest degree by either parent. The higher the index, the higher the level of parents education. Figure 8.4 (a) shows that this index was an inequity factor in all except four countries in the sample (Armenia, Indonesia, Botswana, Russian Federation). The percentage of variance of mathematics achievement accounted for by this index ranged between 37.1 (in Chile) and 1.2% (Italy).

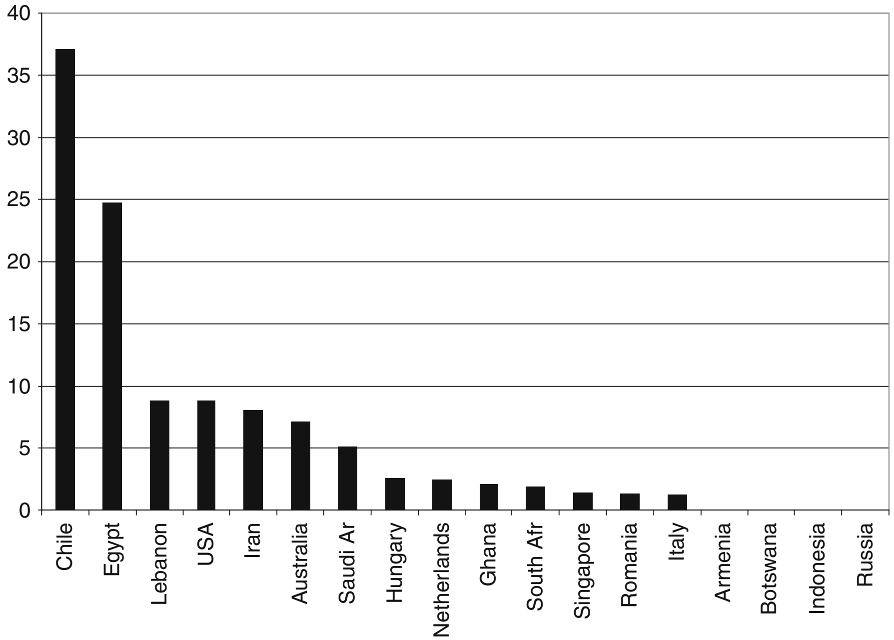
An examination of the bars in Figure 8.4 (a) reveals that the group of the three countries in which this index had the highest impact (Chile, Egypt, Lebanon) are developing countries; whereas, those in which the index had the least impact (Singapore, Romania, Italy) are developed countries. However, there is no clear pattern for the countries in which parents' education had an average impact on mathematics achievement. The level of parents' education was an inequity factor in the great majority of the countries (14 out of 18), and thus its impact cut across cultural, social, economic, and regional boundaries. However, the impact of parents' education level on math achievement may be higher in developing countries than in developed countries.

Figure 8.4 (b) shows that the higher the index of parents' education level, the higher the mathematics achievement in each of the 14 countries in which this index was an inequity factor. The mean difference in mathematics achievement was most pronounced between the parents having a university degree or higher and those having no more than primary education(in favor of the former). This difference reached about 151 points (equivalent to 1.5 standard deviation of TIMSS standardized score) in Chile, for example. This shows that parents' level of education is a strong inequity factor that makes a difference in math achievement.

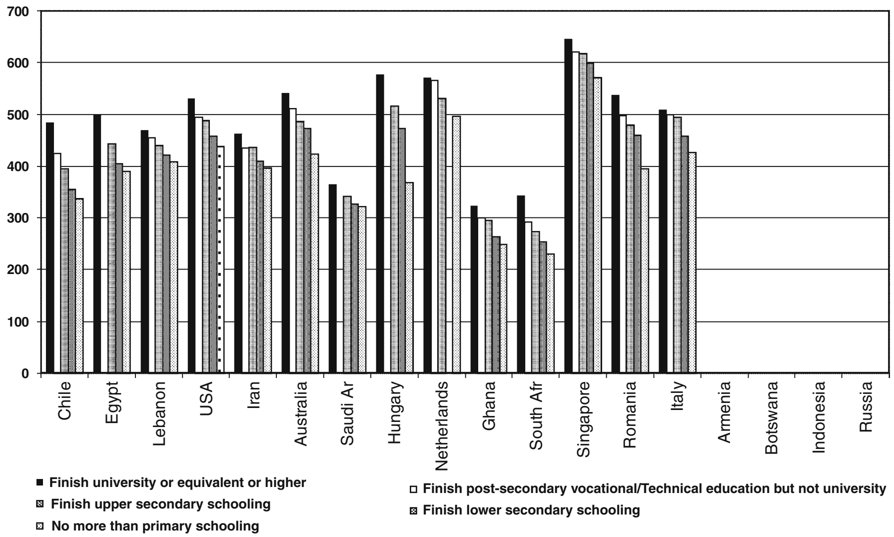
How does parents' educational level relate to the activity system at the classroom/school level? Referring to Figure 8.1, this index seems to belong exclusively to student socioeconomic background. Parents' educational level is outside the influence of the school and hence it is not amenable to change by changing school policies or classroom practices. However, the negative effects of parents' educational level on classroom math learning may be offset by adapting classroom practices and school policies to take into account the needs of students coming from low socioeconomic backgrounds.

8.1.4 Index of Computer Use

This index measures the extent to which students use computers and the context in which they use them. The five levels of the index are: Student uses computer both at home and at school, at home but not at school, at school



(a) Percentage of between-student variance in student math score accounted for by parents' highest education level, by country



(b) National math average by category of parents' highest education level, by country

Fig. 8.4. The impact of parents' highest education level on math achievement

but not at home, only at places other than home and school, does not use the computer at all.

