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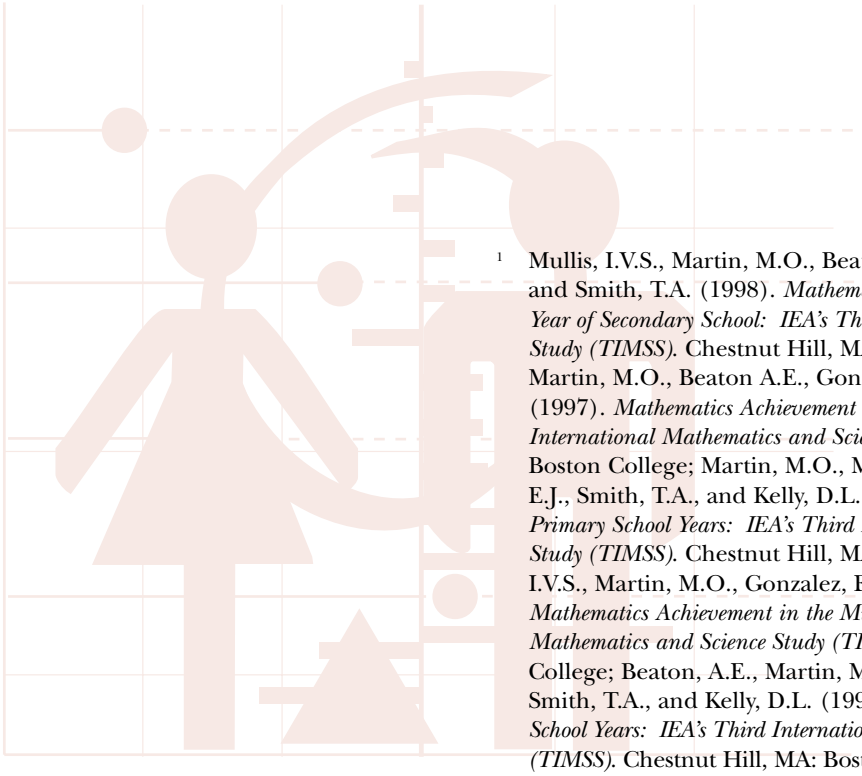
Summary of Results

Introduction

The Third International Mathematics and Science Study, known as TIMSS, is the largest and most ambitious of the international comparative studies conducted by the International Association for the Evaluation of Educational Achievement (IEA) since its inception in 1959. Students were tested in both mathematics and science at five different grades across primary, middle, and secondary school, totaling more than half a million students tested in 41 countries around the world. Including the 15,000 schools involved, many thousands of individuals were involved in the data collection effort. Most countries collected their data in May and June of 1995, although those countries on a Southern Hemisphere schedule tested in late 1994, which was the end of their school year.

The purpose of this report is to provide an in depth look at the TIMSS achievement results by gender. Results previously reported from TIMSS show that much effort still is needed to achieve gender equity in mathematics and science achievement around the world.[1] While the TIMSS results showed few differences in average mathematics achievement by gender at the fourth and eighth grades, there were substantial gender differences in mathematics achievement for students in the final year of secondary school (grade 12 in many countries). In science, gender differences were present in many countries even at grade four and were overwhelming for students in the final year of secondary school.



[1] Mullis, I.V.S., Martin, M.O., Beaton, A.E., Gonzalez, E.J., Kelly, D.L., and Smith, T.A. (1998). *Mathematics and Science Achievement in the Final Year of Secondary School: IEA's Third International Mathematics and Science Study (TIMSS).* Chestnut Hill, MA: Boston College; Mullis, I.V.S., Martin, M.O., Beaton A.E., Gonzalez, E.J., Kelly, D.L., and Smith T.A. (1997). *Mathematics Achievement in the Primary School Years: IEA's Third International Mathematics and Science Study (TIMSS).* Chestnut Hill, MA: Boston College; Martin, M.O., Mullis, I.V.S., Beaton, A.E., Gonzalez, E.J., Smith, T.A., and Kelly, D.L. (1997). *Science Achievement in the Primary School Years: IEA's Third International Mathematics and Science Study (TIMSS).* Chestnut Hill, MA: Boston College; Beaton, A.E., Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Kelly, D.L., and Smith, T.A. (1996). *Mathematics Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study (TIMSS).* Chestnut Hill, MA: Boston College; Beaton, A.E., Martin, M.O., Mullis, I.V.S., Gonzalez, E.J., Smith, T.A., and Kelly, D.L. (1996). *Science Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study (TIMSS).* Chestnut Hill, MA: Boston College.

