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Understanding undergraduate disengagement from mathematics: Addressing alienation

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ABSTRACT

This paper explores the phenomenon of student disengagement from university mathematics through the lens of Marx's concept of alienation. Distinguishing between alienation as an objective relationship and the subjective state of disaffection, it argues that dominant modes of teaching in the English school system produce alienated relationships with mathematics, including among successful students, which university teaching does not necessarily reverse. Drawing on interviews with 15 second-year mathematics single major students from 4 universities, in which they explain their experiences of university mathematics, we argue that 'undoing' alienation and enhancing engagement at university rests on the development of new relationships with mathematics through greater support for students' developing confidence in independent mathematical judgement.

1. Introduction: undergraduate disengagement from mathematics

Student disengagement from undergraduate mathematics in the UK is widely reported (Croft & Grove, 2015), raising basic questions as to how well- qualified students who report high levels of confidence and enjoyment at school can become so disillusioned with a subject which they have actively chosen to study at university. Explanations vary in terms of the assumed locus of the problem and the respective roles of the individual student and their social context. One area of debate focuses on the extent to which students are prepared for university-level study in terms of their mathematics skills and knowledge (Smith, 2004; Hawkes & Savage, 2000); while this is a somewhat deficit model, research which emphasises lack of exposure to proof highlights issues of form or practice as well as content (Harel & Sowder, 2007; Healy & Hoyles, 2000). Focusing less on deficit and more on learner identity, other accounts consider socio-emotional context in terms of the negative effect of the transfer from small classes and close teacher-student contact at school or college to impersonal lecture-based teaching (Wiliam, 2005). On a related theme, relationships with peers and with tutors can be a critical factor in whether or not students express positive attitudes to university study (Solomon, Lawson, & Croft, 2011). While Mathematics Support Centres were primarily introduced to provide support for learning in terms of content, Solomon, Croft and Lawson (2010) reported that the spaces that such centres provided had the potential to generate a collaborative ethos which went beyond emotional support to incorporate perceptions of mathematics as a constructive and participative endeavour. This focus on developments in students' understanding of the *nature* and *practice* of mathematics (as opposed to just its content) is also suggested in dispositional accounts such as Daskalogianni and Simpson's (2002) study of mismatch between

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students' school-based beliefs about mathematics and their experiences of university mathematics. Their work suggested that failure to reconcile such a mismatch often leads to disillusionment and 'cooling off'.

Collecting these themes together, we suggest that students' relationships with mathematics in terms of their understanding of the nature of mathematics and their self-positioning within mathematics as a developing body of knowledge is what underpins engagement and disengagement: it is not just a matter of ability. This is not a new idea, and it is particularly well researched at school level, where the impact of traditional transmissionist teaching practices on understanding and engagement is a major focus (see for example Boaler, 2012). Looking more closely at teaching and learning practices, Pampaka, Williams, and Hutcheson (2012) reported that being positive about transitions into university mathematics was negatively associated with transmissionist teaching at university. Turning to university study itself, research which focuses on students' relationships with mathematics has found that their understandings of the nature of mathematics are central to their attitudes to and expectations of undergraduate study and to their sense of 'belonging' and community in university departments (Biza, Jaworski, & Hemmi, 2014; Jaworski & Matthews, 2011; Jaworski et al., 2012; Solomon, 2006, 2007).

Why all this matters is summarised succinctly by Schoenfeld (1994):

> When mathematics is taught as received knowledge rather than as something that (a) should fit together meaningfully and (b) should be shared, students neither try to use it for sense-making nor develop a means of communicating with it. (p. 57)

We will argue that it is these twin outcomes that underpin alienation and in turn disengagement, because neither recognises that mathematics is

> a living, breathing discipline in which truth (as much as we can know it) lives in part through the individual and collective judgments of members of the mathematical community. . . . Mathematical authority resides in the mathematics, which – once we learn how to heed it – can speak through each of us, and give us personal access to mathematical truth. (p. 68)

Thus the development (or not) of a sense of personal access to mathematical truth – conviction based on participation in the practices of the mathematical community – can be seen as dependent on how far undergraduate teaching is able to counteract a strong likelihood of a legacy of school teaching which emphasizes mathematics as already created rather than mathematics *in* creation. In the following section, we develop a conceptualisation of the impact of mathematics as received knowledge through the lens of alienation, with a view to understanding better how and why students might become disengaged from university mathematics.

2. Conceptualising alienation from mathematics

As many commentators note, school mathematics largely favours didactic teaching of algorithmic approaches applied by the individual learner to find answers validated by the teacher's or text book's authority. In England, where this study took place, this approach is clearly exacerbated by the marketization of education since the 1980s and the employment of technologies of accountability which privilege the easily measurable (Exley & Ball, 2013) and generate an emphasis on the exchange value of education (Williams, 2011). Critics of this system have pointed to the deleterious effect of pedagogic practice which 'teaches to the test' rather than giving time to building understanding, leading to rising levels of disaffection particularly in the later years of secondary schooling (Boaler, 2015). However, we want to draw attention here to the need to distinguish between disaffection and alienation; doing so enables us to see how students who are successful and who like mathematics might be understood as alienated and consequently vulnerable to disengagement. To illustrate this, we examine Boaler and Greeno's (2000) analysis of student identities in the light of Marx's theory of alienation which, we argue, provides a more sensitive tool for understanding students' relationships with mathematics.

Boaler and Greeno's (2000) study of advanced calculus classes in six Californian high schools found that although all the students were in a position to progress further in the subject, differences in their descriptions of their classroom experiences corresponded with their beliefs about the nature of mathematics and their desires to study it further. Classes in four of the schools were characterised by individualistic didactic approaches to learning in which students practised procedures demonstrated by their teachers. Classes in the remaining two schools were characterised by collaborative approaches, and teachers encouraged student discussion when explaining methods. Boaler and Greeno found that students in more didactic classes took up a passive role in relation to mathematics, as something predetermined and unavailable to discussion; success required that their goal was to memorise and be positively evaluated by the teacher or the textbook. While they were highly successful in learning the rules, half of these students disliked mathematics and slightly less than half (generally the same students) did not intend to study it further. Their rejection was based on the lack of opportunity to develop the kind of understanding they sought, and their feeling that studying mathematics ran counter to their sense of self as creative—they rejected mathematics because it did not fit the kind of person they wanted to be. Boaler and Greeno call these students alienated, in contrast to the remaining half of the students who liked mathematics precisely because of the way that their classes positioned them as received, or passive, knowers. Students in collaborative discussion-based classes took an active role in relation to mathematics, as a 'field of inquiry'. Their goal was to understand its concepts as constructed in interaction

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