WHAT DO STUDIES LIKE PISA MEAN TO THE MATHEMATICS EDUCATION COMMUNITY?

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In a real sense, PISA 2003 has touched the mathematics education community by stealth rather than by storm. Although PISA brings "baggage" commonly associated with international assessments, it takes some refreshing perspectives especially in the way that it envisions and assesses mathematical literacy. In this panel discussion we *focus on some of the issues associated with PISA: scrutiny of student performance, construct and consequential validity, what makes items difficult for students and the potential impact of PISA on mathematics education research. In selecting these issues we merely begin the debate and open the way for your participation.*

WHAT IS PISA?

The *Programme for International Student Assessment* ([PISA], OECD, 2005) is an international standardized assessment in reading literacy, mathematical literacy, problem-solving literacy and scientific literacy. It started in 1997 when OECD countries began to collaborate in monitoring the outcomes of education and, in particular, assessed the performance of 15-year-old school students according to an agreed framework. Tests have typically been administered to 4,500-10,000 students in each country. The first assessment in 2000 which focused mainly on reading literacy surveyed students in 43 countries while the second assessment in 2003 involved 41 countries and focused mainly on mathematics and problem solving. The third assessment in 2006 will largely emphasize scientific literacy and is expected to include participants from 58 countries. In this panel discussion we will concentrate on PISA 2003 and those aspects of it that deal with mathematical literacy.

THE PISA MATHEMATICAL LITERACY ASSESSMENT

In describing their approach to assessing mathematical performance, PISA documents (e.g., OECD, 2004a) highlight the need for citizens to enjoy personal fulfilment, employment, and full participation in society. Consequently they require that "all adults–not just those aspiring to a scientific career–be mathematically, scientifically, and technologically literate" (p. 37). This key emphasis is manifest in the PISA definition of mathematical literacy: " …an individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgments and to use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned, and reflective citizen" (OECD, p. 37; see also Kieran, plenary panel papers).

Reflecting this view of mathematical literacy, PISA documents (e.g., OECD, 2004a) note that real-life problems, for which mathematical knowledge may be useful, seldom appear in the familiar forms characteristic of "school mathematics." The

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PISA position in assessing mathematics was therefore designed "to encourage an approach to teaching and learning mathematics that gives strong emphasis to the processes associated with confronting problems in real-world contexts, making these problems amenable to mathematical treatment, using the relevant mathematical knowledge to solve problems, and evaluating the solution in the original problem context" (OECD, 2004a, 38). In essence, mathematical literacy in the PISA sense places a high priority on mathematical problem-solving and even more sharply on *mathematical modelling*.

Although PISA's devotion to mathematical modelling has my unequivocal support, my experience tells me that it is not easy to incorporate effective mathematical modelling problems in a test that has fairly rigid time constraints. In addition, although the term mathematical modelling is relatively new in school mathematics (Swetz & Hartzler, 1991), there are instances of mathematical modelling even in the notorious public examinations of more than 50 years ago. I well remember the following problem in an examination that I took in 1953. It seems to me that it is a genuine modelling problem and it was certainly not a text book problem or a problem that anyone of that era had practised. Moreover, the fact that less than 10% percent of the 15 to 16-year-old students taking the examination solved the problem is both déjà vu and prophetic for those setting the directions for the PISA enterprise.

> In a hemispherical bowl of radius 8 inches with its plane section horizontal stands water to a depth of 3 inches. Through what maximum angle can the bowl be tilted without spilling the water? Give your answer to the nearest degree (University of Queensland, 1953)

Accordingly, even though members of our panel valued the PISA emphasis on real-world problems and mathematical modelling, there was no shortage of issues to debate. In particular, there were issues about the framework, the validity of the assessment, the construction of items, the measurement processes, the conclusions and the interpretations especially interpretations that cast the findings into the realm of an international "league table". Consequently, we faced a problem in selecting which issues to examine. Let me presage the papers of the other panellists by providing an entrée of the issues that reverberated over our internet highways.

WHAT ISSUES DOES PISA RAISE FOR MATHEMATICS EUDCATION?

As the conference theme was *learners and learning* we questioned whether PISA assessment really was designed to support a real-world approach to mathematics teaching and learning. We also raised questions about whether student performance in the PISA assessments mirrored student performance in other mathematics education research on learning and teaching. Although appropriate data was not easily accessible, we wondered what the PISA study told us about patterns of classroom activity in different cultures. Yoshinori Shimizu (plenary panel papers) did examine this from a cultural perspective by scrutinizing Japanese students' responses to some PISA items.

