# UNDERSTANDING THE LOW MATHEMATICS ACHIEVEMENT OF CHILEAN STUDENTS: A CROSS-NATIONAL ANALYSIS USING TIMSS DATA[♦]

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**Abstract**

*The low performance of Chile in the TIMSS 1998/99 international study of mathematics and science achievement was a great disappointment for that country. To investigate the likely causes for low performance in mathematics, this study 1) compared Chile to three countries and one large school system that had similar economic conditions but superior mathematics performance, and 2) examined how important characteristics of the Chilean educational system could account for poor student achievement in mathematics. The study finds that, compared to South Korea, Malaysia, the Slovak Republic, and Miami-Dade County Public Schools: a) Chilean 8th graders had parents with fewer years of schooling and with fewer educational resources at home; b) the Chilean mathematics curriculum covered less content and fewer cognitive skills; and c) the meager official curriculum translated into a weaker curricular implementation. Hierarchical linear models found that, in Chile, school assets were unequally distributed across social classes, with schools in socially advantaged areas more likely to have their own mathematics curriculum and better prepared teachers who emphasized more advanced mathematics content. Schools with their own mathematics curriculum and whose teachers covered more advanced content had significantly higher student achievement in mathematics.*

Keywords: Mathematics education, comparative education, TIMSS, Chile.

Chile is probably the leader in Latin America for its commitment to improving the quality of education. Thanks to sustained economic growth, important reforms have taken place since the return of democracy in 1990 (OECD, 2004). Democracy brought with it a

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greater appreciation of the role education could play in both the life of Chileans and the development of the country.

Nevertheless, the 1998/99 version of the Trends in International Mathematics and Science Study[1] (TIMSS) provided an appalling picture of the low mathematics achievement of Chilean 8th graders. To investigate the likely causes for low performance in mathematics, this study 1) compared Chile to three countries and one large school system that had similar economic conditions but superior mathematics performance, and 2) examined how important characteristics of the Chilean educational system could account for poor student achievement in mathematics.

*The schooling system in Chile*

Chile has a centralized educational system, with the majority of policy-related decisions made by the Ministry of Education, which operates through a network of provincial and municipal offices (*Departamentos Provinciales de Educación* and *Dirección de Administración de Educación Municipal*). The system comprises public and private schools, with the former serving 54% of the students as of year 2000. The municipal offices control public schools; there is minimal regulation for private schools.

[1] In 1998/99, TIMSS stood for Third International Mathematics and Science Study. TIMSS data collection for Chile and the other southern hemisphere countries took place at the end of the school year of 1998, whereas data collection for the northern hemisphere took place at the end of the school year of 1998/99. Because data collection spanned the 1998-1999 period, this comparative assessment study is referred to as TIMSS 1998/99.

The state pays a fixed amount of money to both public and private schools (indirect vouchers) on the basis of student enrollment.[2]

Currently the system is highly segregated by social class: public schools serve the bottom half of the socio-economic distribution, the elite-paid system the top percentages, and the private-subsidized system the rest. Not surprisingly, public schools have consistently attained the poorest results in the national assessment system. The best performing schools have been, by far, the elite-paid, followed by the private-subsidized schools. There has been concern about the negative consequences of the subsidized system. Mella (2003) argued that it has increased the achievement gap between public and private schools, while exacerbating the social class differences among students from different schools.

Between 1990 and 1999, public spending on education increased 2.5 times (MINEDUC, 2000a), and grew from 2.7% of the gross national product (GNP) in 1991 to 3.6% in 1997 (UNESCO, 1999, p. II 500). Access to education was widely ensured during the 1990s, with the vast majority of the population finishing secondary school (80% in 1992) (González, 1999, p. 323). Important reform programs were launched in key areas.

Yet despite wide access to education and the reform efforts, at the end of the 1990s there was no evidence that students were learning more. The results of the national assessment system showed that a considerable gap existed between the goals set by the

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[2] As of 1998, the voucher was about US$40 per month per student, depending upon factors such as level (i.e., primary, secondary) and context (i.e., rural areas, poor community) (González, 1999).

new curricular frameworks and what the students knew and could do (MINEDUC 2003, 2001, 2000b).

*Chile's performance in TIMSS 1998/99*

TIMSS 1998/99 results came after a decade of reform efforts in Chile. Hence, Chileans were in shock to learn about the poor relative performance of 8th grade students in this assessment (Alliende, 2000). Chile ranked 35th among the 38 countries participating in this study. The Chilean average mathematics score was almost one standard deviation (100 score points) below the international average (Mullis et al., 2000). Ramírez (2004) estimated that Chilean students were three school years behind the countries performing near the international average. Moreover, Chile performed significantly below 27 states and districts in the United States, including those serving high proportions of low-income students (Mullis et al., 2001) (Figure 1).

INSERT FIGURE 1 ABOUT HERE

The Chilean performance was also below expectations given its economic level. Cross-country regressions show a positive relationship between mathematics achievement and the national wealth ($r = .57$, $p < .0005$). Nevertheless, countries with similar economic development presented substantial differences in their average achievement. For instance, South Korea ($M = 587$), Malaysia ($M = 519$), and the Slovak Republic ($M = 534$) – with Gross national product purchasing power parity per capita comparable to that of Chile – obtained substantially higher mathematics scores than Chile (Mullis et al., 2000). Chile's observed score of 392 points was almost one standard deviation below its predicted score of 488 (Figure 2).

