British Educational Research Journal, Vol. 29, No. 3, 2003

Carfax Publishing
Taylor & Francis Group

Is Mathematics T.I.R.E.D? A Profile of Quiet Disaffection in the Secondary Mathematics Classroom

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ABSTRACT *Research often focuses on disaffection in the mathematics classroom as evident in disruptive behaviour, absenteeism or special needs: thus, it ignores a group of students whose disaffection is expressed in a tacit, non-disruptive manner, namely as disengagement and invisibility. Ignoring this often large group implies that the mathematical potential of these learners may remain defunct. This article reports on a one-year study of quiet disaffection conducted in three Year 9 mathematics classrooms in Norfolk. Through extensive observation and interviewing of seventy 13/14 year-old pupils, a profile of quiet disaffection from secondary school mathematics was constructed. It is proposed that its characteristics include:* Tedium, Isolation, Rote learning (rule-and-cue following), Elitism and Depersonalisation. *The proposed characteristics are described and exemplified. Finally, the themes that emerged from the students' statements about their images of effective mathematics teaching (Nature of Classroom Activities—the notion of 'Fun', Teaching Styles; Role of the Teacher; Role of Stratification Structures such as Setting) are outlined.*

Introduction

In many countries, an increasingly smaller percentage of students appears to be pursuing the study of mathematics at upper secondary level and beyond (Holton *et al.*, 2001). The students' choice is seriously influenced by their attitudes towards and performance in mathematics and these are in turn deeply shaped by their school mathematical experiences (Dick & Rallis, 1991; Johnston, 1994). In the UK, despite a reported slight improvement of attitudes towards mathematics in the last 15 years (Brown, 1999), recent international comparisons suggest that performance is at rather unsatisfactory levels

Received 4 February 2002; conditionally accepted 30 May 2002; accepted 3 July 2002.

ISSN 0141-1926 (print)/ISSN 1469-3518 (online)/03/030345–22 ©2003 British Educational Research Association
DOI: 10.1080/0141192031000155999

(Jaworski & Phillips, 1999). In sum, given the strong links between attitude, performance and choice of further study and career, research on attitudes towards mathematics, and in particular on disaffection in the secondary mathematics classroom—where the students are on the brink of deciding whether to pursue mathematical studies at post-compulsory level—is essential.

Disaffection is defined often in research as disruption or truancy (Elliott, 1997) and often in association with special educational needs (e.g. Tattum, 1986). Within cultural transmission theory perspectives (e.g. Reid, 1987) disaffection is seen as faulty socialisation into local and familial cultures (so, for example, regular school non-attendance is accounted as parentally condoned absence) whereas within process theory perspectives (e.g. Cooper, 1993) disaffection is seen as a result of the experience of schooling. Research, however, also suggests that schooling, in particular curriculum and pedagogy, can compensate for faulty local and familial socialisation and thus can reinforce or ameliorate culturally transmitted student attitudes (Reynolds & Sullivan, 1979).

Moreover, recently emerging perspectives view disaffection as resigned acceptance rather than deviant behaviour (e.g. Dorn, 1996). These works suggest that a pathology of absence from school can be studied in terms analogous to a pathology of presence: in a world outside school which offers increasing access to knowledge that is independent of adult authority, education through schooling may seem less and less relevant (e.g. Schostak, 1991). Schostak and others contend that it is not curricular provision but an unthreatening environment for self-discovery and development that maintains school attendance.

The above perspective implies a modified definition of disaffection beyond truancy and disruptive behaviour that includes the quietly, invisibly disaffected (Rudduck *et al.*, 1996): those with low engagement with learning tasks, those who perceive these tasks as lacking in relevance with the world outside school and their own needs, interests and experiences, those who routinely execute but do not get substantially involved with the tasks. These students attend school but often underachieve. Re-engagement of these learners is then of strategic importance.

Quiet disaffection in the mathematics classroom is relatively underresearched. In fact, such research is needed in order to highlight the needs of an often large group of learners whose mathematical potential may at the moment remain inert. For this purpose, and in contrast to a traditional but rather counterproductive distinction, an integration of cognitive and affective perspectives on mathematical learning, namely, one that merges the study of students' attitudes towards and achievement in mathematics, seems to be necessary (McLeod, 1992). In fact, the interrelatedness of the two domains emerged as early as the 1960s (e.g. Simon, 1967). Nowadays, non-cognitive predictors of performance (House, 1995) are seen as pertinent in studies of learning: beliefs, attitudes and emotions towards mathematics are an inextricable component of general mathematical performance (Reynolds & Walberg, 1992; Wong, 1992; Jones & Young, 1995; Ma, 1997; Hensel & Stephens, 1997) as well as particular mathematical skills (e.g. abstract mathematical thinking [Iben, 1991]; problem-solving [Kloosterman & Stage, 1992; McLeod, 1993]). Furthermore, various studies address the relationship between attitude and performance as a function of the individual's self-concept (Norwich & Jaeger, 1989; Maqsud & Khalique, 1991; Williams, 1994; Norwich, 1994; Skaalvik, 1994; Jones & Smart, 1995) as well as of the students' experience of mathematics teaching in the classroom (e.g. the role of 'interesting' class activities [Schiefele & Csikszentmihalyi, 1994]; or the role of teachers' attitudes towards error making [Brown, 1992]. In general, disinterest in mathematics generated by certain pedagogical approaches seems strongly linked with underachievement (Boaler, 1997a).

In Boaler's study, two schools with different approaches to mathematics teaching were compared (1998): in the first school, Amber Hill, which used a traditional textbook approach, despite being 'repeatedly impressed by the motivation of the students who would work through their exercises without complaint or disruption', the students' three most frequent descriptors of mathematics lessons were 'difficult', comments related to the teacher and 'boring'. Students believed that mathematics just involved memorising and routine execution of rules. In the second school, Phoenix Park, which used an open-ended project approach despite having 'very little control, order, and no apparent structure to lessons', students were expected to be responsible for their own learning and the three most frequent descriptors of mathematics lessons were 'noisy', 'a good atmosphere' and 'interesting'. Elsewhere (1997b) Boaler discusses gender-related differences on the same issues.

