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ABSTRACT

The Third International Mathematics and Science Study (TIMSS) is the largest and most ambitious international study of mathematics and science achievement ever undertaken with more than 500,000 students in 41 countries being tested in mathematics and science at three different year levels. South Africa is the first country in Africa to have participated in and successfully completed such a comprehensive international survey in science and mathematics education. This report provides detailed information about TIMSS and highlights the results of the performance of middle school students in the Mpumalanga Province of South Africa. (Contains 12 references.) (ASK)

MATHEMATICS AND SCIENCE PERFORMANCE IN THE MIDDLE SCHOOL YEARS IN THE MPUMALANGA PROVINCE OF SOUTH AFRICA

The performance of students in the Mpumalanga Province in the Third International Mathematics and Science Study

TIMSS
SOUTH AFRICA

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TIMSS-SA

THE THIRD INTERNATIONAL MATHEMATICS AND SCIENCE STUDY (TIMSS)

Report for the Mpumalanga Province of South Africa

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PREFACE

On an international scale approximately half a million school students from all over the world participated in the Third International Mathematics and Science Study (TIMSS) during 1995. This was the largest and most comprehensive comparative educational survey ever undertaken. South Africa was privileged to be the only country on the African continent to participate in this international comparative educational study.

The results of TIMSS in South Africa may be regarded as baseline information to mark the *status quo* of education in mathematics and science in a new nation.

This specific report is targeted at educational planners, decision-makers and administrators who are involved in mathematics and science education in the Mpumalanga Province. This report is an introductory report on the overall results of the Std 5 and Std 6 students from the Mpumalanga Province who participated in the TIMSS survey which was conducted in South Africa during the second half of 1995.

The purpose of TIMSS and the methods used will be briefly explained and the average achievements of the Mpumalanga Province's students in Stds 5 and 6 will be compared with those of the national and international samples.

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September 1997

1 Introduction

1.1 Background

In 1995 the Human Sciences Research Council (HSRC) conducted a survey on mathematics and science among 15 000 South African students from more than 400 primary and secondary schools, as part of the Third International Mathematics and Science Study known as TIMSS. World-wide more than half a million students in 41 countries participated in the project. A National Research Co-ordinator (NRC) was appointed in each participating country. In South Africa the Human Sciences Research Council in Pretoria assumed the responsibility for the administration of TIMSS. Each NRC had to establish a working team and an office from which TIMSS could be administered and co-ordinated in collaboration with the International Study Centre in Boston, USA.

Concern has been growing around the world, since the 1960s, that investments in education need to be related to the outcomes of education, which, in turn, are seen as being able to make a substantial contribution to a country's economic prosperity and general well-being. As the twenty-first century approaches, the demand for mathematical, scientific and technological understanding and expertise will be greater than ever before. Students at the forefront of developments in the future will require very high levels of mathematical and scientific skills. These students will need to develop critical thinking, processing and interpreting skills far beyond those required in the previous decade. Competence as well as skills in mathematics and science will be crucial, as students leave school and enter higher education and the workplace.

The need for populations to be better educated, amid a climate of shrinking national budgets has led countries around the world to look for methods of making teaching and learning in these areas more effective. International studies are a means of providing information on student achievement and the factors that play a role in such achievement. The challenge will always be to learn more about effective teaching and learning, both for educators and policy-makers in the education field.

In South Africa, poor matriculation results continue to dominate the news at the end of every school year. 1995 had the best school attendance figures in years, but nonetheless poor results were evident once again. The story was repeated in 1996 despite changes and reforms in the Department of Education. The reasons for failure are varied and whatever changes are implemented, need time to make an impact. A system is required whereby the impact of these changes can be monitored. **This concept of monitoring has long been recognised internationally and has been adopted by other countries introducing reform into their education systems.**

TIMSS is the largest and most ambitious international study of mathematics and science achievement at school level ever undertaken. It is the first time that mathematics and science studies have been combined as an integrated study. TIMSS is also the largest comparative study of its kind conducted under the auspices of the International Association for the Study of Educational Achievement (IEA), which is based in the Netherlands. The IEA is an independent international grouping of national research institutions and governmental research agencies. Its primary purpose is to conduct large-scale comparative studies of educational achievement, with the aim of gaining an in-depth understanding of the effects of policies and practices within and across systems of education. The IEA has conducted more than 15 studies of achievement involving groups from different countries since its inception in 1959.

The IEA officially launched TIMSS in 1994. It was undertaken in more than 60 countries across the world. Highly developed countries and developing countries, from both the northern and the southern hemispheres were included. Of the 63 countries that started the study, only 41 completed it. South Africa was the only country in Africa to do so.