INSERT FIGURE 2 ABOUT HERE

Variations in TIMSS 1998/99 students' performance within Chile also were substantial. The top-performing Chilean students were able to apply basic mathematical knowledge in straightforward situations, while students with the lowest scores were not even able to do basic computations with whole numbers (Mullis et al., 2000). There was a huge gap between what the Chilean students knew and were able to do and the goals set by the Chilean national curriculum.

While Chile shares similar economic indicators with South Korea, Malaysia, the Slovak Republic and Miami-Dade County, it differs from them in other important ways. For instance, as of 2003, only half of the adult population had finished secondary school in Chile (Ministerio de Planificación y Cooperación [MIDEPLAN], 2004). It is well known that parents' education is one of the most powerful predictors of students' academic achievement. Therefore, it is reasonable to hypothesize that the poor educational level of the students' parents was limiting the ability of Chilean students to learn in school.

Among jurisdictions with similar global economic indicators, important social differences may still exist as a consequence of the distribution of the wealth. For example, the distribution of wealth is more uneven in Chile than in the Slovak Republic. Consequently, there may be a greater proportion of poor students in the Chilean schools than in the Slovakian ones. Table 1 presents a selection of social and economic indicators for Chile and the comparison jurisdictions.

INSERT TABLE 1 ABOUT HERE

The school effectiveness literature refers to several factors that may be helpful to understand why some schools attain higher performance levels than others, including: a) the broader social and economic context in which the schools operate, b) the curriculum, c) teacher quality, and d) school resources (Reynolds & Teddlie, 2000). These factors may be also helpful in understanding the achievement gap both between Chile and South Korea, Malaysia, Slovak Republic, and Miami-Dade County Public Schools and among Chilean schools.

## Methodology

This study used TIMSS 1998/99 data from Chile, three countries and one school district from the United States. The comparison jurisdictions were selected on the following criteria:

- Their economic and social situation was similar to Chile's (Gross national product purchasing power parity per capita, human development index and access to education (Table 1)
- They tested the same grade as Chile (grade 8)
- They sampled students with an equivalent average age to Chile (14 years)
- They outperformed Chile on TIMSS 1998/99 [3]

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[3] It could have been interesting to include in this study a jurisdiction with a lower average performance than Chile. But of the three countries with average scores lower than Chile – Morocco, the Philippines, and South Africa – none met the criteria of sampling the same target grade and same students' average age than Chile. All the United States jurisdictions performed better than Chile in the TIMSS 1998/99 mathematics test.

The comparison jurisdictions were South Korea, Malaysia, the Slovak Republic, and Miami-Dade County Public Schools.

TIMSS 1998/99 collected achievement and background information from nationally representative samples of students, their mathematics teachers and schools (Foy & Joncas, 2000a, 2000b; Fowler, Rizzo & Rust, 2001). The number of students tested ranged from 6,114 in South Korea to 1,356 in Miami-Dade County Public Schools; in Chile, 5,907 students took the test. Students, teachers, and school principals were asked to fill self-reported questionnaires that gathered relevant information to interpret achievement results.

The first stage of this study compared Chile with the four jurisdictions with respect to: a) schools' community contexts, b) the official and the implemented curriculum, c) teacher quality, and d) school resources (Table 2 describes the variables). Univariate and multivariate analyses of variance were the statistical techniques used at this stage.

INSERT TABLE 2 ABOUT HERE

The second stage of the study focused on the Chilean data only. Mathematics achievement was modeled using several indicators of the background dimensions above mentioned as predictors. The achievement outcome was modeled at the school/class[4] level using hierarchical linear models.

## Results

In this section, results of both the comparative study and hierarchical linear model analyses of the Chilean data are presented. The comparative analyses are shown in figures where the variables of interest were standardized and centered on the Chilean mean, so that in Chile $M = 0$ and $SD = 1$. The y-axis indicates deviations (in standard deviation units) from the Chilean mean.

In the hierarchical linear model analyses, mathematics achievement was modeled at the school/class level. Cumulative models that added successive sets of explanatory variables were tested. Each new set of variables focused on different dimensions: a) the broader social and economic context in which the schools operate, b) the implemented mathematics curriculum, c) teacher quality, d) school resources, and e) school administration.

*The Broader Social and Economic Context in which the Schools Operate*

Figure 3 shows how much Chile differed from the comparison jurisdictions in mother and father education, number of books at home, and amount of educational resources at home (i.e., study desk, dictionary, computer and calculator).

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[4] As a consequence of the TIMSS 1998/99 sample design, each Chilean school was represented by one class, so achievement differences among the schools could not be distinguished from achievement differences among the classes from the same schools. For this reason, schools and classes are referred to as the school/class level or unit in this study.

INSERT FIGURE 3 ABOUT HERE

Results indicate that Chilean students differed from the students in other jurisdictions by having less educated parents, fewer books, and fewer educational resources at home. On all four measures, the Chilean mean was significantly lower than the mean of the four jurisdictions combined ($p < .005$, one-tailed test). For instance, while slightly more than one-third of the Chilean students reported that their mothers finished secondary school, this proportion reached 50% in Malaysia.