Figure 8.5 (a) shows that this index was an inequity factor in 10 out of the 18 countries in the sample. The range of the percentage of variance of mathematics achievement accounted for by this index was small, the highest being 3.8% in Singapore and the lowest being 1.1% in Iran and Netherlands. Student use of the computer seems to have little impact on math achievement, relative to previous student indices. It is to be noted that the strength of use of the computer as an inequity factor was low, probably because of the small variance in computer use in the countries concerned.

An examination of the bars in Figure 8.5 (a) reveals that there is no apparent pattern in the relationship between the strength of this index and the developmental factors of the countries. For example, the group of the three countries in which this index had the highest strength (Singapore, Chile, Indonesia) and the group in which the index had the least strength (Netherlands, Iran, Ghana) both include countries belonging to different regions and having different developmental indicators.

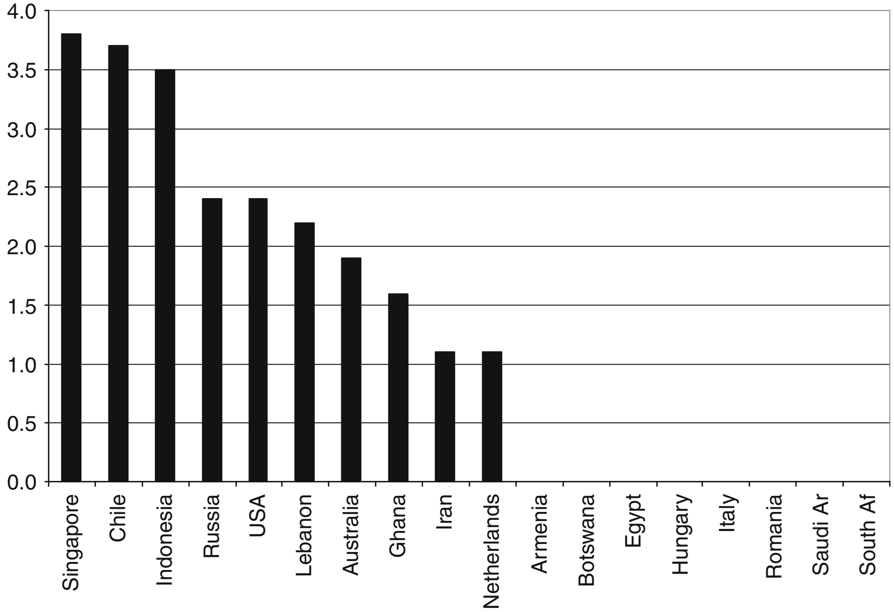
Figure 8.5 (b) shows that computer use at both school and home was associated with the highest mean mathematics score for the nine of the ten countries in which this index was an inequity factor. Computer use at home but not school had the next highest mean math score in seven of the nine countries. In other words, computer use is most effective in enhancing math achievement when it takes place at both school and home.

Figure 8.1 indicates that computer use belongs to the mediating artifacts. The results indicate, however, that computer use is most effective in enhancing math achievement if it used at both home and school. The availability and computer use at home is related to the student socioeconomic background. Hence, the impact of computer use on math achievement is mediated by the student socioeconomic background. This is in line with the results of research we reviewed in Chapter 3.

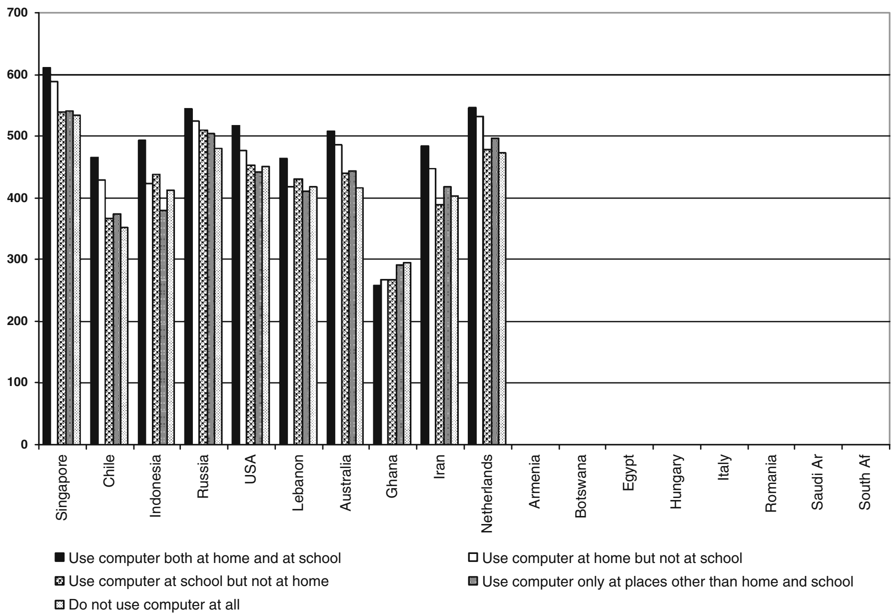
8.1.5 Index of Student Perception of Being Safe in School

This index measures the extent to which the student has a feeling of being safe in school (not subject to stealing, bullying, intimidation, ridicule, or neglect by other students). Figure 8.6 (a) shows that this index was an inequity factor in only six countries out of the 18 countries in the sample. The percentage of variance of mathematics achievement accounted for by this index ranged between 7% (Lebanon) and 1.1% (Ghana). All the six countries, are known to have suffered from political and social unrest.