Non-mathematically-specific research (e.g. Keys & Fernandes, 1993) suggests that it is likely that, as students proceed to the later years of their schooling, they often become more disenchanted with the education process. Keys and Fernandes refer to a number of factors associated with disaffection or disengagement: disillusionment with and dislike of school; lack of interest and effort in class and homework; boredom with school and schoolwork; dislike of certain teachers or types of teachers; resentment of school rules; belief that school would not improve career prospect; low educational aspirations; low self-esteem and poor academic performance. In their work 'teaching and learning practices' ranked highly in the students' questionnaire responses to what made them positive towards school and schoolwork. In considering implications for mathematics lessons, the students expressed a general preference for 'working with their friends', 'making' and 'discussing things'.

Keys and Fernandes also discuss the concept of motivation as intrinsic (arising from interest in the subject being studied) or extrinsic (depending on the availability of external rewards). Norwich (1999) adds to these reasons two more categories: identified (e.g. recognition of the importance of mathematics) and introjected (e.g. parental pressure). In his work, introjected reasons were the stronger influences on 'satisfactory' learning and behaving whilst intrinsic reasons were the stronger influences on 'unsatisfactory' learning and behaving. This substantial reciprocal relationship between attitude towards and achievement in mathematics was evident in another recent quantitative study in the USA (Ma, 1997), with the three attitudinal measures being 'Importance', 'Difficulty', and 'Enjoyment', and with 'Achievement' as the outcome. Significantly, Ma contends, 'making difficult content easy to learn is barely enough to improve mathematics achievement. It is more important to ensure that difficult mathematical content is presented in an interesting, attractive and enjoyable way'. And, 'It is inappropriate to assume that high achievers in mathematics have few attitudinal problems'.

The qualitative study we draw on in this article integrates the above findings and places the emphasis on the experiences of quietly disaffected pupils in Year 9 of their schooling (13/14 years of age), namely, the penultimate year of statutory mathematical learning in Norfolk. In doing so, we suggest a number of characteristics of quiet disaffection in the mathematics classroom. After a brief introduction of the methodology of the study, we describe and exemplify these characteristics. We then conclude with a brief outline of the themes that emerged from the students' statements about their images of effective mathematics teaching.

The Methodology of the Study

Participants in this one-year Economic and Social Research Council funded research project were mathematics teachers and Year 9 pupils based in three Norwich schools that had participated in a previous study (Oakley, 1999). The teachers had reasonable confidence in their mathematics and their teaching and a non-extreme (positive or negative) relationship with their pupils. The focus is on pupils in middle-ability sets (i.e. those pupils centred on a projected General Certificate of Secondary Education [GCSE] C/D in two years' time) who may have the potential for higher achievement. All three schools are oversubscribed, successful comprehensive with an overwhelmingly white, English-speaking population of mixed socio-economic intake and above average GCSE results both in mathematics and in general.

The findings of the research have taken into account the constraints involved and certain biases that have resulted (see Nardi and Steward [in preparation], for more details on the three schools, the previous study in which these schools had participated and the process of school recruitment for this study; also for a detailed account of the *insiderness conflict*, the *invisibility paradox*—in relation to classroom activity and in relation to group interviewing—and the *transience of the phenomenon of quiet disaffection*). Confidentiality and anonymity have been carefully observed.

Data collection took place in two stages: classroom observation and group pupil interviews. The former lasted seven weeks. Combined with consultation with teachers and with some information on the pupils' prior, current and projected achievement in mathematics, the observation field notes resulted in profiles of the observed students and in analytical accounts, the Classroom Observation Protocols (see Nardi and Steward [2001] for preliminary themes that emerged from observation and informed the interviewing—this article draws mostly on the interview data).

In the latter, all the students from the three classrooms were interviewed in groups of one to four (Morgan, 1997) for approximately half an hour. The pupils had to be taken out of their lessons in groups in order to be interviewed. Decisions on the synthesis of the groups were made on the basis of the profiles constructed in the first stage of data collection and include the following: groups were single gendered; where possible, they reflected friendship groups; and pupils who would apparently be intimidated by or disruptive in a group interview situation were interviewed individually. These decisions are also largely supported by relevant methodological literature (e.g. Lewis, 1992). The interviews were audio-recorded. They were semi-structured and explored general attitudes towards mathematics as well as specific disengagement incidents from the observed mathematics lessons. Twenty-seven interviews were conducted.

Data Analysis of the Interview Data

Immediately after each interview an Interview Protocol, a condensed account of the interview where the interviewees' statements are reproduced from the audio-recording, not with verbatim accuracy but as faithfully and concisely as possible, was produced. The interviews were also fully transcribed and the contents of the audiotapes were digitised and copied on compact disks. Within a spirit of seeking data-grounded theory, as proposed in Glaser and Strauss (1967) but with due attention to foundational theoretical perspectives, as indicated, for example, by Hammersley (1990), a first level of coding followed according to seven wide categories, as set out in Table I.

A second-level coding of the now *Annotated* Interview Protocols led to the production

TABLE I.

Name of category	Abbreviation	Content: Interviewees' statements on:
Conceptual difficulty	C	Difficulties in various mathematical topics and ways of coping
Mathematics	M	Nature and significance of mathematics
Performance	P	Own and others' ability and performance in mathematics
Teaching	T	Mathematics teaching including the role of activities, teaching styles, and teacher personality
Social	S	The role of peers, parents and others in mathematical learning
School	Sc	Schooling in general
Methodology	METH	The impact of the researcher's presence in the classroom

of a Code System (a gradually enriched, eventually 'saturated' version of the preliminary one consisting of 36 T, 29 P, 40 C, 30 M, 14 S, 5 Sc, 2 METH categories, a total of 156). Numerous examples of these categories can be seen in the subsequent section of this article. Occurrences of each category in the now 27 *Coded* Interview Protocols were recorded in a massive interviewee-by-category spreadsheet. The frequency of each category is available in the last row of the spreadsheet. By examining the spreadsheet horizontally we could identify the codes in which each interviewee scored higher and thus form an impression of his/her focal points. By examining the spreadsheet vertically we could identify the codes that featured higher frequencies across the total body of interviewees. Subsequently, each category was assigned an ordered pair (x, y) as follows: x corresponds to the number of times the category has been identified in the Coded Interview Protocols and y to the number of students who have referred to the category. Further scrutiny based on validation of significance relating to frequency, researcher emphasis, and external theory led to the selection of the Pivotal Categories around which we clustered all the categories, across the Code System, that were tangentially relevant (covered part of the same ground, highlighted a different angle of the same issue, etc.) Out of this clustering, five major characteristics of quiet disaffection emerged.