Issues associated with item validity, item authenticity, and item difficulty were consistently part of our discussions. The "triangular park problem" (see Williams, plenary panel papers) was hotly debated and members of the team even spent considerable time looking for triangular parks or car parks. This was part of our conversation on *real world* or *authentic assessment* and this issue is taken up further by Julian Williams under the broader topic of construct validity. Carolyn Kieran (see plenary panel papers) takes up the issue of "what makes items difficult for students?" She observes that the *difficulty levels* of some PISA items are problematic and raises doubts about how much we know about what students find difficult in certain mathematical tasks.

The politics of international assessment studies like PISA (OECD, 2004a) and *Trends in International Mathematics and Science Study* ([TIMSS], Mullis et al., 2004) were high on our debate list. Not only do these debates raise highly volatile issues and national recriminations, they also generate profound questions for those countries that are doing well and for those who are not. In addition to issues that focus specifically on the international league, assessment studies like PISA produce a range of related debates about factors such as gender, ethnicity, socio-economic status, systemic characteristics, approaches to learning, student characteristics and attitudes, and of course fiscal support (OECD, 2004b). Julian Williams (see plenary panel papers) tackles a number of these political issues especially those related to accountability: managing targets, dealing with league tables, and performance-related reviews.

There was considerable interest in discussing the impact of international assessment studies on mathematics education research. At the forefront of such issues is the question: What does PISA say to researchers interested in assessment research? Yoshinori Shimizu (see plenary panel papers) will talk about this more specifically as he refers to the benefits that can be gleaned by researchers through an examination of PISA's and TIMSS's theoretical frameworks, methodologies, and findings. For example, he notes that the detailed item scales and maps in PISA will enable researchers to perform a secondary analysis of students' thinking and accordingly gain a deeper understanding of learners and learning. Michael Neubrand (see plenary panel papers) also looks at the potential of PISA to stimulate research in mathematics education. He focuses on the structure of mathematical achievement especially in the way that PISA conceptualizes achievement through the aegis of a *mathematical literacy* framework. This gives rise to an interesting dialogue with respect to both individual and systemic (collective) competencies in mathematics and how they can be measured. There are of course other important questions such as "What do studies like PISA say to mathematics education researchers about methodological issues such as qualitative versus quantitative research?" Although this particular question is not directly addressed, the panel refers frequently to methodological issues and as such issues a challenge to the participants for further engagement and debate.

CONCLUDING COMMENTS

I believe that this panel discussion is most timely as I am not convinced that mathematics educators are as cognizant as they might be about the impact of the burgeoning industry that encompasses international studies like PISA (OECD, 2003) and TIMSS (Mullis et al., 2004). Although the build up and dissemination of PISA has been slow to take root in the mathematics education research community, the findings have certainly not gone unnoticed by national and state governments, educational systems, business leaders and parent groups. They know where their nation or their state came in the "league stakes" but they have little understanding of the intent and limitations of such studies. Accordingly, an important aim of this panel is to encourage mathematics education researchers to be more proactive not only in publicly illuminating and auditing research like PISA but also in identifying ways in which PISA can connect with and stimulate their own research. In the words of Sfard (2004, p. 6) we should exploit these special times in mathematics education:

> Confronting the broadly publicized, often disappointing, results of the international measurements of students' achievements, people from different countries started wondering about the possibility of systematic, research-based improvements in mathematics education

References

Mullis, I. V. S., Martin, M.O., Gonzalez, E. J., & Chrostowski, S. J. (2004). *TIMSS 2003 international mathematics report: Findings from IEA's trends in international mathematics and science study at the fourth and eighth grades*. Chestnut Hill, MA: Boston College, TIMSS & PIRLS International Study Center.

OECD (2004a). *Learning for tomorrow's world: First results from PISA 2003*. Paris: Author.

OECD (2004b). *Messages from PISA 2000*. Paris: Author.

OECD (2005, May 8). *Program for international student assessment* (PISA). Retrieved from http://www.pisa.oecd.org/document/56.

Sfard, A. (2004).There is nothing more practical than good research: On mutual relations between research and practice in mathematics education. In M. Niss (Ed.), *Plenary and regular lectures: Abstracts*. Copenhagen, Denmark: 10th International Congress of Mathematical Education

Swetz, F. & Hartzler, J. S. (1991). *Mathematical modelling in the secondary school curriculum*. Reston, VA: NCTM.

University of Queensland. (1953). *Mathematics B: Junior public examination*. Brisbane, Australia: Author.