Figure 8.6 (b) shows that the higher the student's perception of being safe in school, the higher the mathematics achievement in each of the six countries in which this index was an inequity factor. The mean difference in mathematics achievement was most pronounced between students with high and low perception of safety (in favor of the former). This difference reached

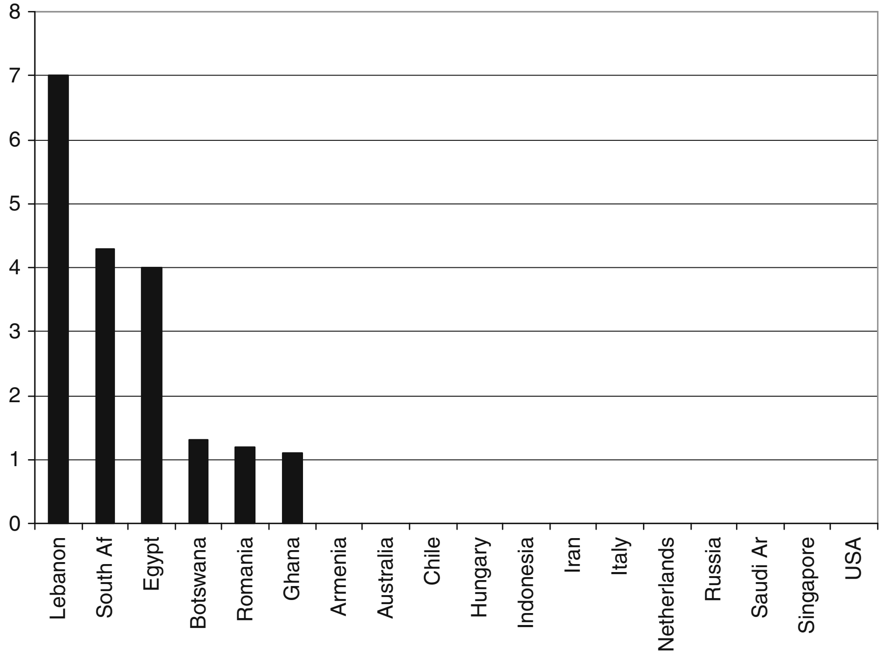


(a) Percentage of variance in student math score accounted for by the index of computer use, by country

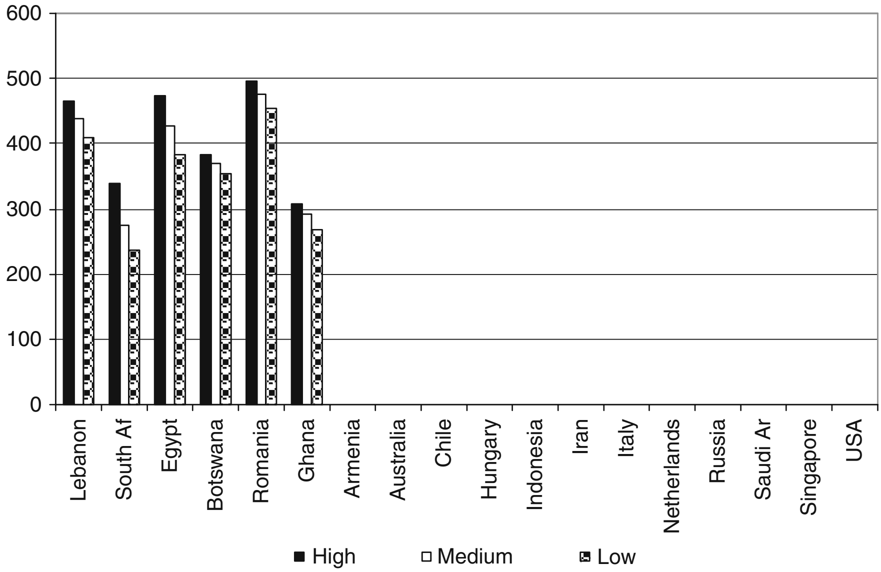


(b) National math average by level of the index of computer use, by country

Fig. 8.5. The impact of the of the student computer use on mathematics achievement



(a) Percentage of between-student variance in student math score accounted for by the index of student perception of being safe in school, by country



(b) National math average by level of the index of students' perception of being safe in the schools, by country

Fig. 8.6. The impact of student perception of being safe in school on math achievement

about 55 points (equivalent to 0.55 standard deviation of TIMSS standardized score) in Lebanon.

Obviously, student perception of being safe in school is related to classroom and school environments which belong to the ‘rules’ and ‘classroom community’ in the activity system at the classroom/school level (Figure 8.1). Explicit school policies and implicit norms in the school impact students’ perceptions of being safe from bullying, intimidation, ridicule, or neglect by other students in the classroom and in the school. It is possible to enhance students’ perception of being safe in school by examining the relevant school policies and classroom practices.

8.1.6 Summary of Student Indices as Inequity Factors

Student indices are composite measures defined by TIMSS to reflect students’ perception regarding their classroom and school experiences. Out of the seven student indices defined by TIMSS 2003, three were math-specific. Two of those, namely, Index of Student Valuing Math, and Index of Time Student Spends Doing Mathematics Homework, did not meet the criterion for inclusion (significant in at least six countries) as inequity factors. The third index, namely, Index of Self-Confidence in Learning Mathematics, had the strongest impact among the five indices that qualified as inequity factors.

Table 8.1 presents a summary of the student indices which were found to be inequity factors, the strength of each (percentage of variance in math achievement accounted for by it), and the possible interactions in the classroom/school activity system, which account for the inequity attributed to each of them. Table 8.1 shows that the interactions of two or more of the following nodes (or their attributes) may account for the inequity in math achievement:

Table 8.1. Summary of student indices as inequity factors in the activity system

Inequity factor	Average strength	Interactions in the activity system that account for the inequity
▪ Index of Self-Confidence in Learning Mathematics	10.9	• Student cultural background • Math mediating artifacts
▪ Index of Student Educational Aspirations Relative to Parents Educational Level	8.8	• Classroom community • Student socioeconomic background
▪ Index of Parents Highest Education Level	8.1	• Student • Classroom community
▪ Index of Student Perception of Being Safe in School	3.2	• Rules • Classroom community
▪ Use of computer	2.4	• Math mediating artifacts • Student socioeconomic background

