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An Analysis upon Ability of Students in Primary Mathematics Education: Patterns and Significances

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Abstract – Ability is a powerful ideology, underscoring many educational practices. We have extensive evidence pertaining to the impacts of these, particularly setting, in secondary mathematics, but there is relatively little research into the impacts in primary schools, despite an increase in ability grouping practices at this level. This paper begins to address this gap, discussing some of the results from my doctoral study. It explores the pervasive nature of ability and the strength of young children's convictions in innate ability. It also examines the role of assessment in perpetuating an ability ideology, suggesting that many of the implications seen in secondary education are also issues for primary mathematics.

Recent scientific evidence demonstrates both the incredible potential of the brain to grow and change and the powerful impact of growth mindset messages upon students' attainment. Schooling practicesare based upon notions of fixed ability thinking which limits students' attainment and increases inequality.

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INTRODUCTION

Many primary schools set pupils for mathematics, but how aware are we of the impacts of these practices? This article reports on some findings from my study into ability in primary mathematics. In the study I examined how ability is understood – both by pupils and teachers – and what impacts these understandings and ability-grouping practices have on pupils' engagement with mathematics.

A finding from this study was that the impacts of setting are far-reaching, may not be fully realised, and may have quite fundamental impacts on learning and engagement. Pressures on teachers to use particular grouping practices perpetuate these impacts whilst restricting teachers' opportunities to notice what is happening within their classrooms.

As teachers we often believe that we understand pupils' experiences within the classroom, interpreting their outward actions and reactions through our belief systems. However, it may be that we are only giving them pseudovoices rather than getting to the core of their experiences. It was my privilege to have the opportunity to gain deeper access to pupils' voices, examining alternative interpretations for pupils' classroom behaviours through their words and pictures; interpretations that may go unnoticed during the usual day-to-day activity of the mathematics classroom.

The fixed view of mathematics ability is linked to a more general view of 'inborn intelligence'. In the space we have here we can only summarise some key reasons why this innate view of ability is wrong. The statistical basis for this theory is fundamentally flawed (Gould, 1981). Success in tests that purport to measure innate mathematical ability is not independent of cultural knowledge or formal and informal education. With practice it is possible for people to increase their test scores which should not happen if the tests were measuring something fixed. Recent studies have also shown a link between intelligence test outcomes and motivation. If you believe that success in a test will lead to a reward you tend to do better (BBC, 2011).

Further, the capability to carry out even relatively simple calculations is situated by context. What people can do in informal situations in their daily lives is very different to the knowledge they display in formal school environments or in tests. Attainment on mathematics tests is not only determined by how much mathematics is known but also by a host of other factors including: physical well being on the day, level of motivation, general test taking skills ; emotional issues such as test anxiety, and the amount of revision an individual might have done. These are only some of the reasons why tests are unreliable and different tests produce different results. Teachers are also used to the experience of finding that students with very similar tests scores have quite different capacities to engage in

classroom activities. Even those who believe that cognitive ability can be measured estimate that differences in scores on cognitive ability tests only explain 36% of the variance in attainment outcomes (Ireson & Hallam, 2001).

Ability thinking also supposes that mathematical ability is a single entity that is generally disconnected from other human capacities. However, mathematics is much more diverse than the content that is included on tests of mathematical ability. For example, research shows that the depth of imaginative play young children engage in and their creativity is a good indicator of later mathematical attainment (Hanline, Milton, & Phelps, 2008). The current curriculum has tended to be shaped by what can be easily tested rather than reflecting the diverse ways that mathematics is used in society or important aspects of mathematical activity. Ability thinking entails and is supported by a narrow view of what mathematics is that can exclude these other aspects of thinking mathematically including problem solving, communicating about mathematics and collaborating with others.

Mathematical labels such as high or low ability are used to predict future attainment outcomes. However, it has long been established that students will tend to fulfil the expectations that teachers and the education system place on them (Rosenthal & Jacobsen, 1968/2003). Ability labels tend to lead to a series of self fulfilling prophecies, lowering expectations of teachers and students as to what is possible. They tend to narrow and restrict learning objectives. By questioning the idea of mathematical ability we are not suggesting that there are not differences in people's capacity to do mathematics, or to learn mathematics. Clearly, learners are not the same and it is important that teachers understand these differences to inform their teaching.

However, we do not believe that these differences are fixed, unchanging and context free. Further, ability thinking can get in the way of understanding and appreciating these differences as it can lead to 'seeing and teaching the label' rather than the student.

The research reported here presents results from my doctoral study into ability in primary mathematics education. It extends our understanding of the implications of ability in mathematics, considering the transferability of the secondary literature into the primary context. The impacts of ability-grouping are often considered in terms of attainment and attitude. Whilst the studies are not fully in agreement, the overall picture is of negligible overall effect (Hallam 2002). However, ability-grouping has the potential to create and extend existing achievement gaps and a number of studies have found

that it is assignment to higher sets and / or enriched curricular that makes the difference in terms of attainment gains (e.g. Wiliam and Bartholomew 2004). These differences may be the result of different expectations and pedagogy in higher sets.

This underscores Boaler's assertion that "the set or stream that students are placed into, at a very young age, will almost certainly dictate the opportunities they receive for the rest of their lives". As with attainment, the impact of ability-grouping on pupils' attitudes is also contested. Studies have shown the potential of grouping practices to polarise attitudes, although Boaler's (1997) study suggests this to be more complex.

