



Achievement studies and TIMSS

In November 2002, about 9 000 Grade 8 learners from South African public schools participated in the Trends in International Mathematics and Science Study (TIMSS). South Africa was one of 50 countries (and educational systems) that participated in this study. TIMSS is a project of the International Association for the Evaluation of International Achievement (IEA), an organisation that has been conducting cross-national studies since 1959. The Human Sciences Research Council (HSRC) has co-ordinated and managed the South African part of the study. TIMSS 2003 is the third TIMSS that South Africa has participated in – the others being in 1995 and 1999.

This analytical-descriptive report provides information, gained during TIMSS 2003, about South Africa's performance in mathematics and science at Grade 8 level. The report will first provide information regarding South Africa's performance in relation to the other countries that participated in the study, and the cross-national comparisons will highlight South Africa's performance in relation to the other participating African countries. The report will then provide information on performance in mathematics and science within South Africa. The national analysis will also track changes over time. This national analysis is important to inform policy and planning within the country. In addition to achievement data, this report will include contextual information relating to learners, teachers and schools.

International achievement studies in mathematics and science

International studies of educational achievement have been conducted since the 1960s. There is an increasing number of studies and participating countries. There are many reasons why countries participate in multi-country and international achievement studies. Most obviously, the studies permit a comparison of performance with other countries. Participation affords access to technical expertise in measurement and analysis, which can be shared and transferred. It may also provide access to resources supporting some of the data-collection costs. Development agencies often encourage participation as a way of increasing government's accountability for improving quality and performance within the education domain.

Mathematics and/or science assessments form part of the following comparative studies: the previously mentioned Trends in International Mathematics and Science Study (TIMSS), Monitoring Learning Achievements (MLA), the Southern Africa Consortium for Monitoring Educational Quality (SACMEQ)¹ initiated studies, and Performance in International Student Achievement (PISA). The promoters of these studies argue that the studies provide information to help improve the quality of education and that cross-national comparisons have a value in benchmarking performance.

Each international achievement test has its own historical roots, its own framework for assessment, and its own sponsors. TIMSS assesses mathematics and science knowledge and skills based on the school curriculum for Grade 4 and Grade 8 learners. Since 1995, TIMSS has conducted these studies on a four-year cyclical basis. TIMSS uses the curriculum as the organising concept in considering how educational opportunities

¹ Programme d'analyse des systèmes éducatifs de la CONFEMEN (PASEC) is the French equivalent of SACMEQ.

are provided to learners. This model is structured upon three aspects: *the intended curriculum*, the *implemented curriculum* and the *achieved curriculum* (Mullis et al. 2003). The IEA has commissioned the Boston College International Study Centre (now called TIMSS and PIRLS Study Center) to co-ordinate the study from Boston. Donor governments and agencies support and encourage developing countries' participation. For the TIMSS 2003 study, the World Bank supported 20 countries and the United Nations Development Program (UNDP) supported five Middle-Eastern countries. South Africa participated in TIMSS 1995, TIMSS 1999 and TIMSS 2003, at the Grade 8 level. In 1999 there were 38 participating countries, including Morocco and Tunisia from the African continent. Fifty countries (and educational systems) participated in TIMSS 2003 and the two additional African countries were Botswana and Ghana.

The MLA project, a UNESCO/UNICEF initiative, was set up in 1992 as part of the international monitoring of Education for All (EFA). MLA aims to monitor the progress of participating countries towards achieving their own EFA goals. The 1999 MLA (Africa) project report (Chinapah et al. 2000:2) indicated that the results of the MLA project may be used to assess progress towards Indicator 15 of the EFA 2000 Assessment, which is, 'the percentage of learners having reached at least Grade 4 primary schooling who master a set of nationally defined basic learning competencies'. The MLA project developed tests to measure the learning achievement of Grade 4 learners in respect of their basic learning competencies, which describes the minimum basic knowledge and analytical skills that learners should be expected to have. In 1999, MLA assessed Grade 4 learners in 18 African countries in the areas of life skills, reading and numeracy, and South Africa was one of the participating countries. In addition to assessing achievement, the MLA project notes the capacity building of national research co-ordinators and the sharing of skills among participating countries as an objective.