To test the effect of school community contexts in mathematics achievement, a socio-economic index was created based on parents' education, books and educational resources at home. As shown in Table 3, this index was strongly related to mathematics performance in Chile ($p < .01$). According to expectations, schools serving socially advantaged communities showed substantially higher mathematics scores than schools working in socially deprived areas.

INSERT TABLE 3 ABOUT HERE

Using Model 6, predicted mathematics scores were computed using the average socio-economic index of each comparison jurisdiction. The predicted score was interpreted as the average score Chile would have obtained if it had the same socio-economic level of each comparison jurisdictions. This predicted score was then contrasted with the observed mathematics score obtained by each jurisdiction. Interestingly, the observed and predicted scores were almost the same in Miami-Dade County Public Schools (423 versus 421). This means that, according to the model, if

Chilean students had the same socio-economic level than students in Miami, they would attain similar mathematics performance.

A very different picture arose when comparing the observed and predicted mathematics scores in South Korea, Malaysia and the Slovak Republic. For each country, there was a difference of more than a 110 score points (equivalent to 1.31 standard deviations in the Chilean achievement distribution) between their observed and predicted scores. This means that, according to the model, if Chilean students had the same average socio-economic level than the students in any of these three countries, they would still score 110 score point below them. This gap can be interpreted as a unique country effect.

*The Mathematics Curriculum*

At the time of the TIMSS 1998/99 data collection, a limited mathematics curriculum was the basis for instruction in Chile (Comisión Nacional para la Modernización de la Educación, 1995; Cox, 1999). The national curriculum (*Planes y Programas de la Educación General Básica,* MINEDUC, 1980) was more of a framework for the schools to develop their own curricula than a curriculum itself. It consisted of three pages of text that listed mathematics objectives for Chilean 8$^{th}$ graders, providing very little concrete guidance for mathematics teachers. The curriculum was deficient; it was not specific enough when compared to the curricula of the other jurisdictions, and covered the least content and cognitive skills (Table 4).[5]

INSERT TABLE 4 ABOUT HERE

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[5] A new mathematics curriculum and program of study for the 8$^{th}$ grade were introduced in 2002.

The idea behind this limited curriculum was that the schools would supplement it by adding their own curricular proposals (or programs of study). However, only a small group of schools developed their own curriculum (around 16%); most of these schools were from the elite-paid and private-subsidized systems.

Despite having more detailed and demanding official curricula than Chile, in three jurisdictions the proportion of students enrolled in schools having their own curriculum was substantially higher: South Korea (66%), Miami-Dade County Public Schools (59%), and Malaysia (47%). The Slovak Republic was the exception, with only 8% of the students enrolled in schools that had their own mathematics curriculum (see Figure 4 with standard deviation units form the Chilean mean). However, as noted previously, the Slovak Republic had a very detailed national curriculum used for all students (see Table 4).

INSERT FIGURE 4 ABOUT HERE

In Chile, schools having their own curriculum performed significantly better than the schools that did not. This difference held true after controlling statistically for the schools' socio-economic index and type of administration (public/private) ($p < .05$) (Table 3, Model 5).

Beyond the official curriculum, it is the curriculum delivered in schools that actually shapes students' opportunities to learn mathematics. An important finding of this study was that Chilean students had significantly fewer opportunities to learn advanced mathematics content (e.g., geometry, algebra), when compared to the students in the other jurisdictions ($p < .005$).

In Chile, 73% of the students were taught by teachers who emphasized basic mathematics content (i.e., mainly numbers). In the comparison jurisdictions, this proportion was substantially smaller: 6% in South Korea, 12% in the Slovak Republic, 19% in Miami-Dade County Public Schools, and 33% in Malaysia (see Figure 4). In Chile, content coverage was significantly related to mathematics performance (Table 3, Model 1). This relationship held true after controlling statistically for schools' socio-economic index and type of administration (public/private) (Table 3, Model 4).

### *Teacher Quality*

In Chile, teachers are perceived as not having the basic knowledge and skills to bring their students to high academic standards. The poor academic performance of Chilean students may be related to the low qualifications and preparation to teach of their teachers, relative to the teachers in other countries.

The students in Chile were taught by less qualified teachers than were the students in Miami-Dade County Public Schools, the Slovak Republic, and South Korea ($p < .005$, one-tailed test). While just 1% of the students in Chile had a teacher with a master or Ph.D. degree, this percentage was 15% in South Korea, 56% in Miami-Dade County Public Schools, and 97% in the Slovak Republic. Nevertheless, Chilean students were taught by more qualified teachers than Malaysian students ($p < .005$, one-tailed test). This difference was largely because 19% of the Malaysian students were taught by teachers with a diploma from a technical/vocational institution. In Chile, teachers were required to have a university degree to teach.

Chilean students were taught by teachers who reported feeling *somewhat prepared* to teach a variety of mathematics content – including algebraic representations, coordinate geometry, and data analysis. In all four comparison jurisdictions, students were taught by teachers who felt significantly better prepared to teach mathematics ($p < .005$, one-tailed test).

The hierarchical linear models showed that neither of the teacher quality variables made a significant contribution to explaining variation in achievement in Chile, when entered in combination with other variables (Table 3, Models 2-4). Teacher preparation, however, was a significant predictor of achievement when analyzed alone ($p = .044$, not shown in Table 3). It appears that better prepared teachers were more likely to work in schools that had their own mathematics curriculum and materials/activities; these teachers were also more likely to cover more mathematics content in classes. Teacher qualifications were unrelated to student achievement, largely due to the lack of variability in this measure: all teachers in Chile had basically the same qualification level – a bachelor university degree with a teacher-training certificate.