- Student: socioeconomic background and cultural background
- Classroom community: classroom practices
- Math mediating artifacts: teaching methodology and computers
- Rules: School policies and home cultural norms

8.2 Student Practices

Student practices are single-items in the TIMSS 2003 Student Background Questionnaire each of which elicits a response regarding the students' perception of how often a math classroom teaching/learning practice occurs. This questionnaire was examined to identify items that measure students' perception of math classroom practices. As a result we identified nine such practices (see Chapter 7 for definitions). For each of the 18 countries, the nine practices were entered in a stepwise multiple regression model using the student math score as a dependent variable. A practice was included in this chapter if it satisfied the criterion for inclusion, namely if it was a significant inequity factor in at least six countries. The four practices of speaking language of test at home, listening to the teacher give a lecture-style presentation, deciding on one's own procedures for solving complex problems, and relating what is learnt in mathematics to daily life did not meet this criterion and hence were not included in this chapter.

Although the teaching/learning practices belong to the classroom community in the activity system of math education at the classroom/school level, their formation, and students' perception of them, are the result of complex interactions of the nodes and their attributes in the activity system. For example, the practice of asking students to solve problems on their own is the result, among other things, of how authority is perceived and practiced in the school community, as well as, of what the school philosophy and culture are.

The deep-rooted causes for math classroom practices are difficult to identify, let alone to change. However, the practices themselves are under the control of the school and math teachers, and in principle, lend themselves to change through teacher professional development and change of school policies. Such changes in teaching/learning practices are not necessarily sustainable, if not accompanied by transforming the activity system as a whole.

8.2.1 How Often Students Explain Their Answers in Mathematics Lessons

Figure 8.7 (a) displays the percentage of variance in mathematics achievement accounted for by students' perception of 'how often they explain their answers in mathematics lessons'. Figure 8.7 (a) shows that this practice is an inequity factor in 11 out of the 18 countries in the sample. The percentage of variance of mathematics achievement accounted for by this practice ranged between 6.2 (in Lebanon) and 1.1% (Armenia).

There seems to be no apparent relationship between the strength of this inequity factor and the developmental status of the country in which this practice was an inequity factor. One would observe, however, that eight of the 11 countries in which this practice was an inequity factor were developing countries and scored below the international math average in TIMSS 2003.

Figure 8.7 (b) shows that the more students explain their answers in mathematics classroom, the higher the mathematics achievement. The difference in the mean mathematics score is the highest between students explaining their answers ‘for every lesson’ and ‘never’. This difference reached 82 points (equivalent to 0.82 standard deviation of TIMSS standardized score, such as in Ghana.

The practice of asking students to explain their answers in math lessons is closely related to the perceived role of the student in math classrooms. In some ways this practice is affected by the perception of responsibility and power in the math classroom, namely the division of labor in the activity system (see Figure 8.1). This division of labor is closely related to the value system of the school community.

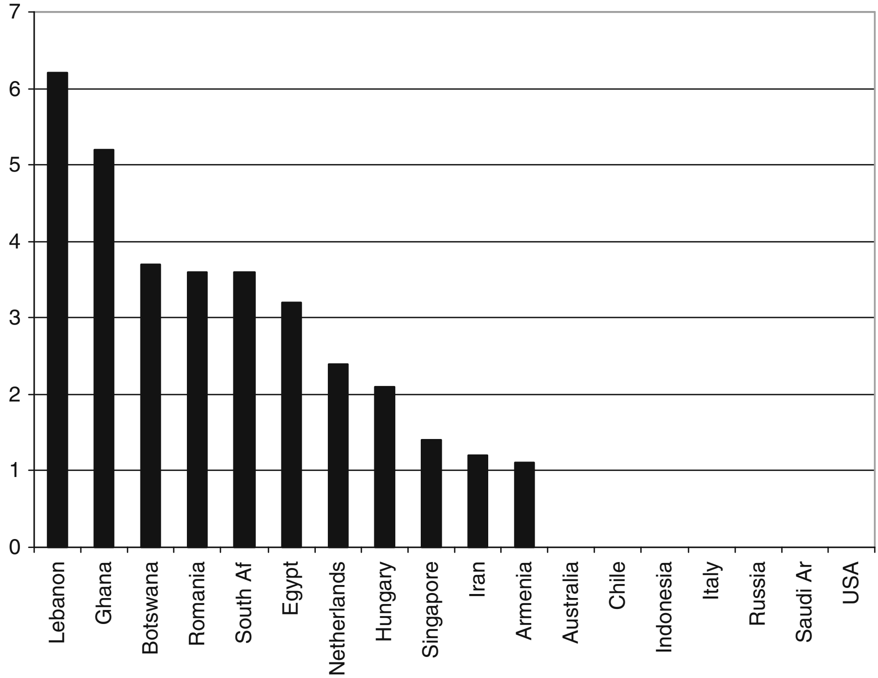
8.2.2 How Often Students Work Problems on Their Own in Mathematics Lessons

Figure 8.8 (a) displays the percentage of variance in mathematics achievement accounted for by students’ perception of ‘how often they work problems on their own in mathematics lessons’. Figure 8.8 (a) shows that this practice was an inequity factor in 11 out of the 18 countries in the sample. The percentage of variance of mathematics achievement accounted for by this variable ranged between 8.6 (Singapore) and 1% (South Africa).

