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The perceived causes of the (assumed) mathematics problems in England and South Africa: A social media experiment

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This paper presents an exploratory study, using a methodology based on the idea of building knowledge through the use of social media such as blogs, discussion forums and twitter. The study builds on work carried out in the UK, collecting and synthesising reports related to mathematics education, and from this developing research on the perceived causes of the (assumed) problems with mathematics education in the UK. It develops the research to take account of the South African context, and investigates the same question in this context. The results are compared, and findings include the fact that in both countries 'negative attitudes' towards mathematics are seen as a major cause. The paper concludes by reflecting on the methodology adopted.

Keywords: Negative attitudes, poor teaching, nature of mathematics, social media.

INTRODUCTION

This paper presents an exploratory study, which draws on, and extends, my previous work on the use of social media (e.g., twitter, blogs, wikis) in research (e.g., Joubert & Wishart, 2012; Joubert, 2011). I constructed a blog in which I collected and synthesised over 50 'official' reports broadly about mathematics education, published in the UK after January 2011. The blog can be found at <https://mathsreports.wordpress.com>. The reports were commissioned by a range of governmental and non-governmental organisations, such as, for example, the Advisory Committee for Mathematics Education (ACME), whose membership includes researchers and practitioners in mathematics education and which aims to advise policy, the Royal Statistical Society and the Nuffield Foundation. Naturally the reports can be seen to reflect the interests of these organisations. Many, but not all, of the reports make

generalised statements without reference to empirical research, raising questions about where these statements came from and what the status of the reports is; there is much more discussion about the reports on the blog.

I used social media such as twitter and online discussion forums to invite the mathematics education community and others (anyone who was interested and was willing) to help me understand more about these reports, by making comments on the blog. For example, what did they aim to achieve? Why were they commissioned? Whose interests did they serve? What is their role in shaping – or reflecting – a collective mindset?

On moving to South Africa in mid-2014, I aimed to carry this work forward but within the South African context. The work is at a very early stage but it is nevertheless perhaps interesting to compare initial results with the findings emerging from the UK. Of course the context is very different and one might expect there to be some differences; the value of any findings is under review.

The research has two distinct focus areas: the use of social media in research and the reported state of mathematics education. In this paper, I focus on one aspect of the latter, (the perceived causes of the perceived problems in mathematics education) and comment on the former.

BACKGROUND: PROBLEMS WITH MATHEMATICS EDUCATION?

In both countries there seems to be a belief that mathematics education is problematic, in terms of, for example, low levels of achievement on international

benchmarking tests and low take-up of mathematics at post-compulsory levels. The extent to which these problems actually exist or could be said to be similar is of course debateable, but for the purposes of this paper the so-called problem is assumed. Perhaps the most compelling symptom of the (assumed) problem is that in both countries employers and higher education claim that the mathematical knowledge of school leavers falls short of what they require (ACME, 2011a; British Academy, 2012; The Centre for Development and Enterprise, 2013).

It could be argued that the commissioning of the UK reports is in itself a response to the assumed problem and a number of reports claim that a problem exists (ACME, 2011a; Harris, 2012; Vorderman, Porkess, Budd, Dunne, & Rahman-hart, 2011).

In South Africa, education generally is troubled (Spaull, 2013) but it seems that mathematics is particularly problematic (Howie, 2003; Human Sciences Research Council, 2011; Mji & Makgato, 2006) with, for example, South Africa at the bottom of the league table in mathematics in the 2008 international benchmarking tests, TIMSS. Even the highest achievers in South Africa performed less well than the average students in top performing countries (Human Sciences Research Council, 2011).

A second, related, problem in both countries is a reported shortage of young people with appropriate skills in mathematics and so-called STEM subjects. (ACME, 2011a; British Academy, 2012; Southern African Catholic Bishops' Conference, 2012).

