Introduction

Sarah Howie & Tjeerd Plomp

The International Association for the Evaluation of Educational Achievement (IEA) has implemented many international comparative studies since its inception in 1959. These studies are largely, although not exclusively, large-scale assessments of student performance in a variety of different fields. Amongst these TIMSS (Trends in Mathematics and Science Study) has been undertaken three times, viz in 1995, 1999 and 2003 (with southern hemisphere countries collecting data in the year before). More than 20 countries have participated in at least two of the TIMSS studies, which permits countries and researchers, in particular, to analyze their national data across two or sometimes even three studies. In addition to the overall monitoring of trends by each country, these trend data permit countries to study the extent to which gaps between sub-groups of students within countries have reduced or narrowed over time. This may also allow the study of the factors, which may contribute to the gaps as well as any possible changes. As in most cases the 'gaps' in achievement are undesirable for most education systems, policymakers are constantly seeking to close these, but most often only succeed in narrowing them which is considered a more realistic goal.

Large-scale assessment is now commonly implemented across the world and has a long history in Western countries (Cuttance, 2000; Greaney & Kellaghan, 1996; Howie & Plomp, 2005; Jones, 2003; Plomp,Howie,&McGaw, 2003).Whilst it has become popular with policymakers providing them with a measure of quality assurance across the system, it is also frequently criticised by educationists in particular as discussed in the March 2007 issue of Studies in Educational Evaluation. However, there are implications for all stakeholders and policymakers within the education system when these international comparative studies are conducted. In particular, in the studies within participating countries, the effectiveness of large-scale assessments (including international comparative studies) to monitor differences (as well as similarities) within and between groups in terms of gender, culture, ethnicity, location and others is in principle an important function of such studies. They also serve to enlighten the broader community about such differences, either confirming anecdotal evidence and concerns of policymakers or public perceptions, sometimes highlighting prejudices and serve to informpolicymakers and other stakeholders in the education system. Bymonitoring the progress over time, these studies are critical in ascertaining the extent of the prevailing gap. In cases where this discrepancy is particularly undesirable or initially unexpected, the studies serve as an importantmeans to monitor the performance of the lesser- or under-performing group and to monitor its improvement in line with the better-performing group.

In doing this, benchmarks may also be provided by such studies, either by the performances of the better-performing groups on the curriculumstandards or by other countries' performances.The latter is more contentious. However, from the perspective of what is possible, adults often underestimate children's ability. For instance, where 13-year olds in a different environment have been exposed to and have mastered what is considered a difficult science topic, this may serve as important information or even as a benchmark in another context, where this may not even have been considered.

Due to the strong equity agenda in education internationally and currently promoted particularly by the Education for All mission (UNESCO, 2007), we feel that the theme 'Narrowing the gap?' is especially important and of interest for readers worldwide. With an eye on the richness of the variety of contexts within the TIMSS studies over the years (Howie & Plomp, 2006) and therefore a number of very different education systems to explore and learn from, the special issue deliberately brings together authors from very different backgrounds and education contexts from Australasia, Middle East, Central Europe, Western Europe and Africa (Australia, Israel, Netherlands, Slovenia, South Africa) in addition to a international comparative paper. Each is pre-occupied with important questions related to differences in sub-groups, which are evident within that context. The equity agenda highlighted by initiatives such as Education for All is an important area for further research that seeks to establish the status quo and to understand the local and relevant dynamics within each context.

This special issue reports on the secondary analysis of the IEA TIMSS data all focusing on gaps between sub-groups. One choice was to select one type of sub-group comparison in a number of countries (e.g. gender), because then a certain type of gap could be analysed in a number of countries, each within its unique context. However, mix of articles provides an insight into the specific situations in some countries that there is a focus in 'gaps' between 'unique' sub-groups that may not be found in other countries. So, apart from gender issues, which occupy the interest of educational policy makers and practitioners across the world, a number of fairly unique cases could be presented. These included Israel, which has a unique situation with a native Hebrew speaking and a native Arab speaking sub-population. The other case being South Africa — this country, as a developing country, is quite unique in the TIMSS studies (Howie, 2002) in having 'third world' and 'first world' schools as a result of political policies in the past elevating the 'white' population at the expense of the 'black' population, the results of which have created a huge gap. In the case of the latter, there was no gender difference in any of the TIMSS studies, but the inequity in terms of the gap between ethnic groups is extremely problematic.

The communication between the SEE-editor and the guest editors resulted in the conclusion that four articles would focus on gender differences, whilst the articles on TIMSS results in Israel and South Africa will focus on ethnic sub-groups that are specific for these countries (as is explained above). Undertaking the analyses

of the gaps in achievement by various sub-groups in different contexts allows us to illustrate in this special issue that repeated and international comparative trend studies may result in datasets that are rich and powerful to study national comparisons between various sub-groups.