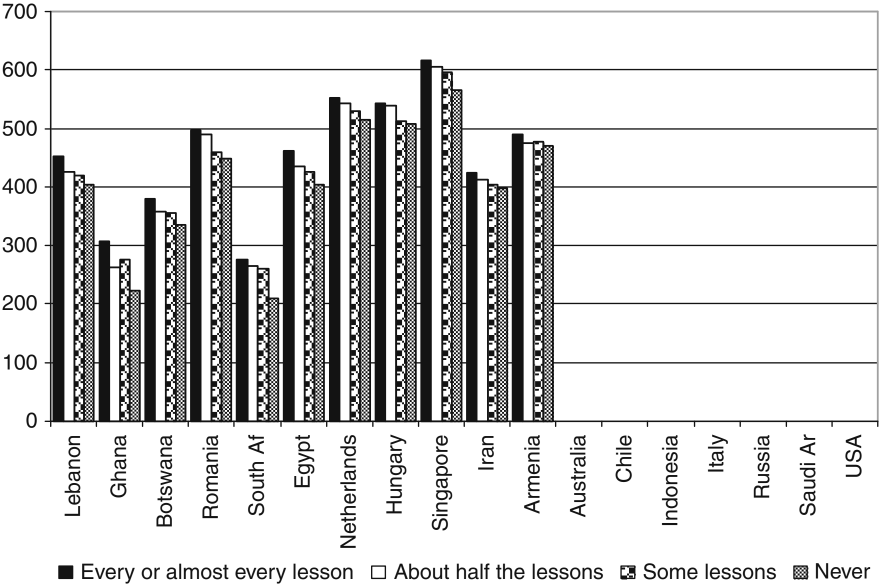
Figure 8.8 (b) shows that the more students work problems on their own in class, the higher the mathematics achievement. The difference in the mean mathematics score was the highest between students working problems on their own ‘for every lesson’ and those ‘never’ doing so. For example, in Singapore this difference reached 105 points (equivalent to 1.05 standard deviation of TIMSS standardized score).

It is worth noting that Singapore, the highest math-achieving country in TIMSS 2003, was the country in which the practice of having students work problems on their own had the highest impact on mathematics achievement. It is also worth noting that the three countries (Singapore, Italy, Australia) in which this practice had the highest impact on mathematics achievement were developed countries, whereas the three countries (South Africa, Egypt, Saudi Arabia) in which this practice had the least impact were developing countries.

The practice of having students work problems on their own is one aspect of the division of labor in the math classroom community. It also reflects the dominant cultural values regarding the role of responsibility and power in mathematical discourse.

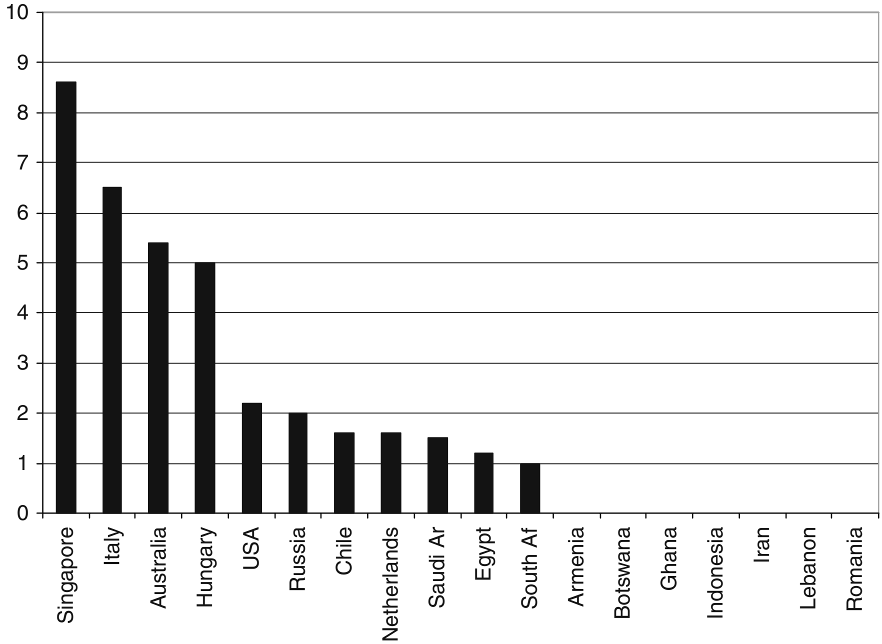


(a) Percentage of between-student variance in student math score accounted for by how often students explain their answers in mathematics lessons, by country

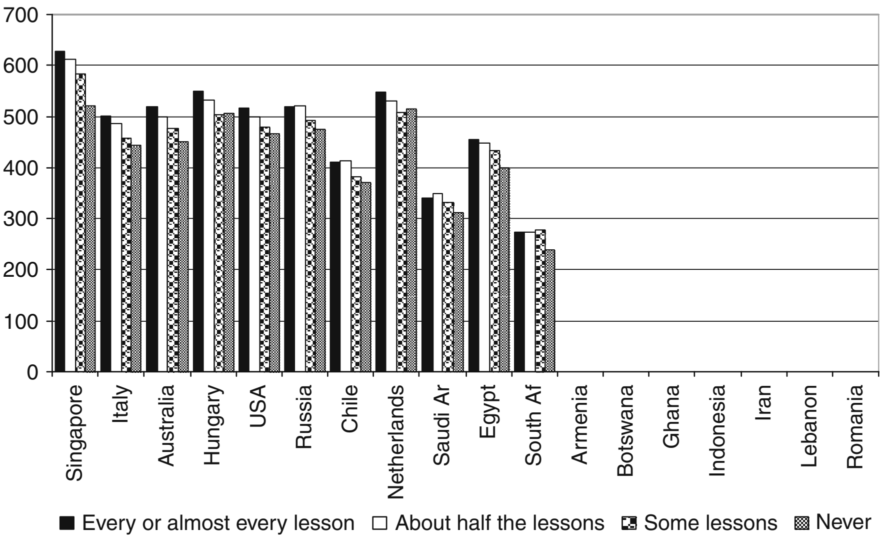


(b) National math average by level of how often students explain their answers in mathematics lessons, by country

Fig. 8.7. The impact of how often students explain their answers in mathematics lessons on math achievement



(a) Percentage of between-student variance in student math score accounted for by how often students work problems on their own in mathematics lessons, by country.