Despite these known impacts, the use of ability-grouping continues to grow. 52% of primary schools began ability-grouping in the first year of the National Numeracy Strategy (Hallam, Ireson, and Davies 2004) and this appears to be increasing, hence the need to develop our understanding of the impacts of this on primary pupils.

ABILITY AND MATHEMATICS

Research evidence that has been collected over the last decade leading to new understandings of the brain, ability and learning has important implications for schools, in particular the ability-based practices and messages that prevail. The most successful countries in the world base schooling and grouping practices on growth mindset messages and beliefs, communicating to students that learning takes time and is a product of effort (Sahlberg, 2011).

The awareness that ability is malleable and that students need to develop productive growth mindsets has profound implications for teaching. Teachers and schools constantly communicate messages to students about their ability and learning (Marks, 2013), through the practices in which they engage and the conversations they have with students. A true commitment to the communication and teaching of a growth mindset probably requires examination of all aspects of teaching. Even the tasks that teachers choose allow different opportunities for messages to be communicated to students. In mathematics for example, if students are working on short, closed questions that have right or wrong answers, and they are frequently getting wrong answers, it is hard to maintain a view that high achievement is possible with effort.

An important and powerful aspect of teachers' practice concerns the ways in which they treat mistakes in mathematics classrooms. Research has shown that mistakes are important opportunities for learning and growth, but students routinely regard mistakes as indicators of their own low ability. Indeed mistakes, like ability grouping, are aspects of learning in which research and practice are severely misaligned (Steele, 2011). Dweck proposes that every time a student makes a mistake in mathematics, new synapses are formed in their brain (2012). When students think about why something is

wrong, new synaptic connections are sparked that cause the brain to grow. This small scientific fact has profound implications for teaching and learning. It suggests that students and teachers should value mistakes and move from viewing them as learning failures to viewing them as learning achievements.

MATHEMATICS ABILITY GROUPING

Ability grouping was most common in mathematics. Fifty six percent of reception classes were taught in within class ability groups, rising to 71 % and 72% in years 1 and 2 respectively. In year 3 the figure dropped to 48%, falling to 41% by year 6. The reduction occurred because 38% of year 5 and 39% of year 6 Maths classes were setted. Setting in same age classes rose from 1% in reception to 24% in Year 6. Cross age setting also increased. In reception classes, 0.8% of all maths classes adopted cross-age setting, rising to 15% in year 6 with the greatest proportion (16%) occurring in year 5. Taking the figures for setting, streaming and within class ability grouping together, in year 6 only 4% of pupils were taught in mixed ability groups. Maths, particularly in the higher year groups is perceived as best taught to homogeneous groups. Figure 2 outlines the percentage of each type of grouping adopted in each year group.

ABILITY MINDSETS

Setting and the ability thinking that supports it is unjust and damaging in other ways. It not only creates barriers to attainment - it also can have profound impacts on learners' beliefs about themselves and their relationship to mathematics. There is now extensive evidence of the ways in which children, including from young ages, are highly aware of their relative position in the class or year group.

The process of 'measuring and being measured' effects how children see themselves and others. For some, including those who appear to gain by being labelled clever or 'top set', it can lead to profound anxiety. Mathematics comes to be seen as an elitist activity that only some can do. One understandable response by teachers of previously low attaining students is to try to further simplify or reduce the challenge in mathematics - to try to make mathematics easy. Unfortunately, this is counter productive as it makes learners over reliant on teachers doing the mathematical thinking on their behalf, robs the mathematics studied of meaning and purpose thus making it harder to learn, and makes students unwilling to tackle questions or topics that appear difficult when first encountered, to engage in problem solving or to apply mathematics in unfamiliar context.

The effect on identities lasts beyond compulsory mathematics education. Mathematical anxiety and shame experienced at school can still be felt in adulthood. Jo Boaler (1997) did a celebrated study in the 1990s of the experience of school mathematics in two schools similar in terms of attainment and socio-economic profiles but which had different approaches to teaching mathematics. In one, mathematics teaching focused on a problem solving curriculum and students worked in allattainment groupings. Hilary discusses this approach in more detail in a later chapter.

In the other school students learnt through a more traditional approach and learning took place in sets. When she later interviewed participants from her original study as adults, she found that those who had learnt mathematics in all attainment classrooms were more likely to be working in higher paid and more highly skilled occupations. She concludes that setting can limit the aspirations of those who are placed in lower sets.

CONCLUSION

Children as young as eight years old demonstrated a strong acceptance of and belief in the mathematical ability myths that pervade education, legitimising resultant practices in the same ways teachers, policy-makers and wider society do. Given the strength of these beliefs it seems likely that even younger children may be holding

and forming similar views. It is important that we understand the views pupils are holding as they may lead to many pupils feeling that mathematics is something they cannot, and never will be, able to do, with potential impacts for their attitudes towards and application in, mathematics lessons.

There is some hope for change. Although many of these practices take place with very little awareness, hence the pervasiveness of ability, teachers, when given the space to think, were genuinely interested in questioning these practices. It seems feasible to suggest that practitioner reflection may be one way into addressing the inequity that is currently legitimised through our discourse of ability.

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