This special issue consists of six articles. Five (of the six) articles will look at sub-groups in their country and study differences in performance in math and/or science between those groups looking for explanatory factors. Three articles focus on science only, one on mathematics only and two on mathematics and science. An assortment of analytical methods is used with three of the articles applying multi-level or hierarchical linear modelling. The data sources vary from the study in 2003 (the focus of three articles but included by five articles), 1999 (the focus of one article, but included by a second) and 1995, which is included by two articles in their trend analyses. The nature of two of the articles was to evaluate the trend data, one within country and the other across various countries. In terms of the topic of the analyses, gender differences were studied in Australia (Grade 8 science), the Netherlands (Grade 4, mathematics) and Slovenia (Grade 8, science), ethnic differences between Arab-speaking and Hebrew speaking sub-populations will be studied for Israel (Grade 8, science), and between traditionally white schools and black schools in South Africa (Grade 8, science). The sixth article will take a multi-national approach in analyzing trends in gender differences across, looking at curricular factors and the item formats in 16 countries that participated in TIMSS 1995, 1999 and 2003 for mathematics and science. One clear perspective emerging from this issue that both the nature and the extent in the gap in achievement is highly dependent on the context inwhich this takes place and the gaps themselves are difficult to generalise across countries and contexts.

This special issue contains the following contributions:

Trends in gender differences in mathematics and science (TIMSS 1995–2003)
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The article contains three major parts: first the gender differences are illustrated within the three TIMSS cycles and the changes in the differences over time are examined. In a second step the achievement of females and males is analyzed in regard to the different content areas. Only those areas are regarded which are common in all three cycles. Finally the influence of the item format on the gender differences in mathematics and science is analyzed, opposing multiple-choice versus constructed-response questions. The major objective of the article is to examine whether the results and patterns with regard to gender differences in achievement found in TIMSS 1995 can be observed also in later TIMSS cycles and try to answer the question to what extent is the gender gap is narrowing over the time?

Examining the evidence from TIMSS: Gender differences in year 8 science achievement in Australia

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The study of science has been a focal area of concern for educators at most levels in Australia for the past few decades. In particular, concerns have been raised about the low levels of participation in secondary and tertiary level science courses by girls and of the male predominance in subjects such as physics and chemistry.

In TIMSS 1995 and 2003, there were a large number of countries, which exhibited significant gender differences in science achievement in junior secondary school science, all in favour of boys. In TIMSS 1995 in Australia there were no significant gender differences at this level, but in TIMSS 2003 year 8 boys scored significantly higher than year 8 girls in science. In addition, in 2003 twice the proportion of boys than girls achieved the advanced international benchmark, whilst girls were outscored by boys in all of the content areas, exhibited lower levels of self-confidence than boys, and did not value science to the same extent as boys.

This paper explores gender differences in science achievement of Australian year 8 students by exploring the influences on achievement and self-confidence in learning science, separately for males and females.

The Dutch gender gap in mathematics: Small for achievement, substantial for beliefs and attitudes

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Studies on gender and mathematics have shown that the disadvantage of girls in mathematics achievement has become very small during the last 40 years. However, the results of TIMSS-2003 showed that for some countries, such as the Netherlands, gender equity in math is still far from reality. Although in the Netherlands, gender differences in TIMSS-2003 in Grade 4 were smaller compared to TIMSS-1995, this decrease was not the result of an improvement in the mathematical skills of girls, but was caused by the decrease in average achievement of boys. The TIMSS international report showed that the Netherlands was the only country in which this occurred (Mullis et al. 2004). Furthermore, Grade 4 boys enjoyed mathematics significantly more and showed a higher confidence in their mathematical skills than girls did. This article aims at explaining how these differences can be explained given the influence of student, teacher and school background characteristics.

Science achievement, gender differences and experimental work in classes in Slovenia as shown by TIMSS studies

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Since 1999, Slovenia is in the process of introducing a 9-year compulsory education to replace the old 8-year compulsory education (with the entry age becoming 6-year instead of 7-year). This system change incurs a number of other changes such as in the curriculum and in teaching approaches. The purpose of this study is to investigate, using the TIMSS 2003 data, whether the 'new' Slovenian science curriculum shows different relationships between achievement and gender, attitudes towards science and the amount of students' experimental work in school, as compared to the 'old' curriculum.

Compared to students in the 'old' curriculum, students in the 'new' curriculum showed a slight decrease of their overall science achievement and large decrease in gender differences. The study also shows that a moderate amount of time devoted to student experimental work seems to raise science achievement of students as well as their low attitudes towards learning science.

Closing gaps between Hebrew-speaking and Arabic-speaking students in Israel: Findings from TIMSS-2003

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Closing achievement gaps between sub-populations in Israel, and amongst them between students in the Hebrew-speaking and Arabic-speaking schools, continues to be one of the priorities of Israel's education system. TIMSS-2003 findings provide the first evidence that efforts made during the 1990s to close these gaps were in the right direction although inequality in input between the two sectors still remains. This paper on the one hand highlights factors that still perpetuate the achievement gap and on the other, detects factors that explain why these gaps have narrowed.

Closing the achievement gap between science classrooms and the persistence of historic inequalities

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The science teacher-level data from TIMSS'99 were analysed with a view to evaluating the politicized gap between what are viewed as well-functioning and provisioned classrooms (predominantly housing white teachers and white or mixed classes in urban areas) and not-well functioning and poor provisioned

classrooms (largely African teachers and African pupils in periurban and rural areas). The data were explored to gain insight into similarities and differences in classroom conditions (and a few on school-level) and teacher actions and the relationship between these and pupils' achievement in science in South African classrooms. Significant differences in achievement were found between classrooms headed by teachers with different racial profiles, where the pupils' average class science score taught by white teachers (most commonly found in the most privileged environments) was significantly higher than those taught by African teachers (most often found in less privileged settings). Furthermore, the average class science score in rural areas was significantly lower than classes in urban areas. These blatant inequalities contribute to what is believed to be an increasing gap in achievement in science.

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