Effective Classroom Organisation in Primary Schools: Mathematics (Updated)

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To set or not to set, what is effective?

The author’s opening assumption is that one of the greatest problems encountered in teaching primary mathematics in England is the great diversity of pupils’ attainment within a class that has long characterised the performance of primary pupils. This study helps teachers, governors and parents consider the relative merits of whether the teaching and learning of mathematics is more effective when children are set by ability, or taught in mixed ability classes. It also helps users to explore different methods of grouping and the ways they affect the attainment level of children. Click here for more details.

The author concludes from her research that there is no support for the view that lower Key Stage 2 children learn more effectively in ‘sets’ for mathematics at any attainment level. She demonstrates that the tail of underachievement is reduced and the range of ability within the class decreases when these children are taught in mixed ability groups. She goes on to recommend mixed ability teaching, as it has social and equitable benefits for children. If you want to see more detailed findings, click here.

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Page 3
What did the researchers set out to do?

The author reports on the effects of recent government initiatives which have an increased focus on a whole class approach to teaching mathematics. In many schools this has led to pupils being ‘set’ by ability in primary classrooms.

The author used the data drawn from the London Borough of Barking and Dagenham ‘Improving Primary Mathematics’ project to investigate:
the effects of setting on subsequent mathematical attainment of the group as a whole;
the extent to which the decision by schools to set pupils by ability was a response to pre-existing greater variation in attainment; and
whether setting pupils had any discernible affect on the diversity of attainment of those pupil groups.

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What is the context of the study?

Until 1988 primary teachers in England enjoyed an unusual degree of autonomy in their classrooms, since, unlike in many other countries, there was no nationally agreed curriculum, and schools were relatively free to make their own decisions concerning curricula and the way that subjects were taught. Variation in levels of attainment was managed by class teachers, by within-class grouping or differentiation according to ability.

The introduction of the National Numeracy Strategy (NNS) in 1999 represented a significant change of approach to the teaching of mathematics in primary schools. Not only was there a more regular and structured approach to the teaching of mathematics, but the NNS encouraged teachers to move away from teaching several smaller groups of pupils (an individualised approach to the learning of mathematics which had dominated for the previous 30 years since the Plowden Report) to adopt a whole class teaching approach for a crucial part of every lesson.

This study uses the data from a project called ‘Improving Primary Mathematics’ (IPM) which was a result of collaboration between inspectors in the London Borough of Barking and Dagenham (LBBD) and researchers at the National Institute of Economic and Social Research (NIESR). Based on earlier work by NIESR, the pilot phase of the project was introduced in the beginning of 1995. The project was influenced by successful continental approaches to the teaching of mathematics and aimed at both raising the average standards of attainment and reducing the large variation of attainment within classes. (This project and its teaching methods influenced the National Numeracy Framework that specified in a detailed way, on a year-by-year basis, the topics to be taught to children.) To find out where to learn more about the National Numeracy Strategy and the LBBD project, click here.

More than fourteen thousand primary children in LBBD and three other boroughs took part in this project, which was designed to raise the standards of primary mathematics. The project was specifically aimed at reducing the proportion of low attainers through the development of lesson materials and teaching methods as well as raising the average levels of attainment of classes as a whole. The lesson materials had certain distinctive features which included:

- more attention to securing a sounder foundation in children’s understanding of mathematics, through sequenced step-by-step teaching in the early years;
greater emphasis on mental work, with an emphasis on oracy;
provision of detailed lesson plans for each mathematics lesson throughout the year, together with necessary resources; and
guidance on pedagogy needed for successful whole class teaching.

Although the lesson materials were designed to be used with pupils in mixed ability settings, a few schools in the project used them with groups who had been set by ability. This enabled the author to use the project data for comparative purposes to investigate differences between those who were set and those who were not.

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What are the different ways of grouping pupils?

The author discusses some of the ways that pupils are grouped for teaching purposes and the way that that focus has evolved over time:

- **Age** – in England it is almost certain that pupils will be grouped first of all strictly by age (with twelve months span of births within each class), although this method is less widespread in its strictest form in other countries;
- **Streaming** – where children of a similar ability are grouped together in classes for all subjects – a policy which was widely used until the 1960s;
- **Setting** – where children are placed in class sized homogeneous groups for single subjects. The practice of both streaming and setting declined by the mid-1960s following the Plowden Report which advocated a greater emphasis on a child centred approach;
- **Mixed ability grouping** - where variation in attainment within a given span of one year, is managed by the class teacher either by within class grouping or differentiation according to ability. With this form of grouping the class teacher sought to provide children with tasks which were appropriate to individual needs, which in turn lead to more complex classroom management issues i.e. preparation and planning; and,
- **Whole class teaching and learning** – as advocated by the National Numeracy Strategy. To facilitate whole class, mixed ability teaching a horseshoe shaped seating arrangement (or double horse shoe depending on classroom size) is recommended, replacing the typical arrangement of pupils in groups of 4 – 6. This arrangement improves sight lines between teacher and pupils, pupils and other pupils, and pupils have a clearer view to the board or OHP screen. This shape also encourages pupils to address the whole class when answering questions, so promoting pupil’s participation and concentration, and improving a feeling of community and cooperation among the class as a whole unit.