TIMSS was developed to assess the national curricula, school and social environment and achievement in science and mathematics in the participating countries and different systems of education around the world. TIMSS tests were designed to measure mathematics and science achievement in order to help inform governments, policy makers and educators about the mathematics and science proficiency of their students at key points in the educational process. The questionnaires were aimed at collecting information about factors related to students' learning of mathematics and science.

The first part of this report outlines the project and the methodology used and the second part focuses on the performance in TIMSS of the Std 5 and Std 6 students in the Mpumalanga Province.

1.2 Conceptual framework for TIMSS

IEA studies traditionally have recognised the importance of the curriculum as a variable for explaining differences among national school systems and for explaining the students' results. These studies represent an effort to understand education systems and to make valid comparisons between them. The curricula and teaching practices have been investigated and compared with the students' results. These three factors have become the focus areas for TIMSS. It was believed that differences in achievement could be explained in terms of variations in curriculum, teaching practices and other variables. It was also hoped that the study would help countries to evaluate national curricula and provide a research basis for future national curriculum reform.

The conceptual model for TIMSS was derived mainly from the models used in earlier IEA studies, especially for SIMS (Second International Mathematics Study) and SISS (Second International Science Study). In this model three "levels" of curriculum are envisaged, namely the intended, the implemented and the attained (Robitaille's model). The educational environment, made up of a variety of factors, should be understood from the perspective of these three curriculum levels. It is believed that there are also factors outside of formal schooling that affect the students' achievement. Therefore there is a unique set of contextual factors that influence the educational decisions for each level of the curriculum (Martin and Kelly, 1996).

Robitaille's model, adopted by TIMSS as its conceptual framework, provides a rationale and context for the key research questions in TIMSS. Four questions are central to the study:

- What are students expected to learn?
- Who provides the instruction?
- How is the instruction organised?
- What have students learned?

1.3 TIMSS curriculum framework

Since the curriculum is regarded as an important variable for explaining achievement differences, it is useful to have a framework to describe and classify the different aspects of the curriculum. Such a framework has been constructed by Robitaille (1992), and is extensively used in TIMSS. In this framework, different aspects of the curriculum are classified under three broad headings. These are

- content or subject matter
- performance expectations, that is: what is expected of the student
- perspectives or content, particularly the attitudes and views of the students that can influence learning.

The detailed categories within the science and mathematics frameworks differ, but the structure and rationale of the two frameworks are the same. The major categories of these frameworks are given in Figure 1.

The framework allows any test question or proposed teaching activity to be classified in detail. For example, a question on naming the different parts of an insect would be classified as a life science question with the performance expectation being "knowing". A question on solving a problem in geometry would be classified by content under geometry, with the performance expectation being "mathematical reasoning" and/or "problem-solving".

The perspectives aspect of the framework is used when analysing documents such as textbooks or curriculum guides.

Figure 1: Major categories of the TIMSS curriculum framework for mathematics and science

CONTENTS

Mathematics

1 Numbers
2 Measurement
3 Geometry
4 Proportionality
5 Functions, relations and equations
6 Data, probability and statistics
7 Elementary analysis

Science

1 Earth sciences
2 Life sciences
3 Physical sciences
4 Science, technology and mathematics
5 History of science and technology
6 Environmental issues
7 Nature of science
8 Science and other disciplines

PERFORMANCE EXPECTATIONS

1 Knowing
2 Using routine procedures
3 Investigating and problem solving
4 Mathematical reasoning
5 Communicating
6 Theorising, analysing and solving problems
7 Using tools, routine procedures and scientific processes
8 Investigating the natural world

PERSPECTIVES

Attitudes
Careers
Participation
Increasing interest
Safety
Habits of mind

Source: Martin & Kelly, 1996, p.1-6

The designers of TIMSS believe that this framework is well suited to dealing with the complexity of student activities involved in learning science and mathematics. It could be particularly useful when dealing with the new forms of assessment that will be used in future as part of the new South African school curriculum.

1.4 Student populations in TIMSS

In TIMSS three different age group levels of students were sampled. The first level consisted of the students in the two adjacent grades containing the biggest proportion of nine year-olds. This is referred to as Population 1. Population 2 consisted of students in the two adjacent grades containing the biggest proportion of 13-year-olds. Population 3 consisted of students in their last year of formal schooling for the purpose of analysis. The age of the students was taken as their age at the time that they wrote the achievement test (Martin and Kelly 1996).

In the context of the South African study, Stds 2 and 3 represented Population 1. At the time of the investigation mother tongue was the medium of instruction up to Std 2. TIMSS required all students to be tested in the language medium of instruction. This population was not included as no resources (human and financial) were available for translations into all the languages. Std 5 and Std 6 represented Population 2 and Std 10 represented Population 3. Stds 5, 6 and 10 (grades 7, 8 and 12) were all tested in South Africa, allowing South Africa to be included in Population 2 and Population 3 of TIMSS.

