Using international survey data to inform policy and practice in mathematics education

Tom Macintyre
The University of Edinburgh, Edinburgh, Scotland, UK

International survey data reported through Trends in Mathematics and Science Study (TIMSS) provide national bodies with benchmarks to monitor standards and achievements within mathematics and science education. There is currently limited reporting of findings from these studies, often restricted to high-level summaries. More could be gained by policy makers and the teaching profession if data is analysed using advanced quantitative techniques to identify principal associations with educational performance. In particular, recent policy initiatives in learning and teaching can be evaluated in relation to student achievement to directly support the planning of future teaching programmes.

Analyses of TIMSS data takes account of the clustered sampling design, favouring a multilevel model of achievement data to accommodate the hierarchical structure of the data and to identify principal associations with educational performance in mathematics for Scottish students in TIMSS2007. Pedagogical practices in Grade 4 and Grade 8 are reported where there are significant associations with achievement; differences across stages are highlighted. An additional feature of analysis concerns the handling missing data, with consequent analyses of plausible values (PVs) that are generated using multiple imputations. The adopted method of analysis uses Rubin’s Rules for handling plausible values, combining findings from each of the five separate PV models.

Scottish education policy was in a period of transition when TIMSS2007 was administered, with the Scottish Government’s flagship Curriculum for Excellence (CfE) being implemented across schools and local authorities. The transformational change-in-practice sought by the CfE policy reflected research that discussed curriculum and assessment policy, and constructivist approaches to learning and teaching in mathematics education. A conceptual framework was developed to reflect this reform agenda in STEM education. The following headings were used as a basis of the analysis: Reform-based practice and discussion; Active learning and practical activities; Learning environment (including opportunities for learning collaboratively); Contexts; Appropriate and effective use of ICT; and Assessment and feedback.

An important finding in the analyses is that a number of research and policy driven practices do not explain variance in the models. Other practices that are significantly associated with achievement scores are not always in line with anticipated direction of association, highlighting negative associations where literature and policy initiatives allude to positive benefits. This type of correlation analysis raises questions for the policy and practice communities. Reflection on the findings can pave the way for discussion of pedagogical practices, their association with achievement, and how they relate to implementation of policy.