

Book Reviews

Cooper, Barry; Dunne, Máiréad:

Assessing Children's Mathematical Knowledge **Social Class, Sex and Problem-Solving**

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Mathematics is widely regarded as a high status school subject and a critical filter to further education and career opportunities. Students' success on mathematics tests, individually and by school, has become the focus of keen scrutiny by concerned parents, on the one hand, and politicians and school authorities, on the other. What mathematics is taught in school, how this is done, and how what is taught is ultimately assessed, continues to attract the attention not only of the profession but of the general public as well.

The authors' overall objective is to question the validity of a widely taken-for-granted assumption: that children will perform optimally if instruction and the test items used to measure achievement are embedded in an apparently relevant or realistic context. Whether certain groups of children might be (dis)advantaged by this approach is explored painstakingly.

The experimental work, which is the focus of the book, is set in England, some years after the introduction of the National Curriculum and its attendant national program of testing children at the ages of 7, 11, 14, and 16. From the outset, competing forces influenced the development and changing content of the high stake National Curriculum tests. Educators voiced strong support for a mix of continuous assessment of students by teachers and performance assessed through externally set tasks – not only paper and pencil items but also practical and investigative activities. Political forces were in favour of relatively simple paper and pencil tests with limited educational objectives. The complex items which seemed most in line with authentic assessment placed severe burdens on teachers. Any changes to be incorporated into successive versions of the test had to be produced within tight time constraints. In recognition of the shortcomings of multiple-choice items, open-ended questions which required a non-trivial written

response continued to be favoured by the test developers. But what was gained and lost by this approach? Can it be assumed that “realistically” contextualized items in timed test papers given at several points in [students'] school career” will yield not only valid achievement outcomes, but outcomes that are equally valid for different groups of students? Thus Cooper and Dunne examine

“whether, and in what ways, the test data (yielded by the National Curriculum testing instruments) validly represented the mathematical knowledge and understanding of children, both in general but also in relation to their membership of a particular group.” (p. 12)

To do this, they set out to compare children's written responses to test items with those given in an interview context. Whether any discrepancies found in the two different measures of achievement could be linked to social class, gender, school or ability was of major interest. The assumptions made by the authors as they planned their study and the operational definitions they used for descriptors of social class and ability are indicated fully and are indicative of the authors' perspectives. Enough information is given to allow informed interpretations by readers of the data presented in the later sections of the book.

The sample comprised students in three primary and three secondary schools (136 Year 6 and 473 Year 9 students respectively). Three relevant group tests were administered. Interviews, during which students worked individually on selected items they had previously attempted in a test setting, were conducted with all the primary school students and some 25 per cent of the secondary school students. Interviews were also conducted with classroom teachers. A number of lessons were observed. Thus both quantitative and qualitative methods were used to gather, and interrogate, the data.

To explain and justify the approach adopted in their own research, the authors focus on shortcomings they perceive in previous work concerned with ways in which children tackle problems set in a “realistic” context. Why should it be assumed that incorrect answers are the result of children having failed “to negotiate successfully the boundary between their ‘everyday’ knowledge and the ‘esoteric’ knowledge represented by mathematics as a formal discipline” or because they have brought their “‘everyday’ knowledge to bear on a problem when it is ‘inappropriate’ to do so” (p.20)? It is equally credible, Cooper and Dunne argue with reference to examples selected from

the literature, to point to other problems: dubious assumptions made by those who devised the supposedly realistic items, or failure to accept as quite plausible unexpected reasoning given by the students to support their answers. Thus, Cooper and Dunne contend, it is too simplistic to assume that it is the students who are at fault when they do not produce the answer expected by those who devised the problems. It is simplistic, too, to ignore possible gender or social class linked "differences between children in their predisposition to make reference (or not) to everyday, common-sense knowledge when operating in school problem contexts" (p 33). A critical analysis of assumptions inherent in certain "realistic" National Curriculum test items leads the authors to conclude that these items are too reliant on decoding requirements obvious to the test designers but not necessarily consistent with the experiences of all students.

Having set the scene, the authors interweave selected excerpts from the work of Basil Bernstein and Pierre Bourdieu with their own experimental findings to illustrate how sociological ideas on social class and culture can usefully mediate the interpretation of performance outcomes in mathematics. In other words, a child's mathematical productions can be constrained or facilitated by the (supposedly realistic) contexts in which the work is presented. Before enlarging on this theme Cooper and Dunne point to another problem: how reporting of data in terms of levels – as is done in the National Curriculum tests – rather than raw scores, can introduce subtle distortions of students' comparative performance by those unaware of the level of approximation inherent in the method of reporting. Quite detailed interrogation of the National Curriculum test data, by social class, by gender, by school, and by ability as defined by scores on the Cognitive Ability Test [CAT] suggests that social class and school significantly affect a student's test score. Comparisons between students' performance on "realistic" and "esoteric" problems, defined respectively as those involving persons or non-mathematical objects from everyday settings and those without such embedding, again yield telling gender and particularly social class linked differences: "all other things being equal, the higher the proportion of 'realistic' items in a test, the greater will be the difference in outcome between service- and working-class children" (p. 86). How slight distortions of apparent achievement introduced by reporting in adjusted, rather than raw scores, can be compounded by subtle (dis)advantages caused by the way items are worded and/or contextualized is modelled, explored, and discussed cautiously but in great detail throughout the book. A convincing case is made that the validity of at least some items on the National Curriculum tests is more doubtful than generally assumed and that the inclusion of "realistic" items is not unproblematic.

Data from the primary and secondary school samples are reported separately and analyzed differently in line with the scope and quality of the information available. For example, tiered testing, a feature of the National Curriculum testing program taken by 13–14 year old students (i.e., the Year 9 students in the current study), allowed careful exploration of the way in which students' performance,

and hence the school's standing, might be affected by a school's decision on the distribution of its pupils over the available tiers of the test. Allocation to tier of entry appeared more problematic than might be expected, with a student's ability but one of several significant variables. Statistical analyses of the available data revealed that 61 per cent of the variance in tier of entry could be explained by ability (as measured on the CAT test), together with school effects, social class, and sex. All these, apart from student gender, appeared as significant variables. As for the younger sample, students' ability and social class were found to be the strongest predictors of actual performance on the tests.

Assessing children's mathematical knowledge is an important addition to the growing literature on assessment in mathematics. In the authors' own words:

"We believe that what we have to report is of practical importance as well as of theoretical interest. ... The handing down to teachers from above of pedagogical and curricular goals, coupled with the absence of research into their effects, both intended and unintended, is no recipe for successful schools. The same applies to forms of assessment." (p. 205)

The conclusions drawn in the book have implications well beyond the National Curriculum tests of the United Kingdom and the sample of school children involved in the research. Those who believe in the objectivity of mathematics tests will be strongly challenged by the book's content; those who argue that students' achievement in mathematics is in part dependent on the format and scope of the test used will have their views confirmed. The concentrated and consciously critical reading needed for justice to be done to Cooper and Dunne's detailed, intensive, and extensive explorations was, to this reader, well worth the effort.

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