In the following, we introduce each of the characteristics using the corresponding cluster of categories and substantiate using extracts from the interviews. The evidence is supported further with references to the classroom observations, the student profiles and the relevant literature.

T.I.R.E.D.: a profile of quiet disaffection in the secondary mathematics classroom

The students whose attitude towards the learning of mathematics this study focuses on apparently engage with mathematical tasks in the classroom but, as our evidence suggests, out of a sense of professional obligation or under school and parental pressure. Most importantly, however, they seem to have minimal appreciation and gain little joy out of this engagement. It is sources of this disaffection we intend to explore here and, in this sense, we expand on the experiences of Jo Boaler's (1997a) certain Amber Hill students. While not engaging with direct juxtapositions, for example, with regard to teaching styles—Boaler seems to recommend a wider adoption of project-based mathematics teaching—our observations are hopefully recognisable by and potentially helpful to teachers who operate within schools such as N, C and T.

Before we introduce each one of the five proposed characteristics of quiet disaffection let us unpack a little the introductory sentences of this section and relate them to some of the categories of our Code System—each category is accompanied by its (*x*, *y*) frequency ordered pair (see Methodology section). So, the students in question *apparently engage with mathematical tasks in the classroom but out of a sense of professional obligation*:

> *P1 Students perceive homework, attendance/concentration, organisation in mathematics lessons and preparation for examinations as a professional obligation. (70, 37)*

> *P12 Students have a utilitarian view of good performance in mathematics (support for other subjects, career prospects). (13, 12)*

In Robin (T)'s words:

> *Robin (T)*: I don't really want to do [maths at A level] but … I have to do it to do the job I want. Therefore if I don't get the job I want I won't be happy.

under school and parental pressure:

> *P13 Students attend mathematics lessons and work hard in mathematics out of fear of sanctions (teacher, school reports) or of parental pressure. (21, 19)*

In Rebecca (N)'s response below to the interviewer's question about the possibility of 'bunking lessons' if they are 'so bad', Rebecca's reason for not taking this option is as follows:

> *Rebecca (N)*: You just get found out and get into more trouble anyway so … we'd have to do extra maths lessons … That would be even worse!

Overall, the students seem to have *minimal appreciation and gain little joy out of their engagement with mathematics* ('I don't enjoy it. I hate it' declared Rebecca [N]).

> *M1 Students have negative feelings towards mathematics (lessons). (70, 46)*

> *M12 Students perceive mathematics as an awful subject. (46, 31)*

As we demonstrate in the concluding section of this article and elsewhere (Steward & Nardi, 2002a,b), the above negative attitudes are not to be confused with an overall unwillingness to engage with mathematics as such. Indeed, a substantial number of students offered us accounts of both negative and positive experiences of mathematical learning and, significantly, linked these positive experiences with an improved image of their mathematical ability. However, a substantial number made no positive comments (about half) and a smaller but not negligible number made clear and firm statements of their decision to opt out of a subject out of which they gain little joy:

> *P25 Students make a conscious choice whether to work in lessons or not. (25, 11)*

For example, Robin (T) said:

> *Robin (T)*: I'll just try like one question and then … or I'll do like five questions so I don't get into trouble.

We now move on into a more detailed profiling of quiet disaffection. The five characteristics we wish to exemplify and discuss are: Tedium, Isolation, Rote learning (rule and cue following), Elitism and Depersonalisation.

Tedium

I want to enjoy maths but I can't because it's so boring. Noel (T).

The overwhelming majority of the students we observed and interviewed expressed views similar to Noel (T)'s: clearly, these students view mathematics as an irrelevant and boring subject, the learning of which offers no opportunity for activity. In this view, mathematical skills are seen as an isolated body of non-transferable knowledge. The students put their highly frequent use of words such as 'boring' into context by citing types of mathematical tasks and activities that yielded such feelings.

T11 Students do not like irrelevant, decontextualised, textbook-based mathematical tasks (formal tasks). (29, 21)

T27 Students do not like repetitive tasks or tasks that are too easy or trivial. (17, 11)

C8 Students find it difficult to engage in mathematical activities (e.g. investigations) that they find too abstract, meaningless or without aim. (22, 14)

M7 Students perceive mathematics of limited use in adult life. (16, 14)

Research in mathematics education (e.g. Tikly & Wolf, 2000) has repeatedly attributed student alienation from mathematics to its abstract nature and its heavy and compressed symbolic representation. In line with the findings in this research, there were occasions where the students found the use of symbolism off-putting and grudgingly admitted its usefulness towards the learning of more complicated mathematics. e.g. at GCSE level. For instance, Jamie (T), during exposition by the teacher in front of the whole class regarding a 'brackets' exercise in algebra, complained, 'What's the point of this?' and later, in the interview, questioned the relevance of this type of algebraic task:

Jamie (T): … really you don't use that unless you are going to be professor or something.

In a lesson we observed, students were administered a question sheet containing approximately 20 calculations of the perimeter of a circle, given its diameter. The students were asked to use the formula πd and were allowed to execute the calculation with the help of a calculator. They had been shown the button for π on the calculator before. The formality, repetition and meaninglessness of such a task ('It's like parrot-work. It is parrot-work. It's just like doing the same stuff over and over again' says Amy [T]—see also section on Rote Learning below) is experienced with exasperation from the students, who sometimes see this as an inextricable part of the nature of mathematics—or, as Rosanna (N) put it:

Rosanna (N): You've got to spend an hour now looking at the book, you've got to work at them … But I suppose you've got to do that and that's why [maths has] got a bad reputation.

However, in recent years there has been an effort to shield contemporary secondary school students from this type of mathematical experience and to contextualise school mathematics through the use of activities perceived by their creators as practical and relevant (e.g. investigations in the 'Using and Applying Mathematics' strand of the curriculum). Most of the students in this study, however, did not seem to share this perception with regard to most of the contexts used in practical and investigative mathematical activities in which they were asked to participate in their lessons. The students' resentment seems to be directed quite acutely towards some of these activities (as also elsewhere, e.g. Boaler [1994]. Vicky (N) and Yianna (N) do not seem to see through fence designing or table manufacturing an opportunity for practising and developing certain algebraic and geometrical skills that are transferable to contexts that are *personally* relevant to them:

> *Vicky (N)*: … some of the topics are just so stupid they're … and … like algebra …
>
> *Yianna (N)*: What are we going to use them for?
>
> *Vicky (N)*: … what are you going to use them in the future? I mean, really. Some things are just so …
>
> *Yianna (N)*: I mean, I'm not exactly going to design fences that, you know, you have to work out a third of this to get round the whole of the circle.
>
> *Vicky (N)*: And I'm not going to make my mum a table for her birthday and do squares on the outside of it.
>
> *Yianna (N)*: Yeah. How many squares!