### *School Resources*

The capacity of the schools to provide quality instruction can be affected by their resources. Table 1 shows that yearly expenditures per student were the lowest in Chile compared with South Korea, Malaysia and the Slovak Republic.

On average, Chilean principals reported that school resources affect the school capacity to provide quality instruction *a little*. It is in South Korea where the principals perceived the most limitations due to scarce/inadequate resources. In interpreting these results, it is important to bear in mind that the TIMSS questionnaires used a subjective measure of school resources, based on the principals' perceptions instead of on the objective physical conditions of the schools. This is a limitation since the principals' perceptions are probably affected by their own expectations of what the school resources should be. It is possible that, in Chile, the positive evaluation of school resources was a response to the reform efforts that have taken place during the last decade. Many Chilean schools have recently benefited from the construction of new buildings and libraries, expansion of grounds, and addition of computers. Principals may still be astonished with the improved conditions of their schools, and tend to be optimistic and generous in their evaluations.

## Conclusions and Policy Implications

The results of this study suggest that countries with similar economic indicators (i.e., gross national product purchasing power parity per capita) may have important differences in family resources and educational attainment of students' parents. These differences may account for an important proportion of the achievement variance between Chile and the comparison jurisdictions. This poorer background of the Chilean families is probably related to the relatively recent expansion of Chile's educational system. Chile reached almost universal enrollment in primary education during the 1990s. In South Korea, the Slovak Republic, and the United States, this goal was accomplished during the 1950-60s. It seems that Chile may need to overcome the educational deficits of the previous generation.

In Chile, schools serving socially advantaged communities show substantially higher mathematics scores than schools working in socially deprived areas. This achievement gap is, in part, the outcome of the differential educational resources students have at home. A student would be in a better position to learn at school if he/she has literate parents who can help with the schoolwork, and if he/she has books and a computer at home.

However, the achievement gap among Chilean schools is also impacted by the unequal distribution of school assets between high- and low-income schools. The former get more funding than the latter charging fees to the parents. This study found that schools in more affluent communities are more likely to have more and better instructional resources (e.g., books) and also more likely to hire better prepared teachers. These teachers, in turn, are more likely to emphasize more advanced mathematics topics. Schools serving more affluent communities are also more likely to develop their own curricula (or programs of study), instructional materials, and activities. These are important resources since the Chilean curriculum provided little guidance on the subject of what to teach and how to teach it.

These findings are consistent with previous studies reporting the unequal distribution of school resources (and opportunities to learn) among schools, and the correlation between school resources and socio-economic level (Gau, 1997; Mella, 2003). To provide low- and middle-income students with access to quality education is a pending task in Chile.

At the time of the TIMSS 1998/99 data collection, the official curriculum in Chile was more of a framework for schools to develop their own curriculum, than a curriculum in itself. The curriculum was deficient; it was the least specific when compared to the curriculum of the other jurisdictions, covered the least content and cognitive skills, and considered appropriate the least content and problems in the TIMSS test.

It seems that having a school curriculum was necessary to operationalize the curricular mandates in Chile. Not surprisingly, the schools that have their own curriculum outperformed by two-thirds of a school year the schools that do not have one, after controlling statistically for the effect of socio-economic level and public/private administration.

An important finding of this study is that Chilean students have significantly fewer opportunities to learn advanced mathematics content, when compared to the students across South Korea, Malaysia, the Slovak Republic, and Miami-Dade County Public Schools. While most of the Chilean students were taught by teachers who emphasized mainly numbers, the students in the other jurisdictions were taught by teachers who emphasized measurement, algebra, geometry and/or data.

The lack of rigor and detail of the pre-reform curriculum is partly to blame for this poor content coverage. However, it is possible that Chilean teachers do not introduce additional content because of the already poor mathematics skills of their students. While slowing down to match the skills of students may be appropriate, it is necessary to highlight the tradeoffs of this approach. The advanced mathematics content is what standardized tests regularly assess.

This study found that there is a positive relationship between content coverage and mathematics performance in Chile. This relationship holds true after controlling statistically for schools' socio-economic level and type of administration (public/private). This finding is consistent with previous studies reporting a positive relationship between students' opportunities to learn and mathematics achievement (Gau, 1997; Secada, 1992).

Another factor that may be contributing to the poor coverage of mathematics content is that Chilean teachers do not feel prepared to teach it. Chilean students are taught by teachers who feel less prepared to teach a variety of mathematics topics, when compared to the students across the four jurisdictions. These results indicate the importance of preparation in the teaching of mathematics in pre- and in-service teacher preparation programs.

Nowadays, Chilean schools have a more rigorous and detailed national curriculum than in 1998, when data was collected for this study. The new curriculum may serve as a leading force to improve other important areas of the educational system. By providing clearer performance standards, the new curriculum should better support teachers in choosing what to teach, in preparing their classes, and in grading their students' performance. The Ministry of Education should closely monitor the extent in which the new curriculum is changing teaching practices.