The problems, it seems, are similar although the extent of the problem is perhaps not. The focus of this paper, however, is on the causes of the problems rather than the differences in the extent of the problems. If the causes are well understood, then governments might be in a better position to target interventions; and if the causes are similar in both countries, then it could be that recommendations or successful interventions in England might be applicable in South Africa and vice-versa.

THE CAUSES OF THE PROBLEMS

Many of the reports collected on the blog suggest the causes of the problems, which fall into three broad areas: young people's (and adults') mathematical ac-

tivity; the curriculum, qualifications and assessment; and teachers, teaching and schools.

In terms of young people's mathematical activity, negative attitudes are widely seen as a cause for the problems. The term 'negative attitudes' includes a general dislike of mathematics and a cultural acceptability of 'I can't do maths'. For example, the Royal Society mentions 'a distinct general lack of warmth towards science and maths' (2011, p. 55). It is further reported that not being good at mathematics is generally seen as acceptable and leads to low levels of post-compulsory participation (ACME, 2011b; Harris, 2012; National Numeracy, 2012; Vorderman et al., 2011). Harris sums up the claim, stating that:

It seems that the UK has a culture where being less skilled in mathematics and numeracy is perceived as acceptable and not uncommon.... learners do not see the need to increase their mathematical skill. (p. 11)

The argument seems to be that because it is acceptable to be bad at mathematics, young people think that they do not need to study mathematics.

The curriculum is sometimes seen as a cause of problems in (mathematics) education. In 2011 the then secretary of state for education announced a review of the national curriculum, stating that 'The previous curriculum failed to prepare us for the future. We must change course.' (Department for Education, 2011). This announcement seems to imply that the Government believed that a different (better?) curriculum would drive standards up.

The ACME report, *Mathematical Needs of Learners*, stated that 'it is not necessarily mathematics itself that is problematic, but rather the nature of the curriculum and the teaching methods and assessment regimes' (ACME, 2011b, p. 8). It went on to say that 'the current curriculum is seen as being fragmented' (p. 6). As described by ACME, the curriculum is linear and lists topics and skills which should be taught and tested in order. This approach can mean that, for students, learning in mathematics is 'fragmented and incoherent' (p. 17).

Assessment is widely mentioned in the reports and there seems to be general agreement that it needs to be improved. However, assessment is not frequently

cited as a cause of the mathematics problems. Where it is given as a cause, this is in terms first of the content of some assessments and second the 'assessment regime'.

In terms of the content, there appears to be a tension between promoting mathematical thinking within, for example, extended investigative projects or problems solving, and the ways in which mathematics is assessed. The claim is that examination questions tend to be routine and familiar, and the only mathematical thinking that is assessed is that which is easy to test, and reliability of assessment tends to be highly valued possibly to the detriment of validity. (ACME, 2011b; Norris, 2012; Vorderman et al., 2011). As ACME says:

GCSE and A-level examinations are dominated by routine procedures and familiar applications. There is strong agreement among teachers, educationalists and Ofsted inspectors that unless all aspects are assessed they will not be given significant teaching time and resource in schools and colleges. (2011b, p. 6)

A bigger concern than the content of the assessments seems to be the 'assessment regime'. Many reports suggest that assessment takes place within a 'culture of performativity' (Norris, 2012, p. 11) driven by the annual publication of league tables and that operating within this culture maybe at the expense of the best mathematical experiences for pupils (ACME, 2011b; Norris, 2012; Ofsted, 2012; Vorderman et al., 2011).

It appears that there are two main causes of the mathematics problems which are directly related to teachers and teaching. First, there is a shortage of specialist mathematics teachers (Parliamentary Office of Science and Technology, 2013; Royal Society, 2011; Vorderman et al., 2011). Second, teacher knowledge is sometimes limited; there is much within the reports to imply that poor or inadequate teaching is the cause of much of the mathematics problem although this point is not always made explicit.