The PISA study is steered by the governments of participating countries through the Organisation for Economic Co-operation and Development (OECD). The PISA survey was first conducted in 2000 and is administered every three years. PISA (an internationally standardised assessment instrument) assesses, on a cyclical basis, competencies in mathematical and scientific skills and reading literacy. PISA is based on the model of lifelong learning and assesses 15 year olds' capacity to use their knowledge and skills to meet real-life challenges, rather than how well they have mastered a specific school curriculum. In all PISA cycles, the domains of reading, and mathematical and scientific literacy are assessed. The main focus of PISA 2000 was on reading literacy; PISA 2003 concerned mathematical literacy and the domain of problem solving, while the focus of PISA 2006 will be on scientific literacy. Forty-three countries (of which one-third were non-OECD countries) participated in PISA 2000; 41 countries participated in PISA 2003, and at least 57 countries will participate in PISA 2006.

SACMEQ, a collaborative network of 15 African Ministries of Education, is a long-term initiative aimed at continuous assessment and monitoring of education quality and learning achievement at various levels of the education system. The programme is also aimed at making informed policy suggestions towards improving the provision of quality education. The SACMEQ project is designed to build the capacity of educational planners in Ministries of Education when undertaking large-scale educational policy research. SACMEQ I Project (1995–1999) involved seven Ministries of Education and focused on reading. SACMEQ II Project (2000–2003) involved 14 Ministries of Education, including South Africa's, and assessed Grade 6 mathematics and reading achievement in 15 Southern African countries.

Benefits and limitations of achievement studies

There has been much written about the concerns and value of conducting international and national achievement studies (Goldstein 1995; Beaton et al. 1999; Shorrocks-Taylor & Jenkins 2000; Kellaghan & Greaney 2001; Taylor et al. 2003). The South African debates surrounding such studies mirror the international debates, with the additional concern that these studies do not provide information on every area of South Africa's education transformational goals, namely, access, redress, equity and quality. More particularly, for South Africa, it may be that success should be judged across these areas, not just in terms of aggregate levels of performance. Participating in international, cross-national achievement studies has both benefits and limitations. Reddy (2005) discussed this in detail in the article 'Cross National Achievement studies: Learning from South Africa's participation in International Mathematics and Science Study.'

The main concerns regarding international comparative studies relate to the following. Firstly, the comparisons or the league table presentation of the results could take on a competitive edge, with negative consequences. TIMSS uses the curriculum as the major organising concept and a way of explaining achievement. However, this approach raises concerns, as it may give rise to pressure for the gradual convergence of differing curricula. In poorer countries, this increased focus on curriculum reform may well be at the expense of engaging in more critical areas of reform, for example, the provision of a basic infrastructure. Some countries (such as England and the United States) are concerned about the possible negative consequences of the TIMSS results trying to shape the national curricula and return the curriculum to a 'back-to-basics' approach, to the detriment of areas in which children are doing well. Furthermore, although instruments are intended to be designed on the basis of consensus among countries, the instruments may be influenced by, and better suited to, the more influential countries. In addition, the background information may not be able to explain what causes higher or lower achievement. For example, the contribution to variations in achievement due to school and home factors in richer and poorer countries is different and needs to be accommodated in the instruments. Large-scale assessment studies are expensive and need both financial and human resources. For poorer countries, especially, there are opportunity costs linked to participation in such studies. Achievement tests are generally paper-and-pencil tests and the mode of testing may influence what participants say about performance.

Comparative achievement studies, whether loved or hated, catalyse a great deal of debate when the results are published, which can, in turn, result in beneficial action being taken. Firstly, for example, the publication of the TIMSS 1999 results in South Africa provoked widespread debate and was one of the events that helped bring about an increased allocation of resources to science and mathematics at school level. Thus, the publication of comparative achievement results can be used as a lever for reform. Secondly, TIMSS has the potential to harness positive changes in countries where policy-making may not be informed or influenced by key research, or in countries where there are no robust civil society structures lobbying for change. In countries with outdated curricula and an insufficiently strong academic voice advocating change, it is these international agendas that can, sometimes, effect this change. Thirdly, comparison of performance with countries of similar context and histories could provide a basis for benchmarking a country's individual performance and thus expose the strengths and weaknesses of its education system. Fourthly, not all countries have the resources and capabilities to organise national studies. The international research organisations possess an expansive

repertoire of technical skills suited to the design and management of these studies. These resources could be used to assist countries which lack these skills.

Achievement studies in South Africa

Countries undertake national assessments and systemic evaluation of their educational system to monitor the performance of that system, improve accountability, and identify opportunities for improving learning outcomes. The National Education Policy Act of 1996 makes provision for the DoE to conduct a systemic evaluation. The main objective of systemic evaluation is 'to assess the effectiveness of the entire system and the extent to which the vision and goals of the education transformation process are being achieved by it'. Systemic evaluation determines the strengths and weaknesses of the learning system on a periodic basis and provides feedback to all the role players, in order that appropriate action may be taken to improve the performance of the learning sites and learning systems.