More About TIMSS

The success of TIMSS depended on a collaborative effort between the research centers in each country responsible for implementing the steps of the project and the network of centers responsible for managing the across-country tasks. Led by the TIMSS International Study Center at Boston College, various centers around the world conducted the tasks associated with sampling, administration and scoring training, data processing, and analysis while emphasizing quality control at every step of the way.[2]

The mathematics and science tests given to the students differed by grade level, with each covering a variety of content areas. For example, six content dimensions were covered in the mathematics test for the middle-school students: fractions and number sense; measurement; proportionality; data representation, analysis, and probability; geometry; and algebra. About one-fourth of the questions were in the free-response format requiring students to generate and write their answers. These types of questions, some of which required extended responses, were allotted approximately one-third of the testing time. The students who participated in TIMSS also completed questionnaires about their home and school experiences related to learning mathematics. In addition, teachers and school administrators completed questionnaires about instructional practices.

All countries that participated in TIMSS were to test students in the two grades with the largest proportion of 13-year-olds, seventh and eighth grades in most countries. Many countries also tested students in the two grades with the largest proportion of 9-year-olds, third and fourth grades in most countries. Additionally, some countries tested students in their final year of secondary education. For students in the final year of secondary school, there were two components to the TIMSS testing. Given the extensive diversity of students' curricula around the world, testing this "grade" was a special challenge for TIMSS. The mathematics and science literacy test was designed for all final-year students, regardless of their school curriculum. By and large, the purpose of this test was to measure how well students could use their knowledge in addressing real-world problems having a mathematics or science component. For students having taken advanced courses in mathematics and science, special tests were developed — one for students having taken advanced mathematics and another for students having taken physics. For the sciences, it was not possible to test all branches in detail. The participating countries chose physics because it is the science branch most closely aligned with mathematics, and came closest to embodying the essential elements of natural science.

[2] Martin, M.O. and Kelly, D.L. (Eds.). (1996). *Third International Mathematics and Science Study (TIMSS) Technical Report Volume I: Design and Development.* Chestnut Hill, MA: Boston College; Martin, M.O. and Kelly, D.L. (Eds.). (1997). *Third International Mathematics and Science Study (TIMSS) Technical Report Volume II: Implementation and Analysis in the Primary and Middle School Years.* Chestnut Hill, MA: Boston College; Martin, M.O. and Kelly, D.L. (Eds.). (1998). *Third International Mathematics and Science Study (TIMSS) Technical Report Volume III: Implementation and Analysis in the Final Year of Secondary School.* Chestnut Hill, MA: Boston College; Martin, M.O. and Mullis, I.V.S. (1996). *Third International Mathematics and Science Study (TIMSS): Quality Assurance in Data Collection.* Chestnut Hill, MA: Boston College.

The procedures used to select the samples of students participating in the TIMSS testing were scrutinized according to rigorous standards designed to prevent bias and ensure comparability. Prior to analysis, the data from each country were subjected to exhaustive checks for adherence to the international formats as well as for within-country consistency and comparability across countries.