(b) National math average by level of how often students work problems on their own in mathematics lessons, by by country

Fig. 8.8. The impact of how often students work problems on their own in mathematics lessons on math achievement

8.2.3 How Often Students Have a Quiz or Test in Mathematics Lessons

Figure 8.9 (a) displays the percentage of variance in mathematics achievement accounted for by students' perception of how often they have a quiz or test in mathematics lessons. The figure shows that this practice was an inequity factor in seven out of the 18 countries in the sample and that the percentage variance of mathematics achievement accounted for by this variable ranged between 4.1 (in Netherlands) and 1.1% (Saudi Arabia).

Figure 8.9 (b) shows that the highest mean mathematics achievement score was associated with the response of having a quiz or test in 'some lessons', and the lowest mean with excessive testing, namely, 'having a test or quiz in every or almost every lesson' or with no testing 'never have quiz or test'. This difference reached 91 points (equivalent to 0.91 standard deviation of TIMSS standardized score) in the United States. It seems that the moderate use of testing in mathematics classrooms is associated with higher mathematics achievement as compared to excessive testing.

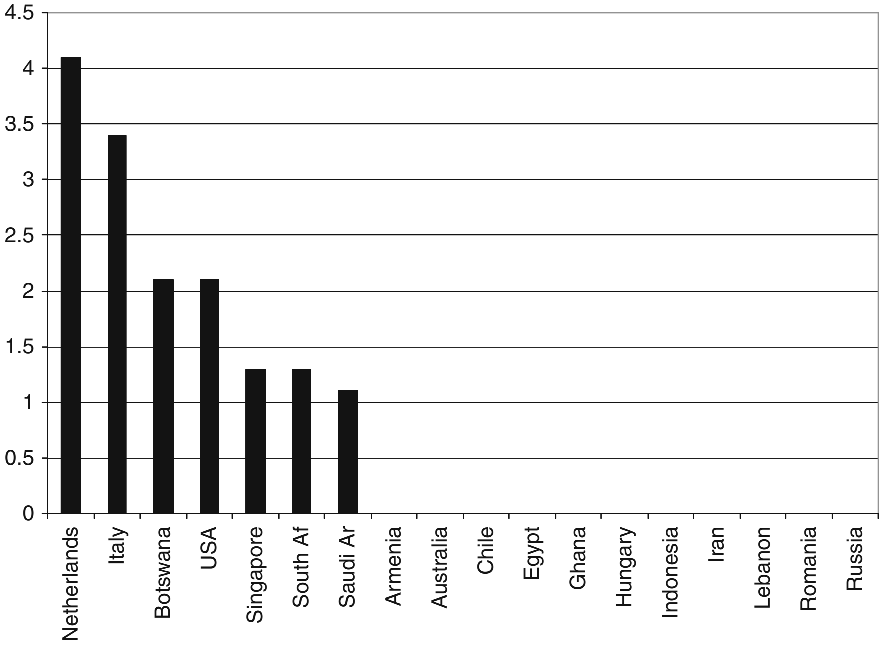
Testing practices in math classroom are affected by school policies and the philosophy of the educational system. Both factors belong to the 'rules' in the activity system.

8.2.4 How Often Students Use Calculators in Mathematics Lessons

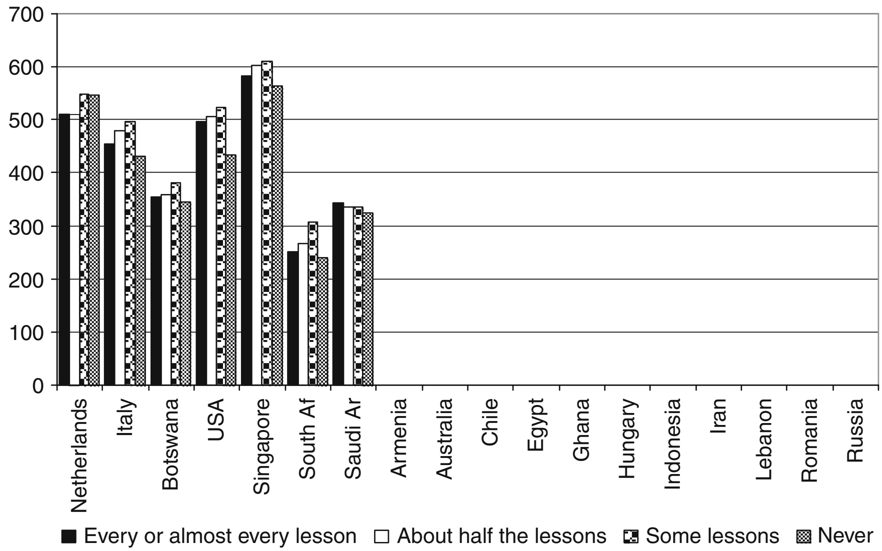
Figure 8.10 (a) displays the percentage of variance in mathematics achievement accounted for by students' perception of how often they use calculators in math lessons. This practice was an inequity factor in eight out of the 18 countries in the sample. The percentage of variance in mathematics achievement accounted for by this practice ranged between 9.5 (Saudi Arabia) and 1.3% (Botswana).

Figure 8.10 (b) shows that there are two patterns. For Singapore, the United States, and Hungary (all three countries scored above international average in TIMSS 2003), the highest mean mathematics achievement score was associated with the response of using calculators in 'every lesson' and the lowest mean mathematics achievement score was associated with 'never' using calculators. For the remaining five countries (all scored below international average), the highest mean mathematics achievement score was associated with the response of 'never' using calculators and the lowest mean mathematics achievement score was associated with 'every lesson'.