The recent change of focus in teaching methodology towards a whole class teaching approach, has affected the way that the variation in attainment is
managed. The author suggests that between class grouping or ‘setting’ by ability is seen as a way of reducing the range of attainment within the class while still enabling the class to progress as a whole.

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What did the study reveal?

The expectation of greater gain by schools choosing to set by ability was not supported by the figures; in fact the results supported a tentative conclusion by the author that children of all levels of attainment do better when taught in mixed ability groups and that the diversity of attainment was unlikely to be widened as a result of this.

There was no evidence to suggest either a beneficial effect of setting on average standards of mathematical attainment for these pupils, or for reducing variation of attainment within the groups which were set.

The effects of the structured teaching approach on any group meant that the actual range of attainment within the classes became narrower, but the class made steady progress as a whole.

The pupils who were taught in mixed ability classes showed an average gain in test scores (of up to 7%) over those taught in ‘set’ classes. They continued to show an improvement in their average attainment score relative to set classes by about 3% over two years. However, the range of attainment within the classes narrowed, meaning that the ‘tail of underachievement’ decreased. The ensuing cohorts in the main project both showed similar, though less marked results.

The variation in attainment (as measured by the standardised test scores) among all pupils as they entered Key Stage 2 was only slightly reduced among mixed ability groups compared to those set by ability. The author interpreted this as evidence that the policy of setting was not a response to a pre-existing diversity of attainment.

The author tentatively concluded that policies of setting were adopted primarily to make the teacher’s tasks more manageable, which is particularly important when there is official encouragement towards whole class teaching.

The author further suggests that if a policy of grouping by ability is introduced for the teaching of mathematics, a widening in the range of attainment may result, so adding to the difficulty of any subsequent attempt to introduce a whole class, mixed ability teaching approach. To find out what the implications for classroom management are, click here.

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How did the author carry out the research?

The author looked at the results of the first cohort of a large-scale initiative in the London Borough of Barking and Dagenham. The children in this cohort reached the end of Key Stage 2 in July 2001. They had been taught using the detailed lesson-by-lesson materials provided by the project which have a common structural framework for lesson progression. The method of teaching, the organisation of resources and topics were all covered by in-service education for teachers (INSET) just prior to the beginning of each term. There was a consistency of teaching approach used by all schools, and all schools used the same teaching material. The materials provided were designed to be used with pupils of all attainment levels in a mixed ability setting. A key objective of the project was to reduce the level of low attainment i.e. the percentages of pupils failing to achieve the expected Level 2 in Mathematics at the end of Key Stage 1. To find out where to get a full copy of this report, click here.

Because the methods of teaching and the materials used were universal within the schools involved in the project, the differences that would normally be encountered could largely be eliminated because of the unique circumstances of the project.

The author analysed the test scores of approximately 1200 children participating in the LBBD initiative between September 1997 and March 2000, when they were in the lower years of Key Stage 2. Only those pupils who were on roll throughout the period (with the exception of statemented children) were included in the test results, to improve comparability. Of these children, 200 were set by ability and 1000 were in mixed ability classes.

In this unique situation, the differences in teaching methods and materials could be said to be largely eliminated. This gave the author the opportunity to make a more 'independent' assessment of the effects of setting on subsequent mathematical attainment. She also sought to find out the extent to which the decision by schools to set pupils by ability for the teaching of mathematics was a response to pre-existing greater variation in attainment and whether their setting had any discernible effect on the diversity of attainment.

How were the data collected?

All pupils were tested routinely from year 2 upwards with short written tests that relate to the curriculum content of the previous term’s lessons. This was in addition to an end of term test designed to test their mastery of lesson materials. Standardised tests were used for those assessments that were designed to be within the capability of the majority of the children. Since each
test was designed to assess the mastery of different topics, it was not expected that the scores on the tests would increase over time.

The distribution scores of all of the participating pupils were standardised on each test to a mean of 100 and a standard deviation of 15, so the arithmetic average score was assessed as being 100 with the majority of pupils falling within 15 points either side, between 85 and 115. The author was able to make direct comparisons between the changes in results of the 'set' pupils relative to those taught in mixed ability groupings.

As there was a bias towards mixed ability groups in the study (1000 pupils in mixed ability classes, 200 in set classes) which may have skewed the results, the author measured the effects on attainment when direct comparisons were made between groups of children with similar size and ability. Two equal sized groups from the same cohort, (one group of which had been set, the other being mixed ability), which had comparable test scores on admission to Key Stage 2 were compared. In order to make direct comparisons the ratio of the scores from the two groups were calculated and then compared again at a later stage to assess the effect of setting on performance of pupils of different attainment levels.

