Chapter 4

MONITORING MATHEMATICS ACHIEVEMENT OVER TIME
A SECONDARY ANALYSIS OF FIMS, SIMS and TIMS: A RASCH ANALYSIS

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Abstract: This paper is concerned with the analysis and scaling of mathematics achievement data over time by applying the Rasch model using the QUEST (Adams & Khoo, 1993) computer program. The mathematics achievements of the students are brought to a common scale. This common scale is independent of both the samples of students tested and the samples of items employed. The scale is used to examine the changes in mathematics achievement of students in Australia over 30 years from 1964 to 1994. Conclusions are drawn as to the robustness of the common scale, and the changes in students' mathematics achievements over time in Australia.

Key words: Mathematics, achievement, measurement, Rasch analysis, change

1. FIMS, SIMS AND TIMS

Over the past five decades, researchers have shown considerable interest in the study of student achievement in mathematics at all levels across educational systems and over time. Many important conclusions can be drawn from various research studies about students' achievement in mathematics over time. Willett (1997, p.327) argued that by measuring change over time, it is possible to map phenomena at the heart of the educational enterprise. In addition, he argued that education seeks to enhance learning, and to develop change in achievement, attitudes and values. It is Willett's belief that 'only by measuring individual change is it possible to document each person's progress and, consequently, to evaluate the effectiveness of educational systems' (Willett, 1997, p. 327). Therefore,
the measurement of change in achievement over time is one of the most important tools for finding ways and means of improving the education system of a country.

Since Australia participated in the 1964, 1978 and 1994 International Association for the Evaluation of Educational Achievement (IEA) Mathematics Studies, it should be possible to examine the mathematics achievement differences over time across the 30-year time period. The IEA Mathematics Studies were conducted in Australia under the auspices of the IEA.

The First International Mathematics Study (FIMS) was the first large project of this kind (Keeves & Radford, 1969) and also included a detailed curriculum analysis (Keeves, 1968). Prior to FIMS, there was a lack of comparative international achievement data. For the last 50 years, however, the number and nature of the variables included in comparative studies of educational achievement have continued to expand.

The main purpose of FIMS was to investigate differences among different school systems and the interrelations between the achievement, attitudes and interests of 13-year-old students and final-year secondary school students (Husén, 1967; Keeves, 1968; Keeves & Radford, 1969; Rosier, 1980; Moss, 1982). Countries that participated in the FIMS are listed in Table 4-1.

School and students who participated in the FIMS study were selected using two-stage random sampling procedures, involving age and grade level samples. The age level sample included all 13-year-old students in Years 7, 8 and 9. The grade level sample involved Year 8 students, including 13-year-old students at that year level. All students in the samples were government school students. In the cluster sample, design schools were selected randomly at the first stage and students were selected randomly from within schools at the second stage. The results of the international analyses of the FIMS data are given in Husén (1967), Postlethwaite (1967) and summarised in Keeves (1995).

The Second International Mathematics Study (SIMS) was conducted in the late 1970s and early 1980s in 21 countries. The main purpose of SIMS ‘was to produce an international portrait of mathematics education with a particular focus on the mathematics classroom’ (Garden, 1987, p. 47). Countries that participated in SIMS are presented in Table 4-1.

The schools and students who participated in the SIMS study were selected using a two-stage sampling procedure. The students were all 13-year-olds and were from both government and non-government schools. The results of the analyses of SIMS data are reported by Rosier (1980), Moss (1982), Garden (1987), Robitaille and Travers (1992), and are summarised in Keeves (1995).