Girls’ Achievement in Mathematics at Key Stage 2

Background to study

Underachievement in girls at Key Stage 2 is a national trend, developing particularly in Years 5 and 6. Each year, more boys achieve level 4+ than girls in statutory tests, while a higher percentage of boys score level 5 (www.dcsf.gov.uk).

Disaffection with many girls in maths may be linked to the way girls perceive themselves as learners, learning styles and ways of working, as well as teachers’ attitudes and perceptions. Goleman (1996) found girls to be perfectly capable of logical and rational thought, but are more likely than boys to use a range of decision-making methods when problem-solving. Girls may not be engaged by a subject which they perceive as void of context and reality and lacking the inclusion of emotional intelligence.

Confidence is critical in determining mathematical success. Anxiety inhibits learning and this has been found to be exacerbated for girls, particularly in top sets (Boaler, 1997). Girls tend to seek perfection, needing to be able to understand and explain the maths. This can leave them behind in fast-paced lessons, where, Boaler suggests, exercise completion often takes precedence over consolidation of understanding.

In challenging situations, heart rate and perspiration increases. The body may translate this into a negative emotional response, for example, fear or trepidation. Therefore, mathematical problems may be associated with dislike rather than stimulation.

Context

This study was carried out during the Summer and Autumn Terms, 2009, in a semi-rural junior school of 201 pupils. Pupils come from relatively advantaged backgrounds with below average numbers of pupils with learning difficulties. It was prompted by an analysis of the 2008 Pupil Attainment Tracker (PAT) which indicated a discrepancy in the performances of boys and girls across Years 3 - 5 in mathematics. In that year, boys consistently outperformed girls, especially in areas involving mental mathematics and calculation. This was most notable in Year 5.

Aims of study

The study aims to investigate the factors influencing the differential achievement of boys and girls at Key Stage 2 and to look for ways to promote a more positive attitude towards mathematics, particularly with girls. The project will enquire into boys’ and girls’ experiences in maths lessons and
the qualities they believe are important to be successful in the subject. It will consider any
differences in male and female perceptions of maths and if these vary between year groups.
Furthermore, it will question whether there are gender differences in views on pace and the
development of mathematical understanding as well as the emotional responses of boys and girls in
the face of challenge.

Findings will be used to inform action the class teacher and whole school can take to enhance a
positive emotional response towards challenge and difficulty, and raise confidence.

Research approach

Evidence was gathered from a variety of sources:

Test Data

Overall levels of attainment for boys and girls were compared using results from the 2009 statutory
tests for Year 6 and QCDA Optional Tests taken in May 2009 for Years 3 – 5. RAISEonline data for
Years 3 – 5 was used initially to compare girls’ and boys’ percentage correct responses for each
paper for each year group. However, this did not allow a study of pupils’ performance in specific
areas of mathematics on all papers combined. Therefore, an additional question level analysis of the
QCDA tests was undertaken for Years 3 – 5 to compare performance in the three areas: Space, Shape
and Measures; Data Handling and Number. This involved recording the marks scored for each of
these three areas for every pupil for every question in the all test papers taken. Furthermore, the
RAISEonline analysis took no account of the fact that not all pupils took all three test papers. When
pupils are selected by ability to attempt Paper B, it will skew the data. Therefore, my own question
level analysis includes only results from papers taken by all pupils in a particular year group.

Pupil questionnaire

A questionnaire (Appendix 1) was completed by every child in the school in June 2009. Responses
were analysed by individual year group and over all year groups by percentage and represented
graphically for each question (Appendix 2).

Pupil interviews

Six pupils per year group (a total of 48) were interviewed individually and their responses audio-
recorded. Appendix 3 lists the questions asked.
Lesson observations

Each class was observed for an hour’s maths lesson or two hours where the class was shared. A total of 10 hours of observation was undertaken. Appendix 4 shows a blank lesson observation sheet. Observations focused mainly on the relative amount of attention given to boys and girls; quality of interactions between teacher-pupil and pupil-pupil; and choice of teacher language to introduce challenge to lessons. Questions and responses from boys and girls are calculated as percentages, adjusted according to the numbers of each in the class.

Analysis of data

Test data

Test results for all year groups reveal that more boys than girls achieve the highest levels (Appendix 5). This is more marginal in Year 3. The greatest difference in levels occurs in Year 5 with 26% of boys attaining level 5 compared to 14% of girls. Eighteen per cent more girls than boys attain level 4 in Year 5.

RAISEonline (password protected data) shows that boys achieved more highly than girls in Years 3 - 5 for the papers which were attempted by all pupils. The only exception is in Year 3, where, according to percentage correct responses, girls and boys achieve equally on Paper A. This discrepancy with levels attained, may be attributed to the fact that although as many girls as boys score highly in Year 3, fewer cross the top level boundary.