The TIMSS Gender Report

This report looks in detail at differences in mathematics and science achievement by gender at the fourth and eighth grades as well as for students in their final year of secondary school. Chapter 1 summarizes the gender results previously published by the TIMSS International Study Center at Boston College. Chapters 2 through 4 present results by gender for high- and low-performing students, for different types of items, and according to several salient background questions.[3] For Chapters 2 through 4, data were analyzed for the 33 countries that followed the TIMSS sampling guidelines at the eighth grade, even though some had low participation rates. For purposes of comparison, data also are presented for these countries at the fourth grade and final year of secondary school, if the countries participated in the portions of the testing conducted for primary and secondary school students. Thus, results at the fourth grade are presented for 22 countries. For the final year of secondary school, mathematics and science literacy results are included for 18 countries, advanced mathematics results are presented for 13 countries, and physics results are presented for 13 countries. Appendix A contains the complete listing of the countries included in this report together with the school and student sample sizes for each country by gender.

Summary of Major Findings Described in This Report

The first chapter of this report summarizes the gender differences in average mathematics and science achievement previously reported by the TIMSS International Study Center. The TIMSS results showed few gender differences in average mathematics achievement at the fourth and eighth grades. At the final year of secondary school, however, data from 18 out of 21 countries showed that males had significantly greater achievement in mathematics literacy. In science, gender differences in achievement favoring males were present in one-third of the countries even as early as the fourth grade. At the eighth grade in science, the gender gap was even wider with male performance being significantly higher than that of females in nearly two-thirds of the countries. At the final year of secondary schools, males in nearly every participating country demonstrated significantly higher achievement in science literacy than females.

[3] Some data in these chapters are adapted from *Examining Gender Differences in Mathematics Achievement on the Third International Mathematics and Science Study (TIMSS)*, December 1999. A dissertation by Edward Garcia Fierros submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, Lynch School of Education at Boston College.

The second chapter presents two additional analyses of the TIMSS achievement data. The first analysis examines those students scoring in the top quarter for their respective country and investigates the gender composition of those high-performing students. The second analysis examines the percentage of students in each gender reaching country-specific benchmarks (upper and lower quartiles). In general, findings of both additional analyses parallel the overall results – few gender differences at the fourth and eighth grades in mathematics with an increasing advantage by males developing by the final year of secondary school. In science, several countries showed males with higher achievement than females at the fourth grade, with the edge for males increasingly evident across countries at the eighth grade, and becoming pervasive at the final year of secondary school.

Chapter 3 describes an analysis using a Gender Difference Index (GDI), and presents examples of items exhibiting the greatest gender differences. In mathematics across the grades, males tended to have higher achievement than females on items involving spatial representation, proportionality, measurement, and problems with no immediate formula. At the fourth and eighth grades, females outperformed males on items involving reading graphs, computation, and algorithmic problem solving. At the final year of secondary school, there were no items where females outperformed males, on average, internationally. In science across the grades, females tended to have higher achievement on items involving health and nutrition while males had higher achievement on items involving earth science and the physical sciences, particularly if the item presentation involved a diagram. In both mathematics and science, an examination of achievement on the same items given to both eighth and final-year students showed some gender differences for the final-year students internationally, when no differences appeared on these items at the eighth grade.

Selected attitudinal and contextual data from the TIMSS background questionnaires are discussed in Chapter 4. At the final year of secondary school, more males tended to identify that it was important to do well in mathematics and science while more females tended to report that it was important to do well in language. Yet, internationally, across the grades, females reported spending more time out-of-school studying mathematics and science than males. Regarding motivating factors for high achievement in mathematics and science, at the eighth grade, more males than females agreed that it was important to do well in mathematics to please their parents and to get a desired job. In science, the same pattern held true. At the final year of secondary school, more males than females reported that they would like a job in mathematics or a mathematics-related field.

It is important to note that the data used in this report are cross-sectional in nature. Nevertheless, the trends in achievement by gender are so pervasive across countries and the sampling procedures employed so rigorous that a clear pattern can be discerned across primary, middle, and secondary school. The gender gap in achievement becomes larger as students progress through school in most countries, and the gap in achievement that is seen in mathematics is even more pronounced in science. This pattern holds for high-performing students and when results are investigated at the item level.