The new curriculum could be used to boost teacher-training programs. Universities should prepare future teachers in how to teach the reformed curriculum. A teacher certification exam may be used to ensure that the future teachers master the new curriculum, and that they are prepared to teach the advanced mathematics knowledge and skills stated in it.

Educational systems are extremely complex social organizations. This study does not pretend to encompass all of this complexity. This study focused on a subset of variables relevant for the analysis of mathematics performance. It is hoped that the findings reported will be useful in understanding the poor academic performance of Chilean students. It is also hoped that these findings will be useful to inform the debate in Chile about how to improve mathematics education.

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## Biographical Sketch

María-José Ramírez is the coordinator of the data analysis and reporting unit of the Chilean Ministry of Education's national assessment system (SIMCE). In 2000-2004, she was a research assistant in the TIMSS & PIRLS International Study Center at Boston College. During this period, she obtained her Ph.D. in educational research, measurement and evaluation in Boston College. Her main areas of interest are school quality, educational policies, and measurement.

**Figures**

Figure 1

*Ranking of mathematics achievement for all the jurisdictions participating in TIMSS 1998/99*

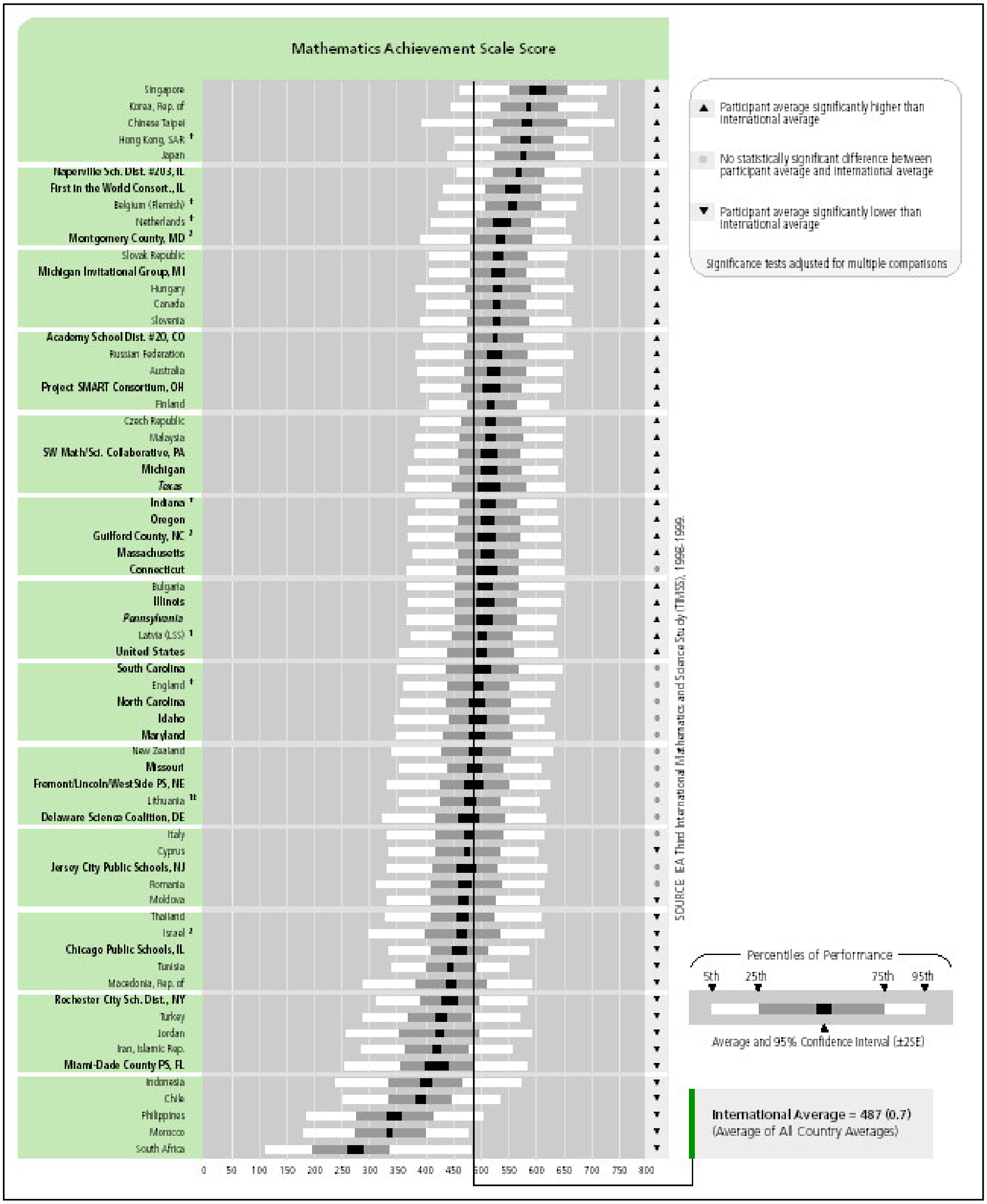
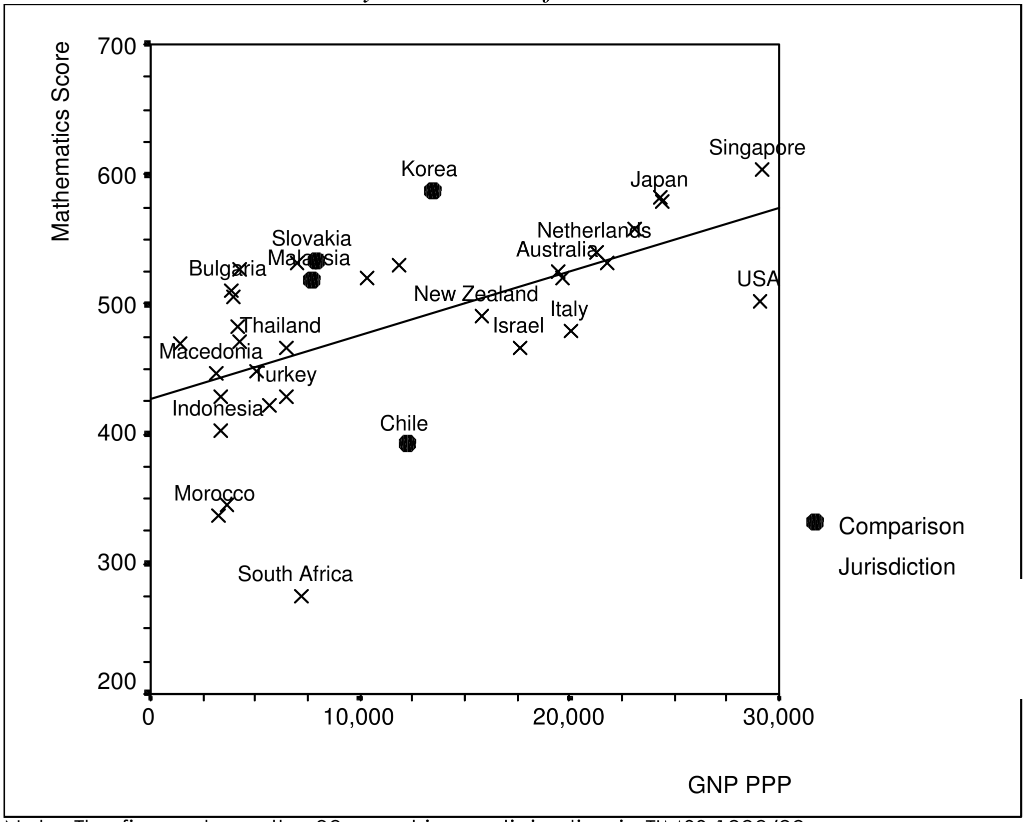


