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Maths and physics participation in the UK: Influences based on analysis of national survey results

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Background

This paper will discuss the interim findings from analyses of the responses to a national survey of year 8 and year 10 students. In addition the analysis will also explore school level data as captured by school questionnaires and data gathered by the DCSF. Together these data sets enable us to explore the factors that shape student engagement with mathematics and physics and their choices for further study post-16.

Research Questions

The survey into the factors that influence post-16 participation in physics in the UK is carried out as part of the Understanding Participation rates in post-16 Mathematics And Physics (UPMAP) project. The aim of the UPMAP project (which is funded by the ESRC) is to identify through systematic research using a mixture of qualitative and quantitative methods the interrelation of these factors, taking account of differences between schools as well as between individuals. Policies that aim to increase post-16 participation in mathematics and physics will only be successful if they are based on an understanding of factors that influence participation in these subjects.

The study is of importance in the current educational climate of Europe, where there are an increasing number of government initiatives to raise attainment in mathematics and science and a growing acknowledgement that there is a problem in post-compulsory participation rates in them, particularly in industrialised countries (Gilbert, 2006; OECD, 2006). These initiatives have been triggered by economic concerns about the implications of a deepening shortage of scientists and mathematicians along with a shortage of specialist teachers in these two domains. Much remains to be done to understand what determines student attitudes towards mathematics and science (Osborne et al., 2003) and what drives student subject choice post-16 (Blenkinsop et al., 2006).

Methods

A student questionnaire was designed that considered factors that may influence participation rates in mathematics and physics. It includes items to assess attitudes to the subject, to school and to teachers, alongside more general potential influences on participation, such as items to assess social capital, engagement in extra-curricular activities, intrinsic and extrinsic motivation for learning, involvement in ICT, personality constructs and family support of study in physics. In addition, we include two items in what we term core conceptual areas in mathematics and physics in order to assess attainment and confidence. The views of students will help to illuminate the contexts, inside and outside of school, which help or hinder post-16 participation in the two subjects.

We also designed two very similar school questionnaires to be completed by heads of the science and the mathematics departments. The purpose of this instrument is to assess departments’ policies in relation to promoting post-16 participation in mathematics and physics, the expertise of their staff and how this is deployed, their activities to boost engagement in the subject through, for example, extra-curricular activities, and their practices in relation to student groups and examination entries.

Frame

When students encounter school mathematics and physics, they respond to them in a variety of ways. Understanding the reasons for these varied responses may help make sense of many of the ways in which different students react differently to mathematics and physics and of the phenomenon, widely found in industrialised countries, in which many of those who do well at school in mathematics and the sciences reject them (Schreiner, 2006).

Research findings

Our preliminary results so far are derived from multilevel analyses of two core datasets put together from various sources of information for year 10 students (aged 14-15) in schools in England. The sample on which we undertook analyses comprised 1881 students in 63 schools (physics) and 2384 students in 75 secondary schools (mathematics). We will now continue with our analysis and explore responses of year 8 students (aged 12-14) with our final larger set of year 10 data. In total we have gathered responses from approximately 23,000 students nationally. The analysis of this paper will continue to utilize multilevel modeling methods in order to ascertain which school and student level indicators have an independent influence in explaining students' intention to participate in mathematics and physics post-16.

Our interim results indicate that the students' self-concept in mathematics and physics and extrinsic motivation are key psychological factors that have an independent influence on uptake of physics and mathematics post-16. Other important factors are students' ethnic and gender background as well as their understanding of core mathematics and physics concepts. We also have found that school policy plays an important role in reducing gender biases and in general, for all student groups, increasing the intention to participate in mathematics and physics. Our multilevel analysis indicates that controlling for the impact of school policy on physics specialist classes and school selection is useful in helping reduce gender biases and ensuring a more advantageous learning environment for females. For mathematics, engagement in external projects had an impact on student intention to participate in post-16 mathematics. Our initial findings also indicated that boys were more likely than girls to have increased motivations in their intention to participate in high attaining high participation schools.

The general trends in participation indicate that students are more likely to express an interest in studying mathematics post-16 than physics. This finding holds for girls and for boys. Our findings to date point towards recommendations to policy makers to: promote and fund interventions, initiatives and practices that will enable students to increase their positive experiences and confidence with learning in general, as well as with physics / mathematics in particular; access additional curriculum support for studying physics and mathematics, when appropriate; and tackle basic misconceptions in core areas of physics and mathematics early on.