Students in Std 10, who were in the selected schools, were tested regardless of the subjects they were studying. Internationally, those

Population 3 students who were specialising in mathematics or physics were identified as subgroups and were given specialised tests. In South Africa, students do not specialise to this degree and therefore the Std 10 students who were tested wrote the general science and mathematics literacy achievement test; and no specialised tests were written. The results of TIMSS Population 3 age group in South Africa will be discussed in reports which are to be released later in 1997.

This report addresses the performance of the sampled Std 5 and Std 6 students from the Mpumalanga province in comparison with the national and international samples in TIMSS.

1.5 TIMSS instruments

1.5.1 TIMSS questionnaires

Three different facets were addressed by the TIMSS research. These were curriculum analysis, achievement tests and questionnaires.

Questionnaires were used to collect information about the national education system for mathematics and science, and how this influenced the intended and implemented curricula in those subjects. This information was supplemented with data collected in the school to see how science and mathematics education varied within the country.

A questionnaire was designed for the principal of each sampled school. The results from these questionnaires should give a good idea of the kinds of schools in the education system. Among the topics addressed in this questionnaire were enrolment, demographics and subject selection, as well as administrative, curricular, budgetary and social issues. The questionnaires administered to the primary and secondary schools were similar in content, with some questions being modified or omitted.

The designers of TIMSS developed three teacher questionnaires to obtain information on the curricula implemented at schools. These included two questionnaires at Population 2 level, one of which was designed for the mathematics teachers and one for the science teachers. The other questionnaire was at Population 1 level. Population 3 had no teacher questionnaire. The teacher questionnaires included five sections: teacher's background, attitudes to teaching and learning, expectations for students, instructional practices, and opinions on mathematics and science education.

The designers of TIMSS also developed three different questionnaires for students, although they were similar in organisation and content. There was one for each TIMSS population age group tested. They included questions on the students' backgrounds, opinions and attitudes to mathematics and science.

1.5.2 TIMSS achievement instruments

Traditionally, large-scale surveys conducted by the IEA and other bodies have used multiple-choice questions. However, recently there has been growing awareness among educators that some important achievement results are either difficult or impossible to measure using the multiple-choice format. It was therefore decided that TIMSS should employ a variety of questions. Four different types of questions were included in the pool of TIMSS questions: multiple-choice questions, short answer questions, extended answer questions and performance tasks. [In TIMSS the short answer and the extended answer questions were referred to as Free Response Items.] The multiple-choice questions consisted of a question and four or five choices of answer, of which only one was the correct answer. As in all other countries, these achievement tests were written in the students' language of instruction, which for South African students in Stds 5, 6 and 10 was English or Afrikaans.

In both the short answer and the extended response questions, students were required to write their responses. The multiple-choice, short answer questions and extended response questions were randomly distributed, in different groups or clusters of questions, throughout the test booklets.

Performance tasks were designed to assess some of the skills and abilities that could not be assessed readily by a written test. Tasks were performed in small groups and these groups were observed by the researchers in participating countries. However, South Africa did not implement this form of assessment owing to financial and other constraints.

Table 1 gives a summary of all the instruments used for the Population 2 survey.

1.6 Curriculum analysis

During 1994 a team of curriculum experts in each country analysed the most used textbooks in mathematics and science from the first to the final year of schooling. Curriculum guidelines and syllabus documents for mathematics and all disciplines of natural sciences were also analysed in each country according to international guidelines furnished by TIMSS. From these analyses a pool of international comparative educational data has been generated for the curricula in mathematics and the natural sciences.

Table 1: The instruments used for TIMSS population 2 age group survey

Survey instrument	Purpose of instrument	Who had to fill in each instrument
Test Booklet 1-8	To contain clusters of questions distributing 135 science questions and 151 mathematics questions in eight equivalent 90-minute tests to assess students' knowledge, ability and understanding in mathematics and science.	One eighth of the students in each sampled class filled in each of the 8 test booklets. If a class had 40 students, then five of them would do test booklet 1, five would do test booklet 2 and so forth up to five of them doing test booklet 8.
Student questionnaires	To collect information on students' perceptions about mathematics and science and about the conditions which influence learning in these subjects.	All students in the sampled class who wrote a TIMSS test.
Mathematics teacher's questionnaire	To collect information about the teaching conditions for mathematics in the sampled school.	The mathematics teacher of the sampled class in each school.
Science teacher's questionnaire	To collect information about the teaching conditions for science in the sampled school.	The science teacher of the sampled class in each school.
Principal's questionnaire	To collect information about the general teaching conditions in each sampled school.	The principal of each sampled school.

2 Sampling and administration of the Population 2 study in South Africa

2.1 Sampling

The sampling procedure was strictly controlled and was designed by the international study group to ensure the statistical validity of the study by providing a random sample of students that was representative of the country as a whole.