Even individualised learning schemes, designed to address and cater for each learner's pace and style of learning and interests, like SMILE (School Mathematics Individual Learning Experience), heavily used by one of the schools participating in the study, attracted criticism from the students for doing so in an unappealing way:

> *Joe (C)*: … the problem with it is that it doesn't actually involve much teacher/pupil interaction at all. It's more just like an endless cycle. You're getting cards out and then just writing down what it says, same as like spewing out information you've soaked up and then you just go and get another one.

In Joe's vivid account mathematics is an isolated activity (see section on Isolation below) that requires the filling in of a succession of cards in which the learner demonstrates that the transmission and absorption of mathematical knowledge—suitably chopped into manageable units—has succeeded.

In the above, certain textbook activities, practical/realistic activities and individualised learning schemes are commented upon by substantial numbers of students. As evident, however, in the students' more constructive comments and accounts of positive experiences, it is not the use of textbook/activity/scheme *as such* they oppose; it is the *exclusive* and *unimaginative* use to which they are put. Relevance, excitement, variety and challenge were cited by students as characteristics of the mathematical activities they wish to be more asked to participate in—see concluding section and Steward and Nardi (2002a,b).

Isolation

> *When he sets it as a class, it's individual—the whole class do it but individual.*
> Sheena (C)

More than other curriculum subjects mathematics is perceived by the students in this study as an isolated subject where little opportunity is on offer to work with peers. Across the spectrum of the Code System a number of categories demonstrated the students' clear preference for collaboration and group work, whether this is in the context of a practical activity ('if we done it all together, then that would be easier because there's more of us thinking', as Sheena [C] put it) or a textbook-based task:

S2 Students enjoy the camaraderie of collaboration in mathematics lessons. (83, 41)

S7 Students appreciate a friendly learning environment and being with their friends. (51, 29)

C3 A student strategy for overcoming difficulty in mathematics is to seek the straight-to-the-point, clear help from a peer. (61, 42)

C19 Students believe that helping peers and working together reinforces understanding. (6, 6)

M14 Students feel that mathematics is a subject they need to talk about/discuss. (4, 4)

T10 Students appreciate a teacher who uses group activities. (13, 8)

We have already seen an example of the students' objection to isolated formats of working in mathematics in Joe (C)'s description of what it is like to work through a succession of cards on one's own (Tedium section above). Mikaela (C) places emphasis in a similar vein:

Mikaela (C): Sometimes you look at a card and think 'this card would be so much more fun and better if I could work with someone else'.

John (T) also recounts the predicament of having to learn while seated away from peers and elaborates on a certain incident where peer support proved helpful:

John (T): … you see we done it once and then we, and then I didn't really understand it then and then we stopped doing it and we done something different. And then when [names a friend] started sitting next to me we done it again … and he understood it better and I just saw him do it and I could see what he was doing.

Interviewer: So it helped you?

John (T): Yeah. So I like kept looking over. And, when I saw what he was doing so I thought—oh, I know what he's doing now. I knew how to do it.

Interviewer: Right. So it's a problem in some ways sitting on your own?

John (T): Yeah.

Interviewer: Cos you've got no one to talk to.

John (T): Cos you can't … you can't … no one to help you along if you don't know it.

Contrary to stereotypical views of mathematics as a deeply individual activity that demands high concentration and is better conducted away from the distraction of others, students here elaborated on the merits of collaboration, and, in particular, of collaboration with peers, as it appears that sometimes it is easier and less stressful to pursue the help of a peer than of a potentially scolding or very busy teacher. Sarah, Laura and Tansy (T) resented having to work in silence during a cover lesson with a different teacher. The three girls celebrate the support they can offer each other:

Interviewer: So you think you do work together?

(All three girls agree)—'Oh yeah.'

Sarah (T): Practically all the time. That's like when we have supply teachers, when we had someone, I think it was Mrs [names teacher], she made us work in silence … We were like struggling, … 'cos I didn't want to ask. I feel it's a lot easier … to my friends, if they explain it, 'cos I'm like more comfortable.

Tansy (T): Yeah, so do I.

Sarah (T): I didn't want to go up to Mrs [names teacher], and say, mm, I don't know how to do this. She'd be like … you know. I wanted to ask Tansy, you know …

Tansy (T): But then you can't.

Sarah (T): … And then I can't, 'cos she's like 'shut up!' That's the thing, I don't like it when teachers make you work in silence.

The students highlight in their accounts what in the relevant literature (e.g. situated learning and constructivism) appears as the significant affective and cognitive merits of peer learning (Lerman, 1998). Moreover, like these theories, the students place emphasis on the significance of working with peers not for mere efficiency, not for simply 'doing' the mathematics, but, also, for understanding it. They seem to suggest that this understanding is generated more efficiently in the context of negotiation and explanation to others. Having placed emphasis on understanding, it is not surprising, then, that the majority of students in this study seem to resent mathematics when perceived and presented to them as a rote-learning activity.

Rule and Cue Following (Rote Learning)

It's like parrot work—it is parrot work. Amy (T)

Several students in this study seem to experience mathematics as a set of rules that suggest unquestionable and unique methods and answers to problems. Certain students, such as Robyn and Yianna (N), contrasted mathematics to other, perceived-as-less-dogmatic subjects like art:

Yianna (N): And in art they don't put you down. In art you can't put someone down if they're not good at drawing.

Robyn (N): Because everybody has their own way of drawing …

In this sense, our findings resonate with the students' descriptions of mathematics as a rule-following activity in Jo Boaler's work. In this frame of mind memorisation and mimicking of correct procedures as demonstrated by the teacher is then an efficient route to an improved performance in mathematics. Or, as Eloise (N) puts it:

Interviewer: … you just said—I was trying to do it one way but then she showed us another way and that's the way to do it. Do you think, … do you think that is the way to do it?

Eloise: Mm …

Interviewer: Would your way have worked do you think?