The impact of using calculators on mathematics achievement seems to be moderate and country-specific. In high achieving countries, the more frequently calculators are used, the higher the mathematics achievement, whereas in low achieving countries, the less frequently the calculators are used, the higher the mathematics achievement. Consequently, the inequities that may arise from using calculators in mathematics classrooms should be

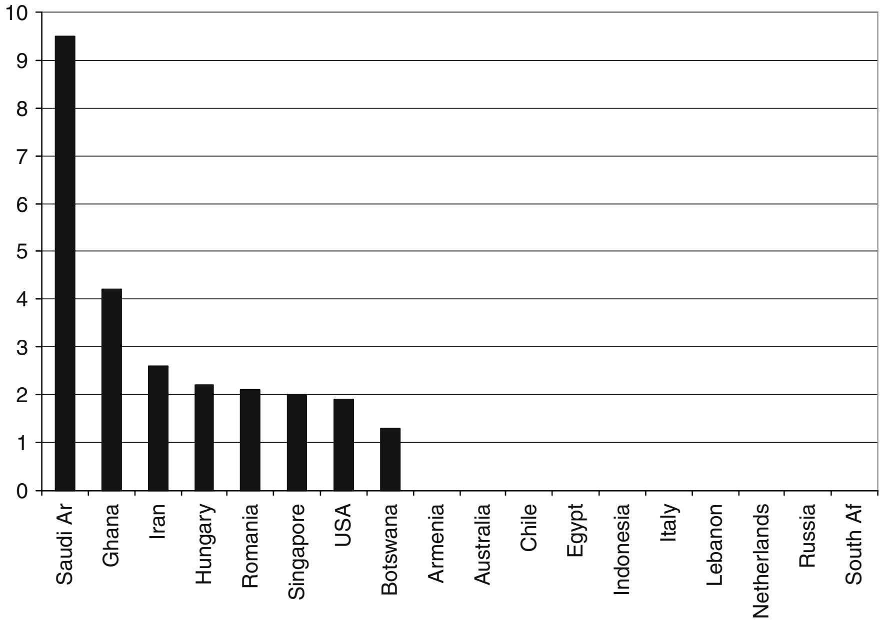


(a) Percentage of between-student variance in student math score accounted for by how often students have a quiz or test in mathematics lessons, by country

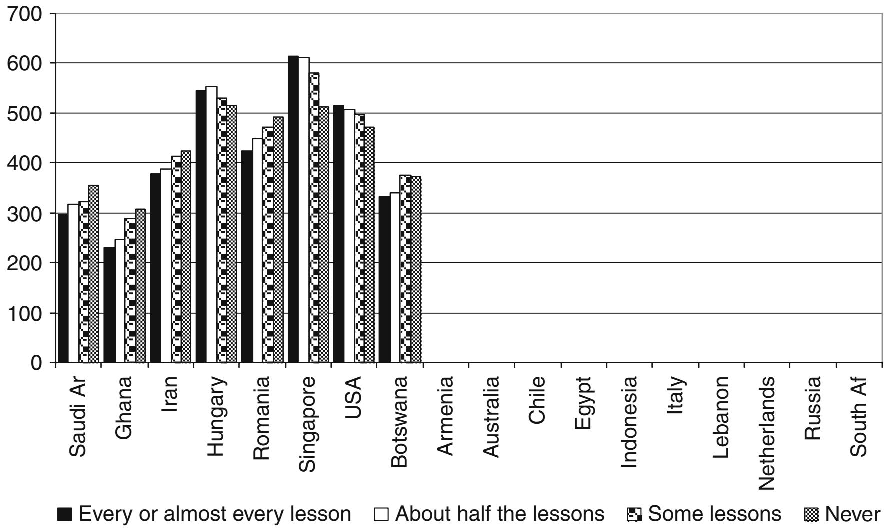


(b) National math average by level of how often students have a quiz or test in mathematics lessons, by country

Fig. 8.9. The impact of how often students have a quiz or test in mathematics lessons on math achievement



(a) Percentage of between-student variance in student math score accounted for by how often students use calculators in mathematics lessons, by country



(b) National math average by level of how often students use calculators in mathematics lessons, by country.

Fig. 8.10. The impact of how often students use calculators in mathematics lessons on math achievement

addressed according to the country in question and according to the objective and modality of using calculators in that country.

The use of calculators in the math classroom is related to a number of factors in the activity system. One factor is the availability of calculators which depends on the socioeconomic level of the school. A second factor is school policies regarding the use of calculators in school instruction and assessment. A third factor is a social-cultural factor, namely, the degree to which the use of calculators is pervasive in the social and economic life of the school community.

8.2.5 How Often Students Work Together in Small groups in Mathematics Lessons

Figure 8.11 (a) displays the percentage of variance in mathematics achievement accounted for by students' perceptions of how often they work together in small groups in mathematics lessons. The figure shows that this practice was an inequity factor in eight out of the 18 countries in the sample. The percentage of variance of mathematics achievement accounted for by this variable ranged between 8.3 (South Africa) and 1.3% (Singapore).