For Population 2 in South Africa, a random sample of schools was drawn from all schools that had more than 40 students in Std 5 in 1991 (Claassen, 1996). The HSRC's database was used to draw samples of 150 primary and 150 secondary schools. These were selected on a random basis according to the prescriptions of the TIMSS International Sampling Control Centre. For TIMSS Population 2, it meant that a sample had to be drawn from the two adjacent school year levels containing the most thirteen-year-old students. In South Africa this coincides with the traditional split between the primary and the secondary school. In some provinces the thirteen-year-olds may be in so-called intermediate or middle schools. [Schools with fewer than 40 students per standard were excluded from this list before sampling, since these were mostly farm schools where the control of the school was not well defined, and many of them were also inaccessible.]

Table 2 gives an indication of how the number of participating students spread over the nationally representative sample for the TIMSS Population 2 age group in South Africa was distributed over the nine provinces.

Table 2: TIMSS Population 2 sample

Province	Number of returns from students sampled in Std 5-6 in each province	Percentage of returned SA sample
Eastern Cape	1 061	9,93
Free State	802	7,51
Gauteng	1 469	13,75
KwaZulu Natal	3 100	29,03
Mpumalanga	903	8,46
Northern Cape	55	0,51
Northern	1 863	17,44
North-West	1 042	9,76
Western Cape	385	3,60
TOTALS	10 680	100

From Table 2 it can be seen that the size of the returned sample of participating students in the Mpumalanga Province represents 8,46% of the total returned sample for South Africa.

2.2 Administration of SA population 2 study

During the actual survey it was decided that both a Std 5 and a Std 6 class would be tested in cases where a middle (intermediate) school was sampled. This principle was accepted by the International Sampling Office, since some of the selected schools were unable to participate for various reasons.

The end result was that the numbers of Std 5 and Std 6 classes in the realised sample were not exactly 150 for either of the standards. Eventually testing materials and questionnaires from 135 Std 5 classes and 116 Std 6 classes were returned contributing successful data from a total of 251 South African classes to the international Population 2 sample for TIMSS.

The achievement tests were administered between August and December 1995. The total number of participating students whose scores were included in the international study was 5 301 for Std 5 and 4 491 for Std 6. The scores of the pupils were weighted so that the resulting average score obtained from the study would be an unbiased estimate of the population average.

3 Comparative achievement of Mpumalanga students in mathematics
by DJ Gray

The students' performance in TIMSS tests was measured on an 800-point scale for each country. In figure 2, the average performance in mathematics of Mpumalanga students at Std 6 level is compared to that of the SA national average as well as selected countries and the international average. The countries selected (Singapore, USA, Colombia) are some of those in which students performed well, average and below average respectively.

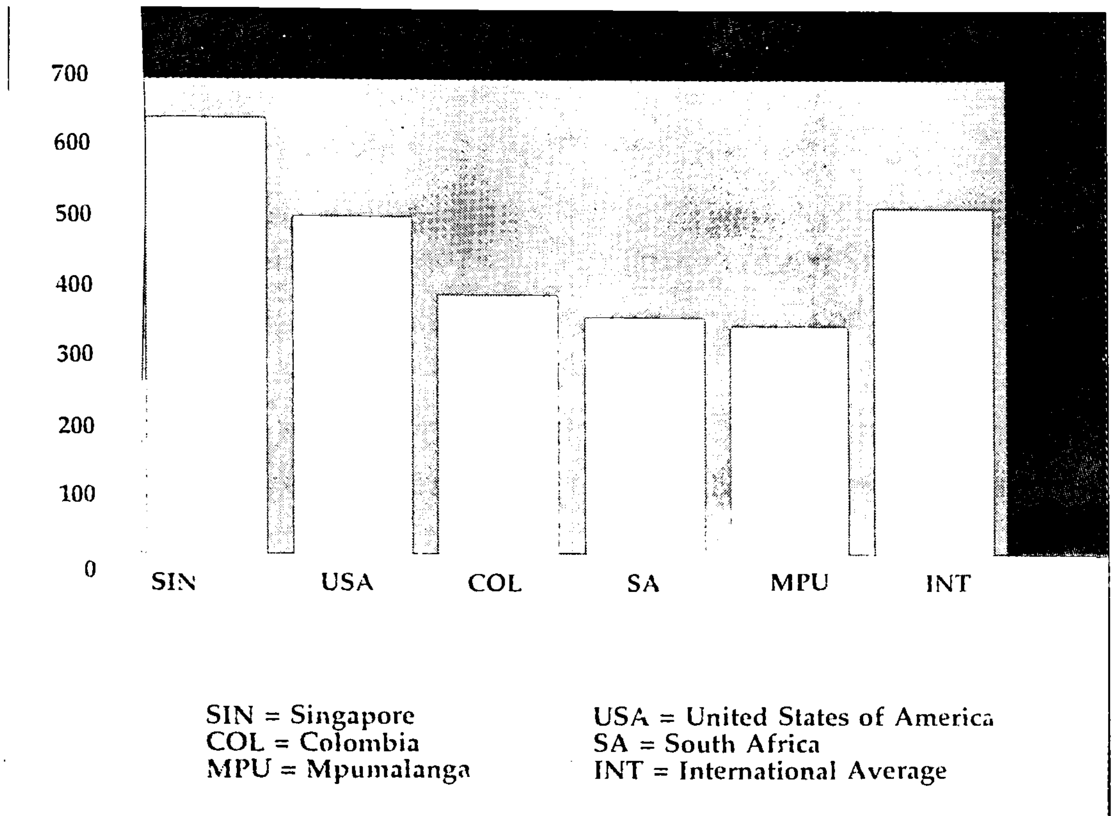
Figure 3 illustrates the Mpumalanga students' performance in mathematics for the Std 5 age group. Again they are compared to the national and international average as well as to 3 selected countries.