Eloise: I don't think so. I kind of, I thought I had an idea that [recaps her idea for a solution], and sometimes when we do the things I'll … I'll try and work out a way and it won't be the right way and Miss will stop us before I actually find the answer out, so then she shows us her way and then it gives us the answer so it's just easier to go with her way then because we actually know how to do it then get the answer.

Interviewer: Right. So do you think that … that sort of implies that you think there's one way?

Eloise: No I think there are many ways. There most probably are many ways to do it but, mm, when Miss shows us I can … if I … she'll give us another one to try and if I can do it on that one then I'll just try it that way … 'cos I know I can get the answer from it, it would just be the quickest one to do. But there most probably are different ways.

Certain students, however, feel that this is not necessarily an appealing or cognitively satisfying way:

P14 Students believe that hard work, practice and memorising ways of working contribute to an improved performance in mathematics. (39, 30)

C9 Students do not believe that teacher prescription of correct answers is an efficient strategy for overcoming difficulty in mathematics. (14, 10)

C32 The rigidity of having to find 'the answer' rather than the acceptability of a range of approaches or answers presents a barrier to progress. (4, 3)

C6 Students find having to repeat a task in mathematics until achieving a correct answer frustrating and annoying. (9, 9)

In Jade (N)'s words:

Jade (N): It probably won't make sense to you but it did make sense to me … I understood what I'd written there. But she was like, oh that's horrible! … I mean, if I do it her way I don't understand it. But if I do it, like … when I get it in my head like, if I stop listening to her or whatever, 'cos she'll like start explaining it to somebody else and like, or to the class or whatever again, then I'll totally forget my way of doing it and won't … oh.

Moreover, as prescription of correct procedures usually implies heavy exposition from the teacher, certain students expressed weariness towards being 'talked at' extensively by the teacher:

T15 Students do not like a large amount of teacher exposition. (12, 11)

T4 Students do not like long-winded/pedantic approaches to mathematical explanation. (14, 10)

C36 Students find their teacher's explanations difficult to understand or make sense of. (10, 6)

Beneath this dissatisfaction with mathematics as dry proceedings lies, perhaps, a longing for deeper, more essential understanding and for engagement with mathematics that goes beyond—borrowing another of Boaler's terms—a following of the cues provided by the teacher (or the textbook). As execution of procedures and memorisation is perceived as an efficient route to a better performance in mathematics, this deeper understanding—and the implied enjoyment—is seen in juxtaposition to what students perceive as their professional obligation towards task completion. Similarly to Boaler's top set girls, a number of students in this study make statements similar to Rosanna (N)'s towards the end of this section:

> *P9 Students perceive task completion as a professional obligation sometimes at the expense of own initiative, deeper understanding and enjoyment. (26, 21)*

> *C15 A student strategy for overcoming difficulty and lack of confidence in tests is to practise and revise in order to facilitate the compression and recall of facts. (20, 15)*

As Charlotte (N) puts it:

> *Charlotte (N)*: There was the question about this in the test. And I knew how to set it out but I don't know how to work it out, because I know how to set it out because she told us but I don't know how to work it out because I don't get it, so …

How the classroom culture seems to foster images of mathematics as a rather mindless task-completion activity that does not require high levels of concentration is evident in the number of student statements according to which:

> *S9 Students believe they can work and talk (about unrelated to mathematics) things at the same time. (16, 14)*

Under the pressure of curriculum coverage and task completion, the students express their unease with the limited time allocated to their need to understand:

> *C2 Students find it easier to overcome difficulty in mathematics when working at own pace and not under much time/emotional pressure. (50, 23)*

They sometimes even go to the extent of saying that a lesser mark in a test or an incomplete answer are preferable when accompanied by a better understanding of the topic:

> *Anna (N)*: Last year we were like, if we'd got given a test back we'd all be like—oh what did you get? And everyone in the class would be happy with their mark, they were …

> *Gemma (N)*: 'Cos they felt that they'd learnt something even though they didn't get the mark, like a top mark or something … you know that you've like understood the work even if you haven't got the answer right …

Crucially, the students emphasise their very strong, positive attitudes towards a mathematics they have a firm grasp of.

> *C11 Students have strong negative feelings towards mathematics when their attempts at understanding fail. (30, 23)*

> *C13 Students have strong positive feelings towards mathematics when they achieve understanding. (29, 21)*

> *P5 Students' image of their ability in mathematics improves when they achieve a sense of understanding—as opposed to achieving task completion. (37, 23)*

Frustration ensues when task completion is not coupled with a gratifying sense of understanding. Rosanna (N) responds as follows to the interviewer's observation that, while she is doing quite well in the class, she herself does not seem to think so:

Rosanna (N): Yeah. I don't know 'cos I do understand like most of the things she says but, I don't know, it just doesn't always like work properly.

Interviewer: … you don't feel completely happy?

Rosanna (N): No. I think like … I've got the idea of it but I can't like just go on and do those questions unless I've really got it.

Interviewer: Right. So there's a bit more that you want to understand?

Rosanna (N): … Yeah, I don't understand it all, like exactly how it would all like work together. I just … I'm just like told that that's how you do it but I don't understand how really you do it. I just do it like that.

Interviewer: Right, so it's not … so it's not satisfying for you? [Rosanna says yes] Because of that.

Rosanna (N): So you … you … you know how to do it because you've been told to do it like that but you don't really understand why it's done like that.

Often it is claimed that this reduction of mathematical learning to an execution of cues and procedures is necessary as it simplifies mathematical thinking, also known as a very abstract and intellectually demanding domain of human cognition. What this line of thinking does not accommodate, however, is the fact that, for example, an algorithm or a formula compresses and reifies an often large number of mathematical ideas. By presenting the learner with an algorithmic task, without inviting them to construct an understanding of the rationale behind the task or an understanding of how the algorithm has come to provide an answer to the set question, while attempting to engage the learner with a task that is perceived as simple and accessible, one mystifies the mathematics behind the algorithm and obscures the power of reasoning that lies within mathematics. This mystification-through-reduction does mathematics no favours as it perpetuates its image as an elitist, remote and inaccessible subject.

Elitism

I hate maths because I'm not very good at it. Rebecca (N)

The students participating in this study seem to perceive mathematics as a demanding subject in which only exceptionally intelligent people can actually succeed. In this frame of thinking engagement with mathematics is fraught with the risk of exposing the weaknesses in the student's intelligence and worsens the student's image of their own intellectual capacity.