In 2001, South Africa undertook a systemic evaluation at the end of the Foundation Phase of schooling. Grade 3 learners were assessed in the areas of literacy, numeracy and life skills. In 2004, the systemic evaluation was conducted at the Grade 6 level in literacy, science and mathematics. According to DoE policy, they will conduct a systemic evaluation at Grade 9 level in 2007.

South Africa has participated in several multi-country studies and undertaken national and provincial assessment studies. In many of these studies low achievement scores in mathematics and science have been recorded; a situation causing considerable concern. A response to low scores could be that the study is inappropriate for the country in question. However, with consistently low scores, it is more useful to shift the debate to centre on how we use the achievement information to inform policy and practice issues in the country. The HSRC decided to co-ordinate the South African participation in TIMSS (with its various limitations) in order to benchmark its performance against other countries, and to provide comparative information relevant to the design and development of strategies for raising mathematics and science standards. The data and the national report provide information that may be of use to national policymakers and practitioners.

TIMSS

TIMSS is a project of the IEA. The main aim of TIMSS 2003 was to provide trend information on learner achievement in mathematics and science. TIMSS 1995 was the first in a series of mathematics and science assessments to be conducted every four years for the provision of this trend information. Boston College's International Study Center for TIMSS and PIRLS² manages the international project activities. The other organisations working closely with Boston College are Statistics Canada in Ottawa, The IEA Data Processing Center in Hamburg (Germany), and The Educational Testing Services in Princeton, New Jersey, USA.

In TIMSS, learners completed achievement tests in mathematics and science and answered questions on their home background, prior experiences and their attitudes towards

² PIRLS is the IEA's Progress in International Reading Literacy Study.

mathematics and science. Mathematics and science teachers completed questionnaires on, inter alia, their teaching preparations, teaching styles, professional development, and attitudes towards science and mathematics. Principals completed questionnaires on school characteristics, parental involvement, Grade 8 teaching and teachers of mathematics and science, learner behaviour, and resources and technology.

The Assessment Technology and Education Evaluation Research Programme in the HSRC conducted TIMSS 2003 in South Africa. The HSRC had also conducted TIMSS 1995 and TIMSS 1999. Financial support for the study came from two sources: the World Bank provided the IEA with funds to assist some countries with the participation costs, South Africa being one of these countries. In-country costs were met by a parliamentary grant the Department of Science and Technology (DST) allocated to the HSRC.

TIMSS is one of the few studies providing national, quantitative data on the state of the South African education system. In-country there are many small-scale, qualitative studies providing information on aspects of science and mathematics education. TIMSS 1995 offered the first national analysis of learner achievement, and the subsequent cross-national studies have provided systemic information and external benchmarking of the South African educational system.

Countries participating in the TIMSS 2003 Grade 8 study

TIMSS 2003 involved 46 countries and four benchmarking participants. The 46 countries were:

Armenia	Iran, Islamic Republic of	Palestinian National Authority
Australia	Israel	Philippines
Bahrain	Italy	Romania
Belgium (Flemish)	Japan	Russia Federation
Botswana	Jordan	Saudi Arabia
Bulgaria	Korea, Republic of	Scotland
Chile	Latvia	Serbia
Chinese Taipei	Lebanon	Singapore
Cyprus	Lithuania	Slovak Republic
Egypt	Macedonia, Republic of	Slovenia
England	Malaysia	South Africa
Estonia	Moldova, Republic of	Sweden
Ghana	Morocco	Tunisia
Hong Kong, SAR	Netherlands	United States
Hungary	New Zealand	
Indonesia	Norway	

The four benchmarking participants were:

Basque Country, Spain
 Indiana State, US
 Ontario Province, Canada
 Quebec Province, Canada

Summary

Since 1994, South Africa has participated in cross-national achievement studies and, since 2001, conducted national achievement studies. Cross-national studies have both benefits and limitations. The external benchmarking the studies offer, means individual countries can critically assess their own educational standing and performance, which represents a definite benefit. Furthermore, an examination of countries displaying similar recorded characteristics can be useful in generating or discarding hypotheses of what may cause improved performance. Regarding limitations, the principal disadvantage could be that if group performance is low, there could be a 'floor effect' of scores; thus, one could not use the data to develop effective models explaining performance.