From Figure 2 it can be seen that -

- South African students performed poorly in comparison to students of the same age groups in other countries, with the lowest score of 354 points compared to the international average of 513. Singapore was the top performing country with 643 compared to the USA with 500 points. SA scored even lower than the other developing country in this figure, Colombia, which scored 385.

- Mpumalanga Province students in Std 6 scored below the national average in mathematics, 342 as opposed to the national average of 354.

Figure 2: Mpumalanga, national and international achievement at Std 6-Level in mathematics



From Figure 3 it can be seen that -

- South African students performed poorly in comparison to students of the same age groups in other countries, with the lowest score of 348 points compared to the international average of 484. Singapore was the top performing country with 601 compared to USA with 476 points. SA scored even lower than the other developing country in this figure, Colombia, which scored 369. The difference between the South African Std 5 and Std 6 students was very small, only 6 points. This was also the lowest increase from Std 5 to Std 6 out of all the countries participating.

- The Mpumalanga Province students scored higher than only two other provinces in the Std 5 mathematics and somewhat below the national average for this Std (337 compared to 348).

Figure 3: Mpumalanga, national and international achievement at Std 5-level in mathematics

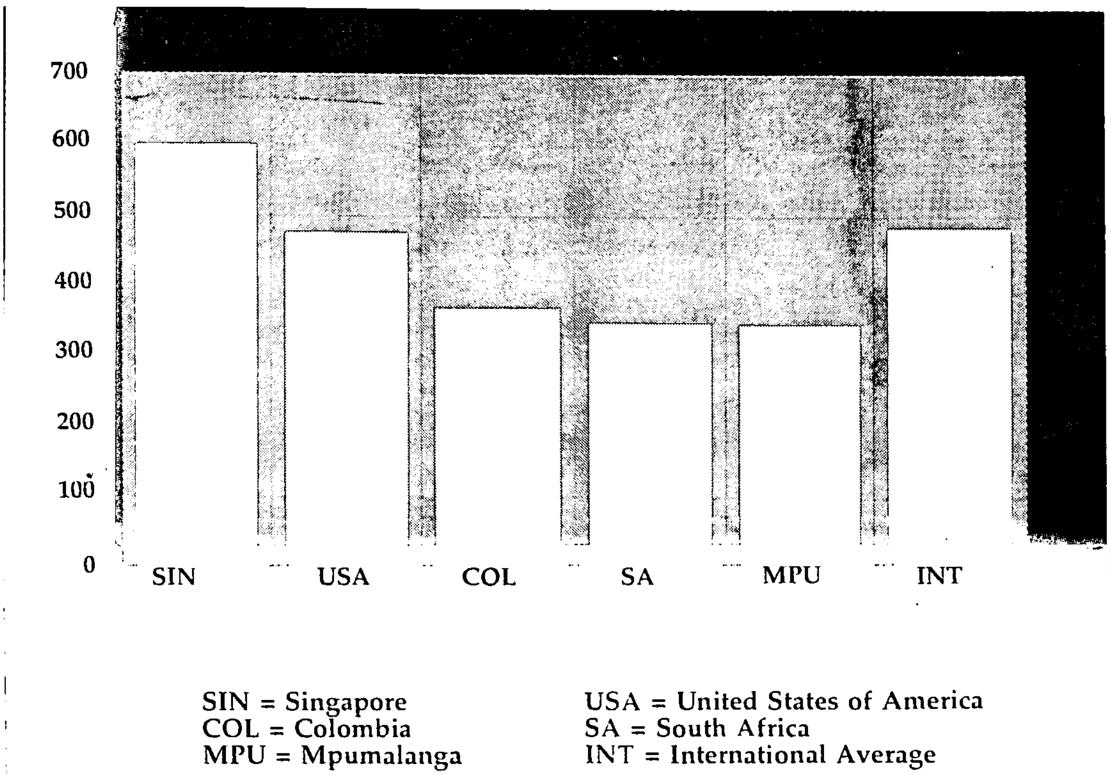


Table 4 illustrates the range of scores measured for student achievements in the TIMSS mathematics tests in the Mpumalanga Province.