The students' self-images of mathematical ability are overwhelmingly negative:

P4 Students perceive (or are told) their ability in mathematics as poor (negative self-image of own ability). (72, 32)

M4 Students perceive mathematics as a hard subject. (22, 18)

This impression from the data is reinforced also by the relatively small number of students with positive or neutral images of their ability and of the difficulty of mathematics:

P22 Students perceive (or are told) their ability in mathematics as strong (positive self-image of own ability). (23, 16)

P23 Students make 'neutral' statements about their ability in mathematics. (12, 9)

M5 Students perceive mathematics as an easy subject. (2, 2)

This already fragile situation with regard to the students' images of mathematics and their own mathematical ability is likely to deteriorate in a schooling environment where setting and testing impose further stratification of ability. In this environment anxiety and nervousness flourish:

P17 Students believe that nervousness/anxiety in tests affects their performance. (20, 18)

T2 Students do not like the compulsory nature of testing. (21, 17)

In Laura (T)'s words:

Laura (T): I don't know why but the atmosphere always puts me off, I start getting panicky and by the time I've finished the test I'm like 'oh my god! It's half my marks for the year'.

In accordance with Rebecca (N)'s words in the beginning of this section, and as nearly half of the students testified, the more positive their image of their own mathematical ability is, the likelier it is that they engage with mathematics keenly.

P11 Students engage with mathematics with a more positive attitude when they perceive their ability in mathematics as strong. (43, 32)

Unfortunately, a worryingly high number of students, and within the context of this study at least an overwhelmingly high number of almost exclusively *female* students (Steward, 2002), express rather fatalistic views on mathematical ability as innate. 'Everybody gets it except me. I'm sitting there, I'm like … help me', says Jade (N), who, in another part of the interview, while discussing with the interviewer the (only partially incorrect) response to a question she had been given to work on, also makes the claim that 'the answer would have been wrong anyway'! The blow on this student's mathematical confidence—which on the basis of the observation and interview evidence seems to be both environmentally and self-inflicted/exaggerated—seems to be a severe one.

In resonance with Boaler *et al.*'s findings (2000), stratification of ability through setting seemed to be the major environmental source of influence on the students' self-image of mathematical ability. Sarah (T) traces the perception of her mathematical ability as low since primary school ('the one I think I'm doing the worst in'). Despite her appreciation of the subject ('it's one of the most important ones isn't it', 'it's not that I like it or not like it, it's just that I'm not very good at it. I don't mind maths. It's okay'), Sarah (T) draws the hard evidence of her low ability from her hierarchical position in the classroom:

Sarah (T): And plus I find it more hard with maths … and I've never been in a high set for maths.

The extent to which the position in a set influences the student's image is evident in Carla (C)'s words below, a quite successful student who, close to the time of the interview, had progressed to level 7. This recent development could not, however, deracinate the firmly held low image of her ability, established in her earlier schooling years:

Carla (C): I think it's come from middle school because I was in the bottom set for maths and I didn't do very well in there either … so that's probably why.

Furthermore, setting also isolates the students who are apparently mathematically more able. Possibly reflecting analogous widespread public images of mathematicians as bizarre intellectuals, the students in the top set are perceived, as Hannah (C) puts it, as 'frightening' because 'they just seem so clever' (yet Hannah herself is in the top set in English).

What the above views seem to suggest is that the students are unwilling to engage in this hierarchical game according to which an individual's intellectual capacity is heavily judged in accordance with their perceived mathematical ability. Their resistance was neatly encapsulated in Yianna (N)'s contrasting of mathematics and art quoted in the Rote Learning section ('in art they don't put you down. In art you can't put someone down if they're not good at drawing').

The students find this strictly hierarchical, elitist mathematics resistible and the blows to their mathematical confidence often painful ('I've suffered greatly over the past few years in maths', states Rebecca (N)). Furthermore, the hierarchy inherent in the above outlined elitist situation alters the nature of the classroom experience from one that focuses on catering for the individual learner's needs to one that focuses on establishing and assessing each learner's position in this hierarchy. The students express their alienation from this depersonalised, deterministic mathematical experience.

Depersonalisation

… we don't get any attention at all. Dominic (N)

The students in this study repeatedly and in various forms expressed their appreciation for a learning environment that cautiously caters for their individual needs:

T17 Students appreciate the use of individualised schemes (like SMILE). (29, 12)

T25 Students appreciate a teacher who adopts an individualised teaching approach or who responds to individual needs. (25, 17)

C2 Students find it easier to overcome difficulty in mathematics when working at own pace and not under much time/emotional pressure. (50, 23)

In Eloise, Ellie and Stephanie (N)'s words:

Ellie (N): I think time is definitely part of it, what you need to understand it. Because sometimes it just goes through your head and you're rushed into doing it and you either get them wrong or it might not stick in your head what we've learned.

Interviewer: So you feel that you can't really work at a pace that you're comfortable with?

Ellie (N): I think she uses the pace of, I mean, by people who are slightly cleverer than other people in the class, and so people don't necessarily don't understand it, they like get confused and they don't have enough time to answer the questions and maybe get them wrong.

Interviewer: So it's not that the work is too hard it's just that sometimes it's too rushed?

All three: Yeah.

The role of a teacher who is capable of balancing sensitivity with challenge (Jaworski, 1994) emerged as paramount and possibly transcended, in the students' views, the importance of scheme, textbook or activity used. Let us note, for example, that the individualised learning scheme, SMILE, seems to be appreciated by some students for its attempt at addressing and resolving the issue of learning at one's own pace but criticised by others—see Isolation section—who wish for a more interactive mathematical experience. Alternation of schemes and styles emerges from the study as a suggestion for accommodating the students' often conflicting accounts of their needs (see concluding section, and Steward and Nardi [2002a,b]).

As seen in the previous section, the students, despite their expressed unwillingness to engage with the hierarchical game implied by setting, seem to attribute importance to the labels it produces. They also attribute importance to this label being accurate:

P18 Students' image of their ability improves when they perceive they have been correctly placed in a set or feel the work they do is appropriate for them. (33, 24)

In this sense, the students who expressed this view seem to acknowledge the potential value of setting in mathematics if it facilitates the allocation of individual work that is suitable to each learner's needs.

