

## The relationship between attitudes and attainment in secondary school mathematics

Margaret Brown<sup>1</sup>, Jeremy Hodgen<sup>1</sup>, Robert Coe<sup>2</sup>, Dietmar Küchemann<sup>1</sup>, David Pepper<sup>1</sup>

<sup>1</sup>King's College London, London, United Kingdom, <sup>2</sup>Durham University, Durham, United Kingdom

### Background

In England, in common with many other countries, too few students choose to continue studying mathematics once it ceases to be compulsory. Despite very substantial increases in examination performance, participation in mathematics is lower than that of 20 years ago.

### Research Questions

In this paper, we report and discuss findings of the Increasing Student Competence and Confidence in Algebra and Multiplicative Structures (ICCAMS) study regarding current secondary (Key Stage 3) students' attitudes in England and the relationship between attitudes and attainment.

### Methods

Phase 1 of the ICCAMS study consists of a large-scale survey of 11-14 years olds' understandings of algebra and multiplicative reasoning in England using three tests of mathematical understanding and an attitudes questionnaire. The attitudes test is adapted from previous work (Boaler, William, and Brown, 2000).

Over two summers in 2008 and 2009, the tests and questionnaire were administered to a sample of approximately 6000 students across Key Stage 3 (KS3) from 19 schools randomly selected using the MidYIS database (Tymms & Coe, 2003). In addition to this quantitative analysis, the paper draws on group interviews with Year 8 students.

### Frame

There is considerable research in England addressing reasons for non-participation in mathematics - students stop studying mathematics because they experience it as difficult, abstract, boring and irrelevant (Osborne et al., 1997). The most recent findings relating to 16 year-olds (Matthews and Pepper, 2007; Brown, Brown, and Bibby, 2008) suggest that students' attainment and attitudes are strongly inter-related. A major factor is that even relatively successful students perceive that they have failed at the subject and lack confidence in their ability to cope with it at more advanced levels, especially in comparison to the perceived 'clever core' of fellow-students. When pressed about the reasons for their feelings of failure, students suggest that they do not understand parts of what they have been taught and point to the predominance of routine and formal work on algebra and multiplicative reasoning (Nardi and Steward, 2003). These perceptions of failure appear to be strongly linked to ideologies of 'ability stereotyping' (Ruthven, 1987) and ability grouping (Boaler, William, and Brown, 2000). Girls' attitudes to mathematics tend to be more negative than boys. Boaler and Greeno (2000) link these more negative attitudes to mathematical teaching practices that do not emphasise understanding.

However, the nature of the relationship between attitudes and attainment is poorly understood. In common with other highly and relatively highly attaining countries in TIMSS 2007, English students' attitudes fell in comparison to TIMSS 1999, the last comparable data (Sturman et al., 2008).

### Research findings

Unsurprisingly, a greater proportion of high attaining students were intending to continue to study mathematics after GCSE. The analysis shows that students' attitudes got more negative as they got older, although the drop was greater for girls than for boys. Although boys' perceptions of their own ability were largely stable and positive across the age range, girls' self-perceptions of their ability dropped considerably with age. More boys than girls thought that they would study mathematics post-16. This figure dropped as students got older. However the drop was greater for girls with only a quarter of the sub-sample of 14 year olds saying that they would continue post-16. A relatively high proportion of students of both sexes were undecided, suggesting at least the potential for an increase in participation. An unexpected result was that a very high proportion of students responded that, for mathematical success, effort was more important than ability. This may be related to a current tendency in schools to emphasise the role of "hard work" in examination performance.

## References

Boaler, J., & Greeno, J. G. (2000). Identity, agency and knowing in mathematics worlds. In J. Boaler (Ed.), *Multiple perspectives on mathematics teaching and learning* (pp. 171-200). Westport, CT: Ablex Publishing.

Boaler, J., William, D., & Brown, M. (2000). Grouping - disaffection, polarisation and the construction of failure. *British Educational Research Journal*, 26(5), 631-648.

Brown, M., Brown, P., & Bibby, T. (2008). "I would rather die": Attitudes of 16 year-olds towards their future participation in mathematics. *Research in Mathematics Education*, 10(1), 3-18.

Leder, G. C., & Forgasz, H. J. (2006). Affect and mathematics education. In A. Gutierrez & P. Boero (Eds.), *Handbook of research on the Psychology of Mathematics Education: Past, present and future* (pp. 403-422). Rotterdam: Sense.

Matthews, A., & Pepper, D. (2007). Evaluation of participation in GCE mathematics: Final report. QCA/07/3388. London: Qualifications and Curriculum Authority.

Nardi, E., & Steward, S. (2003). Is mathematics T.I.R.E.D? A profile of quiet disaffection in the secondary mathematics classroom. *British Educational Research Journal*, 29(3), 345-367.

Osborne, J., Black, P., Boaler, J., Brown, M., Driver, R., & Murray, R. (1997). *Attitudes to Science, Mathematics and Technology: A review of research*. London: King's College, University of London.

Ruthven, K. (1987). Ability stereotyping in mathematics. *Educational Studies in Mathematics*, 18, 243-253.

Sturman, L., Ruddock, G., Burge, B., Styles, B., Lin, Y., & Vappula, H. (2008). *England's Achievement in TIMSS 2007 National Report for England*. Slough: NFER.

Tymms, P., & Coe, R. (2003). Celebration of the Success of Distributed Research with Schools: the CEM Centre, Durham. *British Educational Research Journal*, 29(5), 639-653.