Table 3: Student achievement In TIMSS mathematics questions In the Mpumalanga Province

Year level	Number of students who participated in the Mpumalanga Province	Average score achieved in Maths	Minimum score recorded	Maximum score recorded	Standard deviation
Std 5	459	337	149	524	58
Std 6	444	342	157	583	63

Although the average scores for Std 5 and Std 6 are low, it can be seen that there are some students in the Mpumalanga province sample who scored above the international means. See section 5 for further comment on this table.

4 Comparative achievement of Mpumalanga students in science

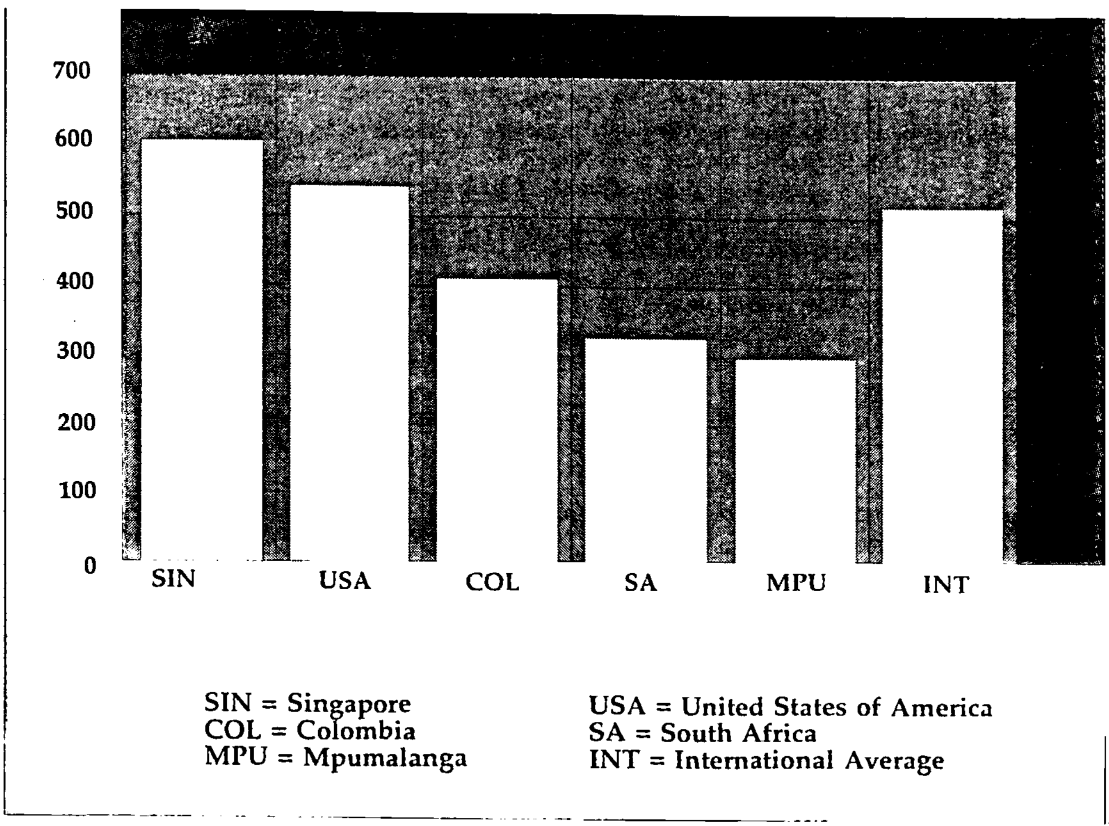
by D.J. Gray

The students' performance in TIMSS tests was measured on an 800-point scale for each country. In Figure 4 the average performance in science of South African students at Std 6 level is compared to that of selected countries and the international average. The countries selected are those in which students performed well, average and below average. Figure 5 illustrates the Mpumalanga students' performance in science for the Std 5 age group. Again they are compared to the international average as well as to 3 selected countries.