However, worryingly, and in resonance with the students' aversion towards the hierarchy implied in setting, a small but not insignificant number of students expressed the view that these more capable teachers are allocated to the higher sets:

T28 Students believe that higher sets get 'better' teachers who expect more from them and / or 'better' or more mathematical activities. (12, 8)

The students elaborated in the interviews on certain individual needs that their current classroom experiences of mathematical learning do not accommodate. Joe (C) finds the logic behind seeing mathematics as a linearly evolving set of building blocks not suiting his learning style (influenced also by a mild form of dyslexia):

Joe (C): I have a particularly poor short-term memory … so I can't do things like times tables and I never have been able to. *(Interviewer comments on dyslexia and asks about other topics of the curriculum such as Shape and Space and Algebra)*. Yeah, I can easily do that. But it's easy for you if you think of maths as building blocks, until you've learnt times tables you're not allowed to move on to anything else. So I've been stuck there for ages!

Having to progress developmentally from arithmetic to algebra seems to be an inappropriate expectation from Joe (C). In his view, persisting with this expectation creates an obstacle to his learning. Hannah (T) expands on another obstacle to her learning imposed, in her view, by her abrupt progress to a higher set:

Hannah (T): … when I got to school it was like quite sort of scary because it was the top band … which isn't just like the next group it's like a really massive step and I was quite scared because it was really harder than the work we were used to doing.

Interviewer: So do you think you've missed out … I mean, if you were in a lower set last year … then it must be that you haven't done the same work that the other people in the group have done.

Hannah (T): Yeah. It's like some of the time she talks about … can you remember us doing this last year or something and they go 'oh yes' … but I'm just like sitting there going 'no'. [*Interviewer suggests she may have been missing some of the 'building blocks*'] Yeah, I suppose I have missed quite a big chunk of stuff that I could have understood. Or actually worked on.

Interviewer: So you … do you think you've suffered from going up too much?

Hannah (T): Yeah. I feel as if I've missed something that I could of … what I was about to do before I moved up, that could have helped me understand in this group.

The students plead for classroom mathematical experiences that are tailored to their individual needs. In the absence of such individualisation they grow alienated from the subject and even eventually wish to drop it. A number of students were eager to reach GCSE, which marks the end of the compulsory learning of mathematics. One student, Chris (N), even went to the extreme of suggesting the banning of the subject given its perceived tedium, elitism etc.: 'Get rid of it', 'ban it', 'drop it', he pronounced. Amongst heavily repeated words like 'grey', 'depressing' and 'boring', Joe (C)'s (a quietly disaffected but apparently engaged pupil) cold detachment from the subject is expressed in rather chilling terms:

Joe (C): If I have a maths lesson I have no negative nor positive emotions. You just sit there and do it—it's like a null period.

Synthesis/Conclusion

The students whose attitude towards the learning of mathematics this study focused on apparently engage with mathematical tasks in the classroom mostly out of a sense of professional obligation and under school or parental pressure. They seem to have minimal appreciation and gain little joy out of this engagement. It is sources of this disaffection we intended to investigate. A substantial number of students made no positive comments (about half) and a smaller but not negligible number made clear and firm statements about opting out of the subject in the first instance.

Most students we observed and interviewed view mathematics as a *tedious* and irrelevant body of isolated, non-transferable skills, the learning of which offers little opportunity for activity. In addition to this perceived irrelevance, and in line with previous research that attributes student alienation from mathematics to its abstract and symbolic nature, students often found the use of symbolism alienating. At the same time, they often resented the use of certain activities—perceived by the teachers as practical, relevant and intended to make the subject accessible.

Even individualised learning schemes, designed to address and cater for each learner's pace, style of learning and interests, like SMILE, attracted criticism. What the students seem to oppose, however, is not the use of textbook/activity/scheme as such; it is the exclusive and invariable use these are put to.

Mathematics is perceived by the students in this study as an *isolated* subject which offers limited opportunities for working with peers. The students expressed a preference for collaboration and group work within all contexts, teaching styles and learning environments and elaborated the merits of this preference (e.g. the relative ease with which one may pursue the help of a peer rather than of a teacher). In the sense put forward strongly by these students, a style of working that emphasises negotiation and explanation to others is not only emotionally more satisfying or more efficient in terms of task completion but it is also prone to generate a better understanding of the mathematics.

The students seemed to resent mathematical learning as a *rote-learning* activity that involves the manipulation of unquestionable rules and yields unique methods and answers to problems (unlike, for example, art). And, despite a perceived efficiency of memorisation and mimicking of correct procedures as cued by the teacher (for example, in tests and examinations), the intellectual appeal of these approaches to the students was limited, especially because their use implied having to tolerate extensive exposition by the teacher. We conjecture that beneath this resentment towards mathematical activity as task completion via *rule-and-cue following* may lie a longing for a deeper understanding (hence intellectual satisfaction and ultimate enjoyment of the subject). Within school mathematics, reducing mathematical learning to an execution of cues and procedures is often intended as simplifying complex mathematical thinking. However, devoid of a rationale for their use, these procedures are then perceived as mystifying-hence-alienating by the learners. This mystification-through-reduction perpetuates an image of mathematics as *elitist*.

Most students expressed a view of mathematics as a difficult, elitist subject that exposes the weaknesses of the intelligence of any individual who engages with it (therefore puts confidence in their intellectual capacity at risk). In our data the students' self-images of mathematical ability are overwhelmingly negative and likely to deteriorate further in a highly stratified environment of setting and testing (which also isolates the more able and accentuates a stereotypical image of mathematical ability as unusual and threatening). The lower their mathematical confidence is, the less willing the students seem to be to engage with mathematics as a hierarchical game (especially as some of them suggested, rather fatalistically, that mathematical ability is innate, therefore more committed engagement will not necessarily yield a better performance).

The students expressed their resentment towards a strictly hierarchical mathematics that has the potential for a painful impact on their mathematical confidence. Instead, they favour a less antagonistic and less *depersonalised* classroom environment that focuses on catering for the individual learner's needs (in this respect, the merits of individualised learning schemes such as SMILE were occasionally mentioned). Also in this sense, cautious, accurate and sensitive setting was seen by certain students as potentially facilitating this intensely needed catering for each learner's individual needs.

The students plead for classroom mathematical experiences that are tailored to their individual needs. In the absence of such individualisation they grow alienated from the subject and even eventually wish to drop it. A number of students were eager to reach GCSE, which marks the end of the compulsory learning of mathematics and, in this atmosphere of extremely low mathematical self-esteem, the contingency of failure at GCSE level is not even surprising:

> *Hannah (T)*: It wouldn't surprise me. I wouldn't expect to get it because I don't see myself as a sort of person that would get, like get good marks on my maths GCSE or pass it or whatever. Because I'm not good at maths and I'd sort of feel quite scared of … even if I did like know the work I'd just look at it and think I can't do this and just sort of get put off really.