It can be seen from the graphs of success rates (Appendix 6) that boys outperform girls in all broad areas of mathematics (Handling Data, Number and Calculations; and Shape, Space and Measures) except Shape, Space and Measures in Years 3 and 5. Here, girls achieve more highly by 1%, a value not statistically significant.

Pupil questionnaire

In the analysis of questionnaire data, emphasis is given to overall trends across the year groups. Some caution has to be exercised when interpreting data from individual year groups because of the small sample sizes involved.

Question 1: The percentage of boys and girls completing the end-of-year test papers was the same overall.
Question 2: Most children (80% girls; 73% boys) felt the pace of maths lessons was about right. Overall, more boys than girls felt the pace of lessons was too slow. This percentage rose steadily with age until Year 6. Because of the small sample size, differences in Year 6 are not significant.

Question 3: Both boys and girls felt that to be able to think logically was the most important contributor to success in mathematics. More boys than girls believed that how quickly you are able to complete questions is a reflection on ability. This became increasingly the case with the older pupils. Conversely, a significantly larger number of girls in Year 6 (45% girls compared to 16% boys) thought that having more time to attempt problems would improve their ability in maths. Additionally, more girls felt that repeated practice and consolidation was important to success. Notably, slightly more boys than girls thought that being able to discuss and talk about maths problems was important.

Question 4: For every year group, boys enjoy maths more than girls. This is particularly true in Years 3 and 6. In Year 6, 46% boys enjoy maths compared to only 15% of girls, although no pupils claimed to enjoy the subject “a great deal”. Interestingly, in Year 4, although more girls than boys (36% to 15%) enjoy maths, 31% of boys enjoy maths “a great deal” compared to no girls. A small, probably insignificant, percentage of children enjoy maths “not at all” but in Year 4 there is a much higher proportion of pupils than in other year groups who enjoy maths very little (rank 2).

Question 5: Overall, more girls than boys (45% girls, 32% boys) are worried when given a difficult maths problem to solve and more are concerned about not getting the question right (44% girls, 24% boys). This is dramatically true in Year 3. Many more boys feel confident when faced with challenge (44% boys, 16% girls), an attitude shown markedly in Years 4 and 6. Boys also gain much more pleasure from the challenge (26% boys, 5% girls). No girls in Years 3 or 4 get any pleasure from the experience, and only 4% in Year 6. This is supported by responses showing that overall, boys are more eager to have an attempt at stretching problems, particularly in Year 6 (74% boys, 36% girls).

Question 6: Over all the year groups, there is mostly no significant difference in the ways that boys and girls react in the face of challenging problems. Slightly more boys than girls will respond by trying a different approach to the problem. In Year 3 and 4, more girls respond to the task by talking to others about it, but this trend is reversed in Year 6 where more boys prefer to discuss it. In Years 3 and 5, more girls than boys claim to try harder to solve the task, but the opposite is true in Years 4 and 6. Very few pupils admit to giving up.

Question 7: Pupils are judged to have low confidence in a topic area if they selected rank 1 or 2 for understanding on the questionnaire, and high confidence if they selected 4 or 5.
More pupils (both boys and girls) have high confidence levels than low confidence levels for all areas of maths, albeit to varying degrees. Overall, but particularly in Year 6, boys are much more confident than girls in all areas of mathematics. This is most noticeable in Mental Maths (70% boys, 42% girls), rising to 92% compared to 36% in Year 4.

**Lesson observations**

Teacher attention was observed to be predominantly directed towards boys in maths lessons across all year groups:

<table>
<thead>
<tr>
<th>Questions directed at girls</th>
<th>Questions directed at boys</th>
<th>Voluntary responses from girls</th>
<th>Voluntary responses from boys</th>
</tr>
</thead>
<tbody>
<tr>
<td>39%</td>
<td>61%</td>
<td>43%</td>
<td>57%</td>
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</tbody>
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There is a particular imbalance in Year 4:

<table>
<thead>
<tr>
<th>Questions directed at girls</th>
<th>Questions directed at boys</th>
<th>Voluntary responses from girls</th>
<th>Voluntary responses from boys</th>
</tr>
</thead>
<tbody>
<tr>
<td>32%</td>
<td>68%</td>
<td>37%</td>
<td>63%</td>
</tr>
</tbody>
</table>

General classroom comments were also most commonly made to boys (70% boys, 30% girls in Year 4).

Many examples of positive teacher talk were heard, although the positive comments to girls frequently praised, for example, neatness of work or speed of tidying up, whereas to boys, the positive comments were predominantly about their learning.

Lessons were dominated by the teacher talking, especially in the older classes where there were few opportunities for pupil-pupil talk. In two of the five lessons observed in Years 5 and 6 there was almost none. Much of the questioning techniques tended to be of the “guess what the teacher is thinking” type rather than genuine open questions inviting discussion.