Where teaching is given as a reason for the problems in mathematics, it is argued that the approaches which are often privileged in classrooms are over-simplified and mechanistic and that students do not benefit mathematically from these (ACME, 2011a, 2011b; Norris, 2012; Ofsted, 2012; Vorderman et al., 2011). A number of reports claim that there is tendency to 'teach to the test' avoiding innovative teaching approaches, and us-

ing methods that are unlikely to lead to anything more than superficial learning (ACME, 2011a, 2011b, 2012; Harris, 2012; NFER, 2013; Royal Society, 2011). It seems that increased accountability (performance tables and inspections) has a role to play in this (Ofsted, 2012).

It is difficult to find South African reports equivalent to those cited above. However, the South African research literature suggests a range of causes for the problems. For example, Spaul (2013) identifies factors such as teacher education, parents' education and speaking English at home as being strongly associated with mathematics performance. Howie (2005) explored the relationships between background variables and mathematics achievement at the school level and the classroom level. She found that the variables at the combined school and classroom level most strongly associated with mathematics performance were the community where the school was located, size of classes, attitudes, beliefs and commitment of the teachers including dedication towards lesson preparation and the workload of the teacher. In a separate earlier study (Howie, 2003), she also explored the relationship between language proficiency and mathematical achievement and found that students who spoke English or Afrikaans at home, and those coming from classrooms where these languages were mainly used, overall gained higher scores in mathematics. In this same study, she also found that there was an association between achievement in mathematics and socio-economic status of the student, their 'self-concept' in terms of finding mathematics difficult and their perception of the importance of mathematics (their own perception as well as those of their mothers and friends).

Research by Mji and Makgato (2006) investigated the causes of poor achievement in mathematics and science by seeking the views of teachers and learners in a small number of schools. They found direct influences such as teaching strategies, content knowledge and understanding (of teachers), motivation and interest (of both teachers and learners) and non-completion of the syllabus; and indirect influences such as parental role and language.

Whereas research such as Spaul's and Howie's, and the reports produced in the UK, can be seen to take a top-down approach, the approach used by both Mji and Makgato and within this research is perhaps more

‘bottom-up’ or grass-roots. Building a comprehensive understanding may require both.

METHODS

As discussed above, this research draws on previous experience of using social media and web 2.0 within research, from which the principle of quick and easy data collection was derived. A very short online questionnaire was devised, which begins by stating ‘Too many of our young people leave school with mathematical understanding which falls short of the needs of employers and higher education’ and then asking ‘Why?’.

Five possible causes were tested in the UK. These were derived from the UK reports and discussion points made on the online forums mostly by teachers and parents: assessment focuses on the wrong things; the curriculum is not fit for purpose; societal attitudes towards mathematics are negative; teaching is not good enough; and ‘mathematics is hard’.

The same questions were used for the South African audience, and to take account of the South African context two further causes were included. The first, ‘Too many learners opt for maths literacy’ because of obvious concern amongst the mathematics education community about it (see for example Southern African Catholic Bishops’ Conference, 2012). Mathematics literacy was introduced in South Africa 2008 as an alternative to pure mathematics and was designed to provide functional mathematical learning to address the needs of the workplace. However, it is generally seen as an easier version of mathematics rather than an effective preparation for the workplace, as explained by Spaull (News 24, 2014). The second additional cause, ‘The language of learning and teaching

(LoLT) is not the home language’, takes into account the findings by Spaull, Howie and Mji and Makgato, see above.

Respondents were asked to rate each of the causes in terms of a) a key reason b) having some influence and c) not a reason. They were also provided with an opportunity to add ‘your longer comment’ in recognition of the fact that these five or seven ‘causes’ are somewhat over-simplified and the list is almost certainly not exhaustive. It also allows respondents to disagree with the ‘causes’. Respondents were also asked for their main interest in mathematics education, to allow for an analysis of the responses of different groups (if needed). Further this provides some sort of understanding of the demographic profile of the respondents.

FINDINGS

There were 101 and 62 responses to the questionnaire in the UK and South Africa respectively. Figure 1, below, gives the breakdown of the respondents’ main interest in mathematics education in the two countries. This has been included to demonstrate that in both countries responses come from a mixed demographic, with the majority of respondents being teachers.