What conclusions can be drawn from the research?

The National Numeracy Task Force recognised the importance of both direct instruction and teacher-pupil interaction which now forms a large part of the daily mathematics lesson. The National Numeracy Framework stated that the aims should be ‘to allow all the children in the class to progress steadily, so that all of them reach a satisfactory standard and the range of attainment is much narrower.’ (DfEE, 1999 Click to Where can I find out more? page 11).

It is in the crucial years of primary schooling that the foundations for later learning in mathematics need to be laid, since success in later years of schooling depends upon a secure understanding of number structure. The initial findings of this study suggest that in the circumstances of this experiment, children, as a whole, generally do better when taught in mixed ability groups, and the diversity of attainment is unlikely to be varied because of this.

This builds upon previous research findings which suggested that lower ability groups achieve more when taught in mixed ability groups, as they observe how others approach problem solving and calculating in mathematics. Low-attaining pupils are known to respond to higher levels of interaction, and their need for interaction is greater than high–attaining pupils who may be more capable of independent work. To find out more about ability grouping, click here. (Click to What are the different ways of grouping pupils? page 5)
The findings from this study confirmed these earlier findings and the author found that slower learning children seem to benefit from learning in mixed ability classes, whereas children of average or high ability do not appear to suffer. The author concludes that pupils should continue to have access to the equality of opportunity and other social benefits that derive from mixed ability teaching.

There is no evidence from the test results to suggest either a beneficial effect from setting on average standards of mathematical attainment, or for reducing the variation of attainment.

The author goes on to suggest that the policy of setting is adopted primarily to make a teacher’s task more manageable, which is particularly important when there is official encouragement to teach through a whole class approach. For example, larger schools with parallel classes sometimes deal with a range of attainment by organising ‘ability sets’ for mathematics lessons. The advantage is that planning can be easier if the attainment gap in a class is not too wide. The author warns that teachers may need considerable support to teach whole class mixed ability groups, as they may not have been trained to teach in this way, and may not have been taught that way themselves.

The evidence presented in this study suggests that if a policy of grouping by ability is adopted for the teaching of mathematics a widening in the range of attainment will result, so adding to the difficulty of any subsequent attempt to introduce a whole class, mixed ability teaching approach.

The success of setting depends on very careful monitoring, close team work and co-operative planning among staff to make sure that expectations for all pupils are suitably high and that lower expectations are not justified simply because pupils are in a 'lower set'.

As standards improve over time, the range of attainment in each year group ought to reduce so that it becomes possible to cater for the diversity of needs by grouping pupils within the same class.

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**Implications**

In completing this digest its authors began to ask the following questions about implications for practitioners:

- children are quick to spot and interpret the significance of setting by ability – do you recap with each group what they have achieved in the lesson to help all pupils to feel that they are making progress? Do you have high expectations for all groups and avoid making explicit comparisons between groups?
the author of the study suggests that inflexible ability grouping in mathematics may lead to widening gaps in attainment over time – do your grouping arrangements allow flexibility and transfer of pupils between them? Do you find out which pupils understand specific concepts or can apply particular skills and regroup accordingly?

the study claims that the ‘tail of underachievement’ is narrowed through whole class teaching – how can you collect evidence that your approach to grouping in mathematics is benefiting children of both high and low ability?

In completing this digest its authors began to ask the following questions

- is extra support, including a range of professional development activities, needed to help teachers differentiate for a wide ability range in mixed ability whole class teaching?
- what monitoring arrangements are in place to measure children’s attainment over time and to relate these to different teaching approaches in your school?
- there is evidence of a very wide ability range even within sets - if setting is used in your school, are staff sufficiently aware of the need to differentiate within the set? How do you ensure that pupils’ individual needs are met within each set?

Where can I find out more?

Online resources
If you are interested in a TRIPS digest on the effects of ability setting in secondary schools click here. (click to Boaler digest)

A GTC Research of the Month summary based on Askew, M. et al ‘Effective teachers of numeracy’ can be found on the GTC Research of the Month website: http://www.gtce.org.uk/PolicyAndResearch/research/ROMtopics/


The Qualifications and Curriculum Authority http://www.qca.org.uk has links to the National Curriculum website and the National Numeracy Strategy, as well as many other resources for teachers and parents.

Association for Teachers of Mathematics http://www.atm.org.uk/

Mathematical Association http://www.m-a.org.uk
DfES Numeracy web pages on the Primary Strategy website:
http://www.standards.dfes.gov.uk/primary/mathematics/

An OfSTED overview on the first three years of the National Numeracy Strategy can be found at: http://www.ofsted.gov.uk/publications/docs/3048.pdf


Other reading