In fact, the contingency of failure turns into demoralisation and impedes further attempts at understanding.

As we demonstrate in more detail elsewhere (Steward & Nardi, 2002a,b), the above negative attitudes are not to be confused with an overall unwillingness to engage with mathematics as such. Indeed, most students occasionally drew on positive experiences of mathematical learning to make statements about their images of *effective* mathematics teaching. We have organised these statements along the following themes: *Nature of Classroom Activities—the notion of 'Fun'*; *Teaching Styles*; *Role of the Teacher*; *Role of Stratification Structures such as Setting*. Let us now exemplify those.

For the students an important component of willing engagement in mathematics was that the activities are relevant and the lessons are 'fun'. This notion of 'fun' was generally not meant in a frivolous manner—there was strong evidence from the data that students perceive enjoyment (relevance, excitement, variety) to be central to learning:

> *P15 Students' image of their ability in mathematics improves when they engage with it with a more positive attitude and enjoyment. (40, 23)*

In Noel and Craig (T)'s words:

> *Noel (T)*: I could be the best mathematician in the world if I actually enjoyed it. That is the main thing, yeah.
>
> *Craig (T)*: It's the key!
>
> *Noel (T)*: The key to MATH! Look, I'm 14, and I know that! Why can't some adult work it out!

What constitutes 'fun' is interpreted by different students in different ways. Most students' descriptions of 'fun' lessons seemed to include a format that was varied or dynamic and a context or content that was practical or relevant.

> *T7 Students appreciate a teacher who uses tasks, including games, that are useful, enjoyable and one can relate to. (84, 47)*
>
> *T14 Students appreciate a reasonable degree of challenge and initiative provided in an open-ended mathematical task (e.g. investigations, project work, coursework) (27, 21)*

The types of activities described could usually be placed within 'Using and Applying Mathematics' and were often games, puzzles or investigations.

> *Charlotte (N)*: … we used to play maths games to make you work it out and you used to understand it more because it was fun and you [were] paying more attention.

Mathematics lessons were often contrasted with other, more popular, school subjects. Art and technology were frequently mentioned. Project-based work in other subjects where students were given the autonomy to express themselves creatively was also referred to, implying the potential for re-engagement though cross-curricular links between mathematics and other subject areas.

Another side to the notion of 'fun' is that if students believe they can do mathematics and engage positively with it then they actually enjoy the subject more—as we demonstrated in the Elitism section and, in particular, the overwhelming evidence the impact setting has on the students' self-image of mathematical ability:

> *P2 Students perceive their ability in mathematics in terms of scores in tests, levels, sets etc.—often in comparison with other students. (182, 61)*

The labelling of pupils, now even at primary level, will prevent many from reaching their potential. The challenge facing mathematics education today (indeed within education generally) is to encourage students to opt to carry on their mathematical studies at tertiary and higher levels. In this the role of the teacher was described by the students as perennial ('If I get on with the teacher I'll get on all right', claimed Jade [N]. And Noel [T]: 'The teacher can make it other than "boring" or "snore" or … whatever words were used [to describe maths]. It could be better than that').

> *P16 Students' image of their ability in mathematics improves when they feel they have a good relationship with the teacher or they have confidence in the teacher. (21, 12)*

> *M17 Liking or not liking the teacher affects students' attitude towards mathematics. (17, 15)*

The students elaborate their expectations from the teacher:

> *T5 Students appreciate a teacher who explains clearly and in different ways, uses concrete examples and builds on previous knowledge. (43, 32)*

> *T9 Students appreciate a teacher who is friendly and invites student questions but does not pick on them. (48, 30)*

> *T22 Students appreciate positive teacher feedback and praise. (8, 5)*

> *T8 Students appreciate a teacher who 'makes you work' or 'makes you think'. (18, 14)*

Unsurprisingly they also express their reservations about an authoritarian teaching style:*T6 Students do not like being ordered to work in an atmosphere of fear, or through humiliation and do not like being 'put down'. (26, 14)*

T23 Students do not like a teacher who cannot maintain discipline. (13, 12)

The possibility for a turnaround of attitudes towards mathematics (especially at an earlier age (McLeod, 1992; Ruffell *et al.*, 1998) when these have not yet crystalised into more entrenched ones) and improving the students' mathematical self-esteem comes across in Hannah (C)'s account of a shift she has recently gone through:

> *Hannah (C)*: Last year I was really struggling and, I don't know … I was surprised that I even got into set three, I was … I just didn't think that was possible and I was doing so badly and I couldn't do the home … I couldn't finish the homeworks because I didn't understand half of them and … And I just kept getting debits and detentions and … this year … this year I just seemed to have, kind of, gone off on my own pace and it's just worked out all right…. 'Cos since I was just a little kid, my mum used to be really good at maths and she used to try and teach me things at home and I was like, leave me alone, I don't want to know this. I really hated maths so much. And, mm, in middle school it just got worse and worse. Then in … last year, it just got so bad to the point where I felt like, just like bunking off lessons and hiding up somewhere. And I almost did a few times. Now I just like … I like maths now. Some of the reasons 'cos of them two. But most of it is because it's a lot easier and light-hearted and I can … I can actually do it…. It's a change that I can do maths. Oh my god, whoa!

In this article we proposed a detailed profile in which disengagement/invisibility in the secondary mathematics classroom was characterised. In a milieu currently under the influence of the extended use of the National Numeracy Strategy within secondary mathematics education, subsequent research may utilise this profile in order to formulate re-engagement strategies through a synthesis of the observations, interpretations, reflections, analyses and rationalisations of the partners in this research. In such a study, significant will be the raising of issues fundamental to effective teaching as well as teacher education. Through publication, conference presentation and workshops the dissemination of these findings has targeted audiences and readerships that include both mathematics educators and practitioners of mathematics teaching at secondary level. It is hoped that in this way a much-needed collaboration between practitioners and researchers in mathematics education will be inaugurated which may in the future evolve into more permanent and established forms.

Acknowledgement

We wish to extend our warmest thanks to the Economic and Social Research Council for its support (Award No R000223451) and the heads of mathematics, mathematics teachers and pupils who participated in the study.

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