Figure 2

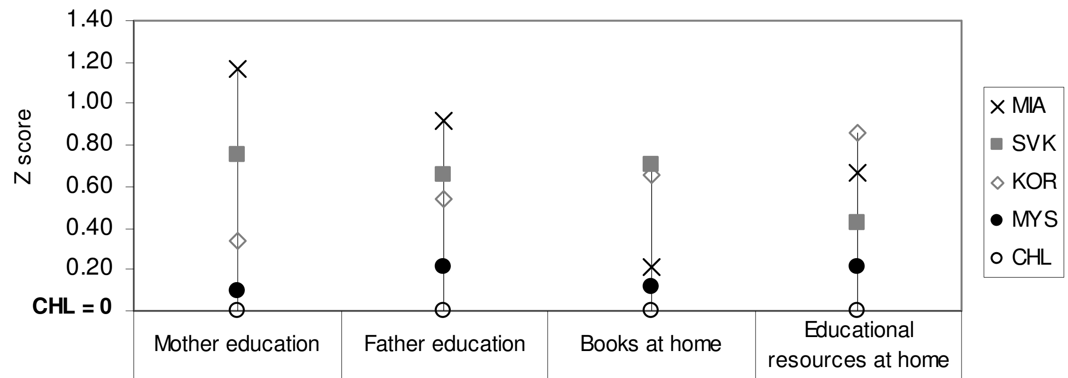
*Mathematics Achievement by the Wealth of the Countries*




Note. The figure shows the 38 countries participating in TIMSS 1998/99.
Data for Miami-Dade County Public School was not displayed. Source: TIMSS 1999 dataset.
GNP PPP = Gross national product purchasing power parity as for 1999.

Figure 3

*Differences in Socio-Economic Indicators*
*Between Chile and the Comparison Jurisdictions*

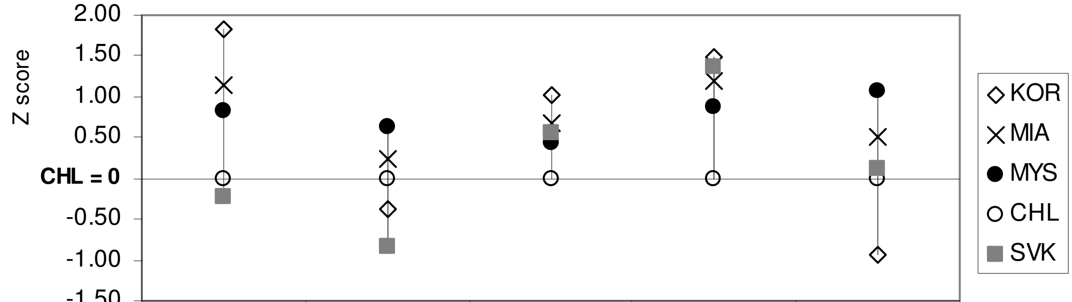



| | Mother education | Father education | Books at home | Educational resources at home |
|---|---|---|---|---|
| MIA | 1.17 | 0.92 | 0.21 | 0.67 |
| SVK | 0.76 | 0.65 | 0.71 | 0.43 |
| KOR | 0.34 | 0.54 | 0.65 | 0.86 |
| MYS | 0.10 | 0.22 | 0.12 | 0.21 |
| CHL | 0.00 | 0.00 | 0.00 | 0.00 |

*Note*. CHL = Chile (*M* = 0, *SD* = 1), MYS = Malaysia, SVK = Slovak Republic, KOR = South Korea, MIA = Miami-Dade County Public Schools. Valid cases by column: 80%, 76%, 99%, and 99%. Analysis weighted with TOTWGT.

Figure 4

*Differences in the Implemented Mathematics Curriculum Between Chile and the Comparison Jurisdictions*




| | School with own math curriculum | School with own math materials | Content coverage (advanced) | Emphasis on advanced contents | Additional math courses |
|---|---|---|---|---|---|
| KOR | 1.82 | -0.38 | 1.01 | 1.50 | -0.93 |
| MIA | 1.16 | 0.24 | 0.69 | 1.20 | 0.50 |
| MYS | 0.83 | 0.63 | 0.44 | 0.88 | 1.08 |
| CHL | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SVK | -0.24 | -0.85 | 0.55 | 1.36 | 0.12 |

*Note*. CHL = Chile (*M* = 0, *SD* = 1), MYS = Malaysia, SVK = Slovak Republic, KOR = South Korea, MIA = Miami-Dade County Public Schools. Overall response rates by column: 88%, 94%, 95%, 94%, and 99%. Analysis weighted with TOTWGT.

Table 1

*Selected Social and Educational Indicators for Chile and the Comparison Jurisdictions*

| Jurisdiction | GNP PPP per capita[1] | Gini Index[2] | Human development index[3] | Public Expenditure on education as % of GNP[4] | Yearly expenditures per student[5] | Net enrolment ratio in primary education[6] |
|---|---|---|---|---|---|---|
| Chile | 12,240 | 57.1 | 0.835 | 3.6% | 1,767 | 88% |
| South Korea | 13,430 | 31.6 | 0.878 | 3.7% | 3,208 | 97% |
| Malaysia | 7,730 | 49.2 | 0.789 | 4.9% | 1,813 | 99% |
| Slovak Republic | 7,860 | 25.8 | 0.842 | 5.0% | 1,811 | 89% |
| Miami-Dade | – | – | – | – | 6,613 | – |
| United States | 29,080 | 40.8 | 0.935 | 5.4% | – | 94% |

[1] GNP PPP per capita = Gross National Product Purchasing Power Parity per capita. An international dollar has the same purchasing power over the GNP as a U.S. dollar in the United States. Source: World Bank (1999) World development indicators, p. 12-14.
[2] Gini Index: Measures the extent to which the distribution of income (or consumption) among individuals or households within a country deviates from a perfectly equal distribution. A value of 0 represents perfect equality, a value of 100 perfect inequality. Source: United Nations Development Program.
[3] Human development index. A composite index based on a long and healthy life, knowledge and a decent standard of living. All data from year 2000 with the exception of the Slovak Republic, where data from 2002 is reported. Source: United Nations Development Program.
[4] Source: UNESCO Statistical Yearbook (1999), p. II (500-511).
[5] OECD/UNESCO UIS WEI, 2003. Data for Miami-Dade County Public Schools was estimated by the author based on *Statistical Abstract 2002-03* (Miami-Dade County Public Schools, 2003, p. 34).
[6] Net Enrolment ratio = Number of pupils in the official age-group for a given level of education enrolled in that level expressed as a percentage of the total population in that age-group. Primary education = ISCED 1. Source: UNESCO Institute for Statistics.
– Data not available.

Table 2

*Detailed Information About Background Variables*

| Variable | Description |
|---|---|
| SCHOOLS' COMMUNITY CONTEXTS | |
| *Socio-economic index of the school community.* Index score based on father and mother education, number of books at home, and possessions at home (e.g., study desk/table, computer). | |
| *Urban/rural*. Type of community in which the school is located. | |
| IMPLEMENTED MATHEMATICS CURRICULUM | |
| *Content coverage (advanced)*. Index score computed across 20 questions by averaging the score points associated with each response option. Topics were grouped in 4 content areas (measurement; geometry; algebra; and data representation, analysis and probability). Score points were weighted proportional to the number of mathematics problems from the advanced content areas in the TIMSS mathematics test. This index was used for the international comparisons only. Since this measure did not have enough variability in Chile, the general index was used for the national analyses. | |
| *Content coverage (general)*. Same as advanced index but including 14 additional questions about fractions, number sense, and probability topics. Score points were weighted proportional to the number of mathematics problems from each content area in the TIMSS mathematics test. | |
| *Subject emphasis*. Basic content (whole numbers, fractions, decimals, percentages) versus advanced content (geometry, algebra, or a combination of them with other subjects) | |
| *Additional mathematics courses*. None; either remedial or enrichment; both remedial and enrichment. | |
| *School curriculum*. If the school has its own written statement of curriculum content to be taught for mathematics. | |
| *Instructional materials*. If the school has developed instructional activities or learning materials to address the curriculum taught in the school. | |
| TEACHER QUALITY | |
| *Teacher qualification*. Index score based on highest level of formal education, teacher training certificate, major or main area of study. | |
| *Preparation to teach*. Index score based on how well prepared teachers were to teach 12 mathematics topics (e.g., ratios, geometric figures, equations). | |
| SCHOOL RESOURCES | |
| *Limitations in school resources.* Index score based on principals' perceptions of resources (e.g., textbooks, computers, school buildings) affecting their schools' capacity to provide instruction. | |
| SCHOOL ADMINISTRATION | |
| *School administration* (MINEDUC). Public/municipal versus private (elite-paid or private-subsidized). | |

MINEDUC = Data provided by Ministry of Education, Chile.

