U.S. Performance in Mathematics Literacy

PISA's major focus in 2003 was mathematics literacy. Mathematics literacy is defined as:

...an individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgements 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 2003, p.24)

PISA's emphasis is on the ability to apply a range of knowledge and skills to a variety of problems with real-life contexts. In the PISA 2003 mathematics literacy assessment, students completed exercises designed to assess their capabilities in using a range of mathematical competencies, grouped and described as "competency clusters." These clusters—reproduction, connections, and reflection—describe sets of skills students may use to solve problems. The reproduction cluster involves the reproduction of the practiced material and performing routine operations. The connections cluster calls for integration and connection of material, and the modest extension of practiced material. The reflection cluster relates to students' abilities in advanced reasoning, argumentation, abstraction, generalization, and modeling applied to new contexts.

The problems themselves were designed to come from the variety of situations (personal, educational/occupational, public, or scientific) that students encounter, and to have a real-life context. The mathematical content of the problems was drawn from four overarching ideas: *space and shape, change and relationships, quantity,* and *uncertainty*.

These overarching ideas represent a way to organize mathematical content broadly and encompass many traditional curricular areas such as algebra or geometry (see also Steen 1990).

- *Space and shape* includes recognizing shapes and patterns, describing, encoding, and decoding visual information, understanding dynamic changes to shapes, understanding similarities and differences and relative positions, and understanding the relationship between visual representations and real shapes and images.

- *Change and relationships* covers the representation of change, including mathematical functions such as linear, exponential, or logistic, as well as data analysis needed to specify relationships or translate between representations.

- *Quantity* focuses on quantitative reasoning (including number sense, estimating, mental arithmetic, understanding meaning of operations, having a feel for the magnitude of numbers, and computations) and understanding of numerical patterns, counts, and measures.

- *Uncertainty* includes the two related topics of data and chance, or statistics and probability, including data analysis and graphic and numeric representations of data.

A comparative analysis of the NAEP, PISA, and TIMSS mathematics assessments sponsored by NCES found that the 2003 PISA mathematics literacy assessment used far fewer multiple-choice items than NAEP or TIMSS. PISA also had a much stronger content focus on the "data" area (which often deals with using charts and graphs), which fits with PISA's emphasis on using materials with a real-world context (see technical notes for more information on the results of the assessment comparisons).[4]

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[4]See Neidorf, T.S., Binkley, M., Gattis, K., and Nohara, D. (forthcoming) and the technical notes in appendix A for more information. Other comparative analyses focus on assessments of science and reading in PISA, NAEP, TIMSS, and PIRLS. See Neidorf, T.S., Binkley, M., and Stephens, M. (forthcoming); Binkley, M., and Kelly, D. (2003); Binkley, M., Afflerbach, P., and Kelly, D. (forthcoming); and Nohara, D. (2001).