0565

Exploring the impact of schools and teachers on mathematical progress

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Background

There are widespread concerns about participation in Science, Technology Engineering and Mathematics (STEM) courses beyond the age of 16 in England (Roberts, 2002; Royal Society, 2008) and elsewhere in the developed world (Gago, 2004; National Academies, 2007). Such concerns are based upone argument that our ability to sustain our economic position in a changing world is predicated upon being able to innovate and therefore we need to produce an increased supply of STEM workers/innovators at all levels. Mathematics is of central importance to this policy agenda.

School effectiveness research, which, despite its many critics, has had a considerable impact upon schooling (Goldstein & Woodhouse, 2000), suggests that schools have a small but significant impact upon learner progress. A small number of school effects studies in mathematics also suggest that the within-school, between-teacher differences are greater than between-school differences (Opdenakker, Van Damme, De Fraine, Landeghem, & Onghena, 2002). What we do not know very much about is what kinds of practices might be associated with these differential ‘effects'. It is well known that performance at GCSE is the clearest indicator of whether a student will continue to A level mathematics (Matthews & Pepper, 2007; Noyes, 2009a) and so understanding between-school differences in progress is really important. Previous studies from the wider project from which this present paper comes have also highlighted the between-school differences in completion of A level mathematics (Noyes, 2009b). It is these complex systemic differences that this paper seeks to explore

Research Questions

The paper will examine the differential effects on progress of learners of mathematics made by schools between the ages of 11 and 16. I do this by comparing progress in mathematics with that in other subjects in order to take account of what might be due to the school culture and what might be more attributable to the department/teachers. I will also explore some between-school and between-teacher differences using survey-derived measures of classroom culture and intention to study mathematics.

Methods

There are two data sources for this paper. Student performance data and social data from the National Pupil Database have been used to carry out multilevel modelling (Goldstein, 2003), i.e. ‘contextual value added' (CVA) from Key Stage 2 to GCSE. The full dataset covers students completing their GCSEs in the Midlands of England from 2004-2008 but for the purposes of this paper I limit the analysis to four Local Authorities (~130 secondary schools) which is still a very substantial dataset. Bivariate models are constructed to compare progress in mathematics with progress in other subjects and multiple imputation techniques are employed to handle missing data.

Survey data from 16 of these schools will also be reported briefly. During 2008 Year 7, 11 and 12 students from these 11-18 school was collected in order to try and explain their ‘position' as suggested by the multilevel models . Using the year 11 cohort data measures of mathematics working culture were constructed and are used to show how between-school differences can hide more critical between-teacher differences in learning culture. I will also consider how such differences are related to student intentions towards further study.

Frame

See above

Research findings

This kind of modelling of mathematical progress has not been conducted for English schools and this analysis shows that the variation in 'CVA' from one cohort to the next in a school is important, i.e. schools/departments do not seem to be too consistent in the overall impact they have on learner progress. The modelling also shows that there exist pairs of schools that have a similar impact upon pupil progress outside mathematics but in one of these schools students typically achieve a whole GCSE more than in the other school, all other things being equal. This makes a significant difference for these students. Some of this can probably be explained by the between-teacher effects but we need to better understand how what happens in classrooms over five years contributes to such differences. The survey data highlights the variations in students' perception of classroom culture and the critical impact that this can have if the classes in questions are those from which we would normally expect a large number of A level mathematics recruits.

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