From Figure 4 it can be seen that:

- South African students performed poorly in comparison to students of the same age groups in other countries, with the lowest average score of 326 points compared to the international average of 516. Singapore was once more the top performing country with 607 compared to the USA with 534 points. SA scored even lower than the other developing country in this figure, Colombia, which scored 411.
- In the Std 6 findings the Mpumalanga Province students recorded a average score of 298.5 as compared to the national average of 326

Figure 4: Mpumalanga, national and international achievement at std 6-level in science

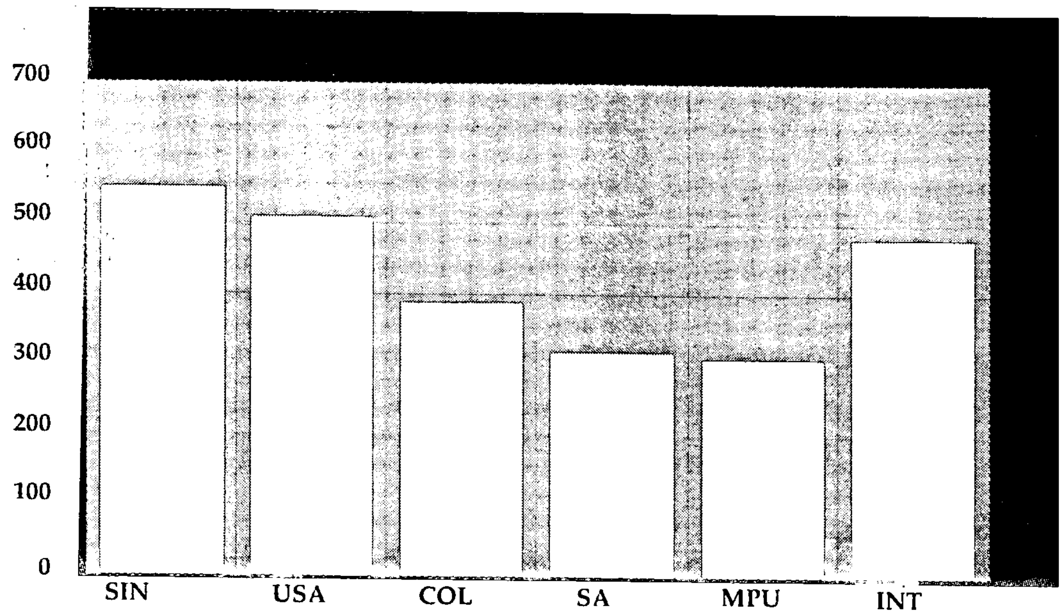


From Figure 5 it can be seen that:

- South African students performed poorly in comparison to students of the same age groups in other countries, with the lowest score of 317 points compared to the international average of 479. Singapore was once more the top performing country with 545 compared to USA with 508 points. SA scored less than the other developing country in this figure, Colombia, which scored 387. The difference between the performance of the South African Std 5 and Std 6 students was again very small, only 9 points. Once again this represented the smallest improvement between the two years out of all the countries.

- The Mpumalanga Province average for Std 5 science average score at 308 was again below the national average of 317 and substantially below the international average which was 479. Surprisingly, the Std 5 Mpumalanga average science score is higher than the Std 6 score.

Figure 5: Mpumalanga, national and international achievement at std 5-level in science



SIN = Singapore
COL = Colombia
MPU = Mpumalanga

USA = United States of America
SA = South Africa
INT = International Average

Table 4 illustrates the range of scores measured for student achievements in the TIMSS science tests in the Mpumalanga Province.

Table 4: Student achievement in TIMSS science questions in the Mpumalanga Province

Year level	Number of students who participated in the Mpumalanga Province	Average score achieved in science	Minimum score recorded	Maximum score recorded	Standard deviation
Std 5	459	308	50	595	93
Std 6	444	298	75	664	89

Although the average scores for Std 5 and Std 6 are low, it can be seen that there are some students in the Mpumalanga province sample who scored above the international means. See section 5 for further comment on this table.

5 Comments on results and findings for Mpumalanga Province
by DJ Gray

5.1 Scores in mathematics and science

- The average Std 6 score for mathematics in Mpumalanga Province is 342 which is somewhat below the national average of 354. In science the Mpumalanga Province average of 298 was noticeably lower than the national average of 326.

- The Std 5 results for mathematics show that the Mpumalanga Province sample group had an average of 337 compared to the national average of 348. In science the average score of this group was 308, compared to the national average of 317.

- Comparison with other provinces shows that the Mpumalanga Province was one of the middle range achieving provinces. Mpumalanga Province also failed to perform well in international terms.

- The Std 5 results for Mpumalanga Province are equally disappointing, except for the fact that the Std 5 science average scores were relatively slightly better that those for mathematics.

- Another method of comparing the Mpumalanga students with their national and international counterparts is shown in Table 6. In this table the percentage of Mpumalanga students scoring above or below certain benchmarks is given.

Table 5: Percentage of Mpumalanga students scoring above or below certain benchmarks

	Mathematics Std 5	**Mathematics Std 6**	**Science Std 5**	**Science Std 6**
Percentage of Mpumalanga students scoring above the international average	1,3	2,3	5,2	4,3
Percentage of Mpumalanga students scoring above the national average	40,5	39,0	40,5	30,0
Percentage of Mpumalanga students scoring below 250 points	6,3	4,1	26,6	27,3
Percentage of South African students scoring below 250 points	4,5	3,8	23,4	23,3

The Mpumalanga Province results show clearly the small increase in achievement from Std 5 to Std 6. In the case of science, Std 6 results are poorer than the Std 5 results.