Most learning challenges were introduced by the teacher by simply stating the task (neutral stress-weighting). The lowest stress-weighted language examples occurred in Year 5, e.g. introducing “practical work” not problems; “looking for people who can...” or in a few cases, taking the blame personally (not explaining properly) or handing out an unclear worksheet (“the problem’s with the
sheet – it’s a bit unfair”) for why the challenge presented difficulty or why the pupils didn’t understand what to do. The greatest stress-weighted language also arose in Year 5, for example, tasks that were “a bit of a challenge - to sort the chickens from the geese!” and “some of us love the challenge”.

Pupil response to challenge showed that boys demonstrated more confidence (e.g. where there was a choice of times tables or differentiated task). When asked why he had left out some of the earlier questions, one boy replied “I want to have a go at the bigger numbers at the bottom”. Although there were few situations where mixed-sex pairs occurred, where they did, boys dominated discussions, for example, “you got it wrong” even when the girl was correct. In contrast, girl-only pairs showed more equally balanced discussions and active listening. Boys were observed to rush to get finished, but were not always accurate. If they couldn’t complete a challenge, boys tended to dismiss it as not important. Girls worried that if they wrote something down the teacher “would know I’ve got it wrong”.

**Pupil interviews**

Many pupils found it difficult to articulate their feelings towards mathematics. For this reason, much of the time spent on interviewing the pupils resulted in silence, to avoid leading them towards particular answers or opinions.

Pupils, especially the younger ones, were generally unclear about what, if anything, they enjoyed about mathematics. Some pupils in Years 5 and 6 (both boys and girls) enjoyed the satisfaction of solving a problem correctly. Pupils were much clearer about what would help them enjoy maths more. This was not divided on gender grounds. Most common examples were:

- Making a greater use of the school’s outdoor space in maths lessons
- Using games more frequently to help learning
- Doing more open investigations “like in science”
- Using ICT more often
- Using maths apparatus more or other “hands on” methods

Most pupils felt they were encouraged to take part in lessons – again there was not a gender-split – and very few believed that one gender was better at maths than the other. Where a pupil thought there was a difference, the pupil named the opposite gender.
A significant number of pupils expressed the opinion that the teacher talked too much in maths lessons. Furthermore, they spent too much time going over aspects of maths they had covered in previous lessons. This was particularly true for the more able and older pupils who felt lessons did not move on at a fast enough pace. No gender difference was noted.

Conclusion and discussion

The test data confirms that boys attain higher test levels than girls in all year groups.

Boys enjoy mathematics more, and are more engaged in their learning, than girls. Boys are more inspired by the subject (particularly in Year 4). However, no pupils in Year 6 said they enjoy the subject “a great deal”. This is possibly due to the timing of the survey – just after SATs.

Challenging maths questions are far more pleasurable for, and more eagerly attempted by, boys than girls. Girls have higher levels of anxiety, less confidence in the classroom and worry more what the teacher thinks. Replacing the notion “I can’t do it” with one of “I cannot do it yet” may help to raise confidence. It allows learners, in this case girls, to expect that they will succeed eventually, rather than feeling they have failed instantly. Boys have much more confidence in their ability than girls in all areas of mathematics, most notably in mental maths.

Boys receive a disproportionate amount of teacher time and attention in the maths classroom. They are asked more questions and respond more readily. This probably fuels their confidence. Boys dominate mixed-sex groupings, while girls appear to be more confident in single-sex groups. Boys are more often valued for their learning, girls for their compliance with the classroom rules.

The observations and interviews indicate that, currently, lessons are dominated by teacher-talk, especially in the older classes. More opportunities for pupil-talk and exploring mathematical concepts and solutions through discussion may benefit girls’ learning (as well as boys in Year 6), giving them a chance to include emotional intelligence and take more time to tackle questions (one aspect regarded by themselves as valuable in raising achievement in maths). The questionnaire results suggest a differentiated lesson pace or teaching style, allowing more time for solving problems and consolidating learning, would be an advantage for girls. A greater variation in the lengths of time expected to solve problems could prevent girls becoming anxious if they cannot do them straight away.

There is a wide variation in the use of stress-weighted language. There needs to be an awareness that language choice may be a contributing factor in raising girls’ anxiety levels. Girls do not get
pleasure from being singled out or “sorted” by challenges and further diminishing their enjoyment of the subject.

Pupils of both sexes had valuable suggestions for making their maths experience more engaging. These emphasised a more active learning style, with less teacher-led lessons and more pupil-pupil interaction. A focus on questioning, collaborative work and challenge through investigations and enquiry, may give responsibility for learning to the pupil, especially in the older classes.

**Reflection and next steps**

The limitations of this study are obvious. Concrete conclusions are difficult to reach in only ten hours of lesson observations or when year groups total only approximately 50 pupils. Children may respond the way they do in a questionnaire for a variety of reasons, while face-to-face interviews with an adult are daunting and may produce well-meaning, but not necessarily honest, replies. Given this caution, suggestions for further enquiry and to promote a