In both countries, negative societal attitudes are seen as a major cause of the problems in mathematics; in both countries fewer than 10% of the respondents gave this as ‘not a reason’ and in both almost 50% gave it as a key reason.

For assessment, similar proportions in both countries (about 20%) stated this was not a reason. There is a relatively big difference, however, in whether it is a

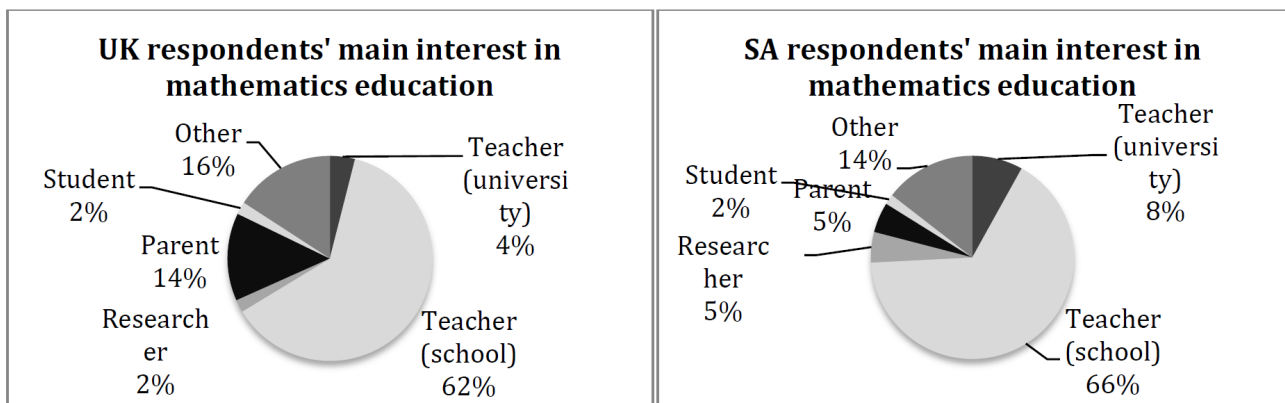


Figure 1: Main interest in mathematics education

key reason; in the UK the figure is over 30% while in South Africa it is under 15%.

In terms of the curriculum, the biggest difference in the two countries is in the numbers stating that it is not a reason, with under 20% in the UK making this choice in comparison to just over 40% in South Africa.

In the UK, under 20% gave 'teaching is not good enough' as a key reason, in contrast to 50% for South Africa. Just under 30% in the UK stated that they did not think it is a reason, whereas fewer than 10% said this in South Africa.

Finally, for 'maths is hard', fewer than 10% chose 'key reason' in the UK, whereas almost 30% made this choice in South Africa. In both countries about 40% chose 'has some influence' but the figures for 'not a reason' are 50% and just over 30% in the UK and South Africa respectively.

For South Africa, for mathematics literacy, just under a third of the respondents chose key reason (28%), just over a third chose 'has some influence' and about a third (32%) chose 'not a reason'. For the language of learning and teaching, however, almost 50% stated that this is a key reason with under 20% stating that it is not a reason.

Almost all respondents also provided longer answers sometimes adding further causes, such as a lack of commitment by the students in both countries (twelve comments). A number (seven) of responses from the UK mention accountability, 'excessive' monitoring, a target-driven approach and the need to see constant progress. In contrast, South African responses give reasons such as lack of accountability, unsafe schools and large classes. In both countries home life is given as a reason. Five UK respondents made comments to this effect, suggesting, for example, that parents do not support the students or that they 'have rotten home lives'. Six comments from the South African survey suggest that home life and parents cause problems in mathematics learning. Of these, four suggest that parents do not support their children in their school work, sometimes explaining how difficult it is for parents:

'Majority of our learners have no support at home and therefore have no culture of learning. Parents are too busy trying to make a living and

do not have time to check up on their children's progress or lack thereof. The learners only do the Mathematics during the Mathematics period and do not consolidate/practice/do homework, at home.'

