TIMSS in a Western European Context

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ABOUT TIMSS

This special issue focuses on national findings and analyses from five Western European countries that participated in the Third International Mathematics and Science Study (TIMSS). TIMSS is an international, comparative study designed to provide policy makers, educators, researchers, and practitioners with information about mathematics and science achievement and its learning contexts in order to enhance mathematics and science learning within and across systems of education. TIMSS is conducted under the auspices of the International Association for the Evaluation of Educational Achievement (IEA). It is co-ordinated by the International Study Centre at Boston College in the United States. More than 40 educational systems participate in TIMSS. It is the most complex IEA study to date and the largest international comparative study on educational achievement ever undertaken. The study focuses on three populations of students (Beaton, Martin, & Mullis, 1997; Robitaille & Garden, 1996):

• Population 1, the two adjacent grades containing the most 9-year-olds at the time of testing, third- and fourth-grade students in most countries, students in Years 4 and 5 in England.
• Population 2, the two adjacent grades containing the most 13-year-olds at the time of testing, seventh- and eighth-grade students in most countries, students in Years 8 and 9 in England.
• Population 3, students in their final year of secondary school.

This special issue focuses on population 1 and 2 issues.

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Building on the approach of previous IEA studies, TIMSS has been conceptualised as an examination of mathematics and science curricula at three levels (Robitaille & Maxwell, 1996; Robitaille et al., 1993). The intended curriculum is composed of the mathematics and science instructional and learning goals as defined at the system level. It is embodied in textbooks, in curriculum guides, in the content of examinations, and in policies, regulations, and the official statements generated to direct the educational system. The intended curriculum may be described in the form of the concepts, processes, and attitudes students are expected to study and learn. The implemented curriculum is the mathematics and science content as interpreted by teachers and made available and taught to students. It is influenced by the intended curriculum, and by factors related to the context of the school and the teaching-learning process. The attained curriculum is the mathematics and science content that students have learned and their attitudes towards these subjects. What students learn will be influenced by what was intended for their learning and by the quality and types of opportunities made available to them. To aid in meaningful interpretation and comparison of results, TIMSS also collected extensive information about the social and cultural contexts for learning, much of which is related to variation among different educational systems.

In the northern-hemisphere countries, data collection took place in spring 1995. Twenty-four educational systems participated in population 1 (cf. Martin et al., 1997; Mullis et al., 1997) and 41 educational systems took part in population 2 (cf. Beaton, Martin, et al., 1996; Beaton, Mullis, et al., 1996). The design of the study included a wide variety of instruments. To measure the attained curriculum, a rotated mathematics and science achievement test was administered, in most countries in one intact class per grade. The mathematics test covered six and the science test covered five content dimensions. About one-fourth of the questions were in the free-response format requiring students to generate and write answers. Extensive information was collected about the home, the school, and national contexts using a broad array of questionnaires. The students who participated in TIMSS answered questions pertaining to their attitudes towards mathematics and science, classroom activities, home background, and out-of-school activities. Mathematics and science teachers of sampled students responded to questions about teaching emphasis on curricular topics, instructional practices, textbook usage, professional training and education, and their views on mathematics and science. The heads of schools responded to questions about school staffing and resources, mathematics and science course offerings, and teacher support. In addition, a volume was compiled that presents descriptions of the educational sys-
tems of the participating countries (Robitaille, 1997). In several countries also a performance test has been administered in the upper target grade. Besides, an extensive curriculum analysis was conducted (Schmidt, McKnight, Valverde, Houang, & Wiley, 1997; Schmidt, Raizen, Britton, Bianchi, & Wolfe, 1997).

SPECIAL ISSUE

This special issue focuses on findings from five Western European countries that took part in TIMSS populations 1 and 2: England, Germany, Sweden, Switzerland, and the Netherlands. It consists of eight contributions, covering a rich variety of topics and research methodologies. Six contributions pertain to population 2 and two to population 1; five focus on mathematics, one on science, and two on both mathematics and science. Some of the articles are primarily descriptive in nature by discussing issues like the characteristics of and performances on the TIMSS tests in the context of national curriculum priorities and appearances. Others focus on relational data analyses, using regression analyses, exploratory path analyses or structural equation modelling, aimed at gaining more in-depth understanding of how various factors contribute to outcomes of mathematics and/or science education. One contribution dwells on comparisons between the outcomes of TIMSS and the International Assessment of Educational Progress (IEAP, an international comparative study with data collection in 1991). In most articles an attempt is made to draw implications for the further development of TIMSS and for national or international efforts in research and educational improvement.

The first contribution (Kuiper, Bos and Plomp, the Netherlands) focuses on the issue of performance of Dutch population 2 students on the TIMSS mathematics test in the context of the curricular appropriateness of this test. Dutch population 2 students performed relatively well on the TIMSS mathematics test although influential mathematics educators heavily criticised the inappropriateness and unfairness of the test in terms of the new, application- and inquiry-oriented mathematics curriculum that was implemented beginning in August 1993. This new intended curriculum differs drastically from the old, more formal and abstract curriculum used before 1993. The article addresses how the discrepancy between students’ performance and appropriateness of the test should be interpreted, and whether there is a discrepancy.