5.2 Students' background

As mentioned earlier, questionnaires requesting background information were completed by all students. Later, responses to the questionnaire will be analysed in some detail for each province, so that judgements can be made on which factors covered by the questionnaire are related to the test results.

A preliminary analysis of the student questionnaire responses is given below.

- Language of instruction vs. home language is an issue of considerable importance in South African education. In the Mpumalanga Province, Std 5 student questionnaire returns reveal that 21% of students use the language of instruction at home 'always' or 'frequently'. 23% of students claim never to use the language of instruction at home. The remaining 56% of students use the language of instruction at home occasionally. These figures are close to the national averages for use of language of instruction in the students' homes.

- With regard to household services such as electricity supply which influences students' opportunities to learn, just over 71% of the sampled students have this facility in their homes.

- For Std 5, just over 89% of students claim to receive mathematics homework 'always' or 'regularly' and 85% claim that it is 'regularly checked' by the teacher. In the case of science, 80% of the Std 5 students receive home work 'always' or 'frequently' and 77% say that it is 'checked regularly'. The science teachers in Std 5 set less homework than their mathematics counterparts but supervise it equally closely. The Std 6 students receive regular homework (84-87%) in both subjects. More than 85% report that homework is checked by the teachers in both subjects.

- The students' attitudes toward mathematics show that in Std 5 just under 64% 'enjoy' mathematics and slightly more students (65%) 'enjoy' science. At Std 6 level, the percentages of students claiming to enjoy mathematics and science are about the same as for Std 5.

- The percentage of students who feel it is important to do well in mathematics and science decreases from Std 5 to Std 6. It decreases from 90 to 84% for mathematics and from 91 to 86% for science.

- The educational level attained by the parents of the Mpumalanga Province sample of students was such that 29% of the Std 5 mothers had received comparatively little education (up to incomplete secondary school or less) whilst for the fathers this figure was 26%.

- Just under 24% of both parents were reported as having received a complete secondary school education and/or vocational training. 25% and 28% of mothers and fathers respectively were claimed to have received complete or partial tertiary education. The figures for the parents of Std 6 students show that a greater proportion (32%) of the fathers of this group had received at least some tertiary education. The returns for this question were characterized by a substantial number of 'don't knows'.

5.3 Concluding remarks

As mentioned previously, further analysis of the data , from the tests and the student questionnaires, is underway. A few examples of the kind of information that the HSRC could provide to the Mpumalanga province, once the analysis is complete, are:

- What are the main factors in the Mpumalanga Province that influence mathematics and science achievement in the middle school years? International studies suggest that the school plays a much bigger role than the home in determining mathematics and science achievement in developing countries. Is this also true in the Mpumalanga Province?

- Why does science achievement lag behind mathematics achievement in disadvantaged schools, whereas the reverse is true for better-resourced schools? Does it indicate that science teaching is a bigger problem than mathematics teaching in disadvantaged schools, or are there other reasons?
- Some of the disadvantaged schools show much higher achievement than others, in spite of difficult circumstances. Are there special factors at work here, from which we can learn?

6 References

Beaton, A.L., *et al.*, *Mathematics Achievement in the Middle School Years*, TIMSS, Boston College, 1996 a.

Beaton, A.L., *et al.*, *Science Achievement in the Middle School Years*, TIMSS, Boston College, 1996 b.

CEPD, *Curriculum*, Johannesburg, 1994.

Claassen, N., *Sampling Procedures for TIMSS in South Africa*, HSRC, 1995.

HSRC TIMSS Data Collection, 1995.

Keeves, J.P., *IEA Monograph: The World of Learning*, Key Selected Findings from 35 years of IEA Research, The Hague, 1995.

Martin, M.O. and Kelly, D.L. (eds), *Third International Mathematics and Science Study, Technical Report* Volume 1, Boston College, 1996.

Martin, M.O. and Mullis, I.V.S (eds), *Third International Mathematics and Science Study, Quality Assurance in Data Collection*, Boston College, 1996.

Robitaille, D.F. *et al.*, *TIMSS Monograph No.1: Curriculum Frameworks for Mathematics and Science*, Pacific Educational Press, Vancouver, 1996.

Robitaille, D.F. and Garden, R.A., *TIMSS Monograph No.2: Research Questions and Study Design*, Pacific Educational Press, Vancouver, 1993.

Venter, E.J., Tables compiled from TIMSS dataset using Statistical Analysis System (SAS) Programme.

White Paper on Education and Training, Government Gazette No. 16312, Cape Town, 1995.

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