Two further comments explain that children are hungry and lack the basics in life.

DISCUSSION

The sample for this research was an opportunity sample of 101 in the UK and 62 in South Africa, very many of whom are teachers. Some of these people were invited directly to complete the survey but most responded to invitations on social media which implies at least that they had access to the Internet and excludes those without Internet access. It probably cannot be seen as a representative sample and I do not claim that the results reported above hold true for the whole population. However, the findings of this study do seem to indicate that there are differences in the two countries with respect to the perceived causes of the (assumed) problems with mathematics education. This is hardly surprising as the contexts are so different. What is more interesting, perhaps, is what the differences and similarities are.

In terms of the findings, in both countries the reason 'negative societal attitudes' was selected as a key reason or as having some influence by very many respondents, with almost half the respondents selecting it as a key reason. This is the only reason where there is strong similarity in the responses in the two countries. Of course, 'negative societal attitudes' over-simplifies the issue, which has many facets and could be seen as related to 'maths is hard' in complex ways. However, the point is that a) this is seen as the 'biggest' cause by the samples in each country and b) that there is agreement between the two respondents from the two countries. In the UK, this cause is well recognised and attempts are made to tackle it (e.g., setting up the charity 'National Numeracy'). The extent to which these attempts are successful is difficult to gauge, but it could be that South Africa might learn something from the UK's example.

A key difference between the responses from the two countries is in terms of teaching. For the South African respondents this cause was selected as a key reason or as having some influence by as many people

as selected negative societal attitudes, whereas the figure for the UK is considerably lower. The biggest difference, however, is in the numbers selecting it as a key reason. It seems that the standard of teaching is a major concern in South Africa. One major factor contributing to the poor teaching, across all subject areas, could be the lack of accountability reported above (Spaull, 2014). However, in the UK accountability does not seem to work well, also reported above as a cause of the problems. It is not clear how or whether either country could learn from the other.

There is also a difference in the responses from the two countries related to the cause 'maths is hard' where the proportion of South Africans selecting this as a key reason is over double the proportion for the UK. There is no obvious explanation for this although it may be related to the language of learning and teaching.

Finally, for South African respondents the fact the language of learning and teaching is not the mother tongue appears to be a major cause of the problems. Whereas this is probably the case across all subject areas, in mathematics it is possibly more acute as many of the African languages do not have words for mathematical concepts (e.g., there is no word for 'parabola' in Zulu).

CONCLUDING COMMENTS

The mathematics education landscape is highly complex in the UK as is perhaps evidenced by the large numbers of reports produced on the topic. It seems clear that there is no 'quick fix' (such as a review of the national curriculum) for the problems although there does appear to be some general agreement about what needs fixing (attitudes mainly). The landscape in South Africa, however, is perhaps even more complex, and it is less clear where to put efforts in; negative attitudes, poor teaching and LoLT are all seen as major causes.

It would be unrealistic to expect research of this kind to capture the complexity of the situation in either country but the research does, perhaps, begin to reveal something of the causes of the problems. Learning from this research, further work in the area will pay more attention to the school environment, policy and accountability.

The research approach is experimental and I conclude with a review of its success. To some extent the blog can be seen as successful as it has had over 11 500 views (at January 2015) from all over the world. However, the number of comments, and the level of debate, is perhaps disappointingly low. The comments did not help me answer the questions posed at the start of this paper, but in a sense that is not relevant to this paper which has a different focus. The online forum activity generated active discussion which was useful in informing the questionnaire design. The micro-blogging (twitter) attracted some visitors to the blog and the questionnaire.

As remarked above, the respondents and commenters were essentially a self-selected opportunity sample, mostly anonymous (although some provided email addresses). These were people who volunteered to contribute, and, for the questionnaire, many of them gave substantial responses to 'your longer answer'. In my view, the data collected is interesting and worthwhile and justifies the approach adopted. However, I would like to explore further about how to use web 2.0 and social media approaches more effectively.

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