Ramseier (Switzerland) conducted an analysis of the difficulty of single tasks in the TIMSS science test for population 2 and identified characteris-
tics that explain what tasks are especially difficult for Switzerland compared to other countries. The analysis shows that Swiss students are thoroughly prepared to investigate the natural world and to apply scientific principles. However, they are insufficiently prepared for questions about difficult topics, especially those using difficult technical language. This pattern of achievement closely reflects the priorities of Swiss science education, which has a limited time scope and focuses on scientific processes and on a child’s understanding of the immediate natural environment. The analysis helps to explain the divergent Swiss achievement in TIMSS and in the IAEP study that preceded it by 4 years, and indicates that curricular priorities have a strong impact on achievement. Remarkably, the relative achievement based on subgroups of tasks defined by cognitive requirements and terminological difficulty varies not only for Switzerland but for many other countries too.

According to mass media in Sweden, the results for TIMSS population 2 indicated that Swedish student achievement in mathematics was average. There were even reports that indicated that Swedish students had some of the lowest results in mathematics. The issue that is addressed in the third article (Adolfson and Henriksson) is whether the performance of Swedish students is average or bad indeed. To answer this, to their opinion the basis of comparison between the different countries needs to be discussed. In national mass media, the comparison was based on all more than 40 countries participating in TIMSS population 2. In the national report for Sweden a different selection of countries was presented (only the 25 countries that met the sampling requirements), with different results. This focuses the discussion on what approaches are used when comparing results from different countries in an international comparative study.

In a second Swiss contribution (Huber), the design and outcomes are presented of a study investigating co-ordination strategies within schools, their relationships to both teacher and student commitment to school, and the relationship between student commitment and student achievement in Switzerland. To her opinion, two different kinds of co-ordination strategies, structural and cultural, can be distinguished. Structural co-ordination strategies have to do with formal, lasting arrangements that allow an organisation to operate. These include roles, rules, procedures, and authority relations. Cultural co-ordination strategies are related to the nature of communications and the consensus on organisational goals in the school. Cultural mechanisms shape what teachers want to do. Drawn from TIMSS, the sample for the analyses included principals, teachers and students in classes at the lower secondary level in three Swiss cantons: Bale-Country,
Bern, and Zurich. Multiple regression analyses carried out with different indicators of teacher and student commitment to school showed that school co-ordination strategies can make a difference, although the effects were rather small. A further analysis that included student commitment indicators as predictors of mathematics achievement suggests that the affective/social and the cognitive domains are relatively independent at class level.

In international comparative studies like TIMSS data analysis is aimed at differences and similarities between education systems (countries). In the fifth contribution (Bos and Kuiper), the outcomes are presented of explorative path analysis on data collected with grade 8 students and classrooms in eight Western and two Central European education systems. For the 10 education systems the resulting general path model explains 19% or less of the variance in achievement in mathematics. In many systems, home educational background and students’ attitudes towards mathematics have a positive relation with achievement in mathematics, out-of-school activities a negative. Due to the psychometric quality of scales and non-availability of measures of important factors at classroom level (e.g., time on task and teacher’s expectation), no significant results were found of factors that can be manipulated by policy makers.

Parts of the model of educational productivity provided by Walberg and colleagues were tested on the basis of the German TIMSS data. Due to its national extensions, the German study allows longitudinal analyses. Köller, Baumert, Clausen, and Hosenfeld applied structural equation modelling to the data at student level. Their findings, described in the sixth contribution, supported cum grano salis the model of educational productivity. The most powerful predictors were cognitive variables. Nevertheless, motivational determinants, leisure activities and students’ gender were also significant predictors of achievement. Mass media as well as home background, that is, the educational level of parents, their job prestige and their number of books at home, had no direct impact on learning.

In most of the countries taking part in TIMSS, students scored at similar levels for mathematics and science. England was one of the few countries where the results did not conform to this pattern. The key question for mathematics educators in England is: why did students in England perform relatively well in science but relatively badly in mathematics? The results for 9-year-olds were particularly intriguing since the majority of students at this age in England were taught mathematics and science by their class teacher. In order to seek answers to the question posed above, Keys compares the responses to the TIMSS context questionnaires made by 9-year-olds and their teachers in the 13 European countries taking part in the TIMSS survey of that age group (Population 1). Issues examined
include: curriculum content; lesson time; homework; class size; use of calculators in mathematics; practical activities in science; classroom organisation, and students’ attitudes.

Knuver, in the end, describes and discusses the results of Dutch students of grades 3 and 4 in primary education on the TIMSS mathematics and science test. Despite severe criticism of subject matter experts on the test, the Netherlands is very high in the international ranking list for population 1. The nature of the criticism and the features of Dutch mathematics and science education are described to serve as a background for interpreting these surprising results.

REFERENCES