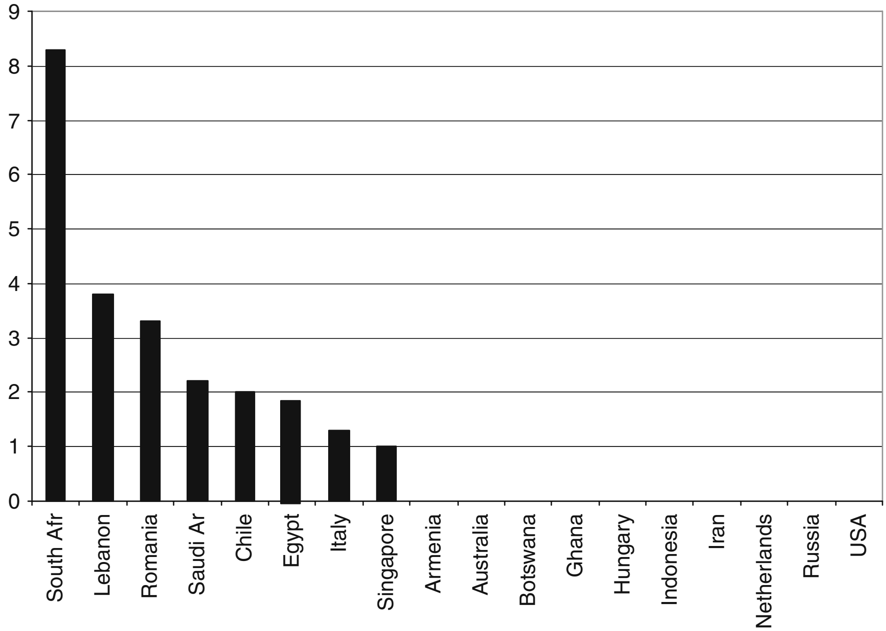
Figure 8.11 (b) shows that the highest mean mathematics achievement score was associated with students' responses of working together in small groups in 'some lessons' or 'never'. The lowest mean mathematics achievement score was associated with students' responses of working together in small groups in 'all lessons'. The impact of students' working together in small groups on mathematics achievement seems to be moderate. It seems that the less frequently students work together in small groups, the higher the mathematics achievement.

The practice of having students work together in small groups is closely related to school policies regarding classroom organization. On the other hand, school policies are influenced by the dominant cultural values regarding competition, cooperation, and team work.

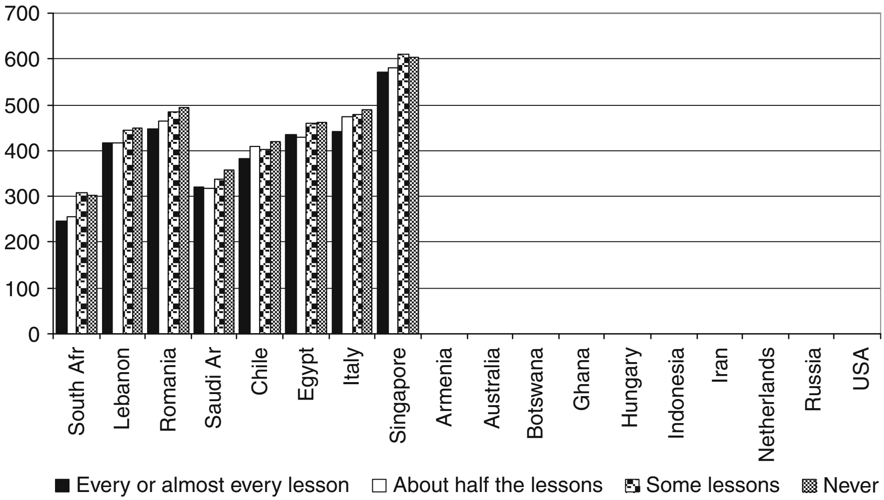
8.2.6 Summary of Student Practices as Inequity Factors

What we called student practices refer to students' perceptions of math classroom teaching and learning practices. Out of the nine student practices, five qualified as inequity factors. The impact of those five student practices on mathematics achievement, and hence their strength as inequity factors, was much less than for student indices. This is probably because the index, by definition, is a multidimensional composite score, while the practice is a single item score.

The five practices differ in the direction of their impact on math achievement. For the two practices, namely, having students explain their own answers in math lessons and having students solve problems on their own, the more students explain their answers and solve problems on their own in math



(a) Percentage of between-student variance in student math score accounted for by how often students work together in small groups in mathematics lessons, by country.



(b) National math average by level of how often students work together in small groups in mathematics lessons, by country

Fig. 8.11. The impact of how often students work together in small groups in mathematics lessons on math achievement

lessons, the higher the mathematics achievement. The frequency of testing in mathematics classrooms had an impact on mathematics achievement and the trend was that moderate use of testing in mathematics classrooms was associated with higher mathematics achievement, while excessive testing (almost every lesson)was associated with low math achievement.

The two practices, namely, the use of calculators in mathematics classroom, and working together in small groups seem to have a moderate impact on math achievement. However, the use of calculators is country-specific. In high achieving countries the more frequently calculators are used the higher the mathematics achievement, while in low achieving countries the less frequently the calculators are used the higher the mathematics achievement. In general, the less frequently students work together in small groups, the higher the mathematics achievement. It seems that the excessive use of this practice does not necessarily promote mathematics achievement.

Table 8.2 presents a summary of the student practices which were found to be inequity factors and the possible interactions in the classroom/school activity system, which may account for the inequity attributed to each of them. Table 8.2 shows that the interactions of two or more of the following nodes (or their attributes) may account for inequity in math achievement:

- Division of labor: Division of responsibility and power in classroom
- Classroom community: Classroom practices and organization
- Math mediating artifacts: Teaching methodology and calculators
- Rules: School policies and cultural norms

Table 8.2. Summary of student practices as inequity factors in the activity system

Inequity factor	Interactions in the activity system that account for the inequity
▪ How often students explain their own answers in math lessons	• Division of labor • School community culture (rules)
▪ How often students solve problems on their own in math lessons	• Division of labor • School community culture (rules) • Math mediating artifacts
▪ How often students use calculators in math lessons	• School socioeconomic level • School policies and culture (rules) • Math mediating artifacts
▪ How often students work together in small groups	• Classroom organization • School policies and culture (rules)
▪ How often students have a test in math lessons	• School policies • Educational system