Table 3

*Models of Mathematics Achievement at the School/Class Level ($N_j$ = 182)*

| | Model 1 | | Model 2 | | Model 3 | | Model 4 | | Model 5 | | Model 6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Among schools/classes variance accounted for by model ($R^2$) | 30% | | 30% | | 34% | | 72% | | 72% | | 69% | |
| Reliability | .95 | | .95 | | .94 | | .87 | | .87 | | .88 | |
| | *B* | *(SE)* | *B* | *(SE)* | *B* | *(SE)* | *B* | *(SE)* | *B* | *(SE)* | *B* | *(SE)* |
| Mean mathematics score | 388 | (8.8) | 363 | (6.7) | 367 | (6.6) | 382 | (5.3) | 385 | (3.2) | 391 | (2.7) |
| **IMPLEMENTED MATHEMATICS CURRICULUM** | | | | | | | | | | | | |
| School curriculum (0 = no, 1 = yes) | 67.8** | (11.5) | 67.5** | (11.7) | 61.9** | (11.3) | 23.1** | (7.9) | 22.1* | (8.8) | | |
| School materials/activities (0 = no, 1 = yes) | 19.5** | (7.3) | 18.8* | (7.4) | 17.2* | (7.1) | 2.5 | (5.0) | | | | |
| Content coverage (general)[z] | 5.1 | (4.0) | 5.2 | (4.0) | 5.3 | (3.9) | 4.5* | (2.2) | 4.8* | (2.3) | | |
| Subject emphasis (0 = basic, 1 = advanced) | 15.0 | (8.7) | 13.5 | (8.9) | 10.6 | (8.8) | 3.5 | (5.9) | | | | |
| Additional math courses[z] | -0.3 | (3.8) | -0.3 | (3.8) | -1.6 | (3.7) | 1.5 | (2.4) | | | | |
| **TEACHER QUALITY** | | | | | | | | | | | | |
| Teacher qualification[z] | | | 1.9 | (4.0) | 2.0 | (3.8) | -0.6 | (2.3) | | | | |
| Preparation to teach[z] | | | 2.5 | (3.6) | 1.0 | (3.6) | -5.1 | (2.7) | | | | |
| **SCHOOL RESOURCES** | | | | | | | | | | | | |
| Limitations in school resources[z] | | | | | -11.9** | (3.7) | -0.5 | (2.4) | | | | |
| **SCHOOLS' COMMUNITY CONTEXT** | | | | | | | | | | | | |
| Socio-economic index[z] | | | | | | | 39.5** | (3.5) | 38.2** | (3.1) | 44.1** | (2.8) |
| Urban level (0 = rural, 1 = urban) | | | | | | | 4.1 | (5.1) | | | | |
| **SCHOOL ADMINISTRATION** | | | | | | | | | | | | |
| School administration (0 = public, 1 = private) | | | | | | | | | 6.7 | (5.9) | | |

*Note*. Hierarchical linear models with random intercepts weighted with HOUWGT.
Method: Restricted maximum likelihood with robust standard errors.
Valid cases = 98% of the schools/classes sample. $^{**}p < .01$. $^{*}p < .05$.
[z] Standardized variable.

Table 4

*Selected Characteristics of the Official Mathematics Curriculum in Chile and the Comparison Jurisdictions*

| Jurisdiction | Emphases on approaches and processes[1] | | | | Percent of TIMSS content appropriate[2] | Percent of TIMSS problems appropriate[3] |
|---|---|---|---|---|---|---|
| | Basic skills | Real-life applications | Solving non-routine problems | Assessing student learning | | |
| Chile | ● | ○ | ○ | ○ | 61% | 58% |
| South Korea | ● | ● | ◒ | ◒ | 80% | 75% |
| Malaysia | ● | ● | ◒ | ◒ | 80% | 83% |
| Slovak Republic | – | – | – | – | – | 100% |
| Miami-Dade County Public Schools | ● | ● | ● | ● | 93% | 100%* |

[1] Source: TIMSS 1999 International Mathematics Report, chap. 5; and TIMSS 1999 Mathematics Benchmarking Report, chap. 5.

[2] Percent of TIMSS contents included in the official mathematics curricula up to the 8th grade. Source: TIMSS 1999 International Mathematics Report, chap. 5; and TIMSS 1999 Mathematics Benchmarking Report, chap. 5.

[3] Source: Test Curriculum Matching Analysis, TIMSS 1999 International Mathematics Report, appendix C.

* Data from the United States was imputed to Miami-Dade County Public Schools.

– Data not available.

● Major emphasis ◒ Moderate emphasis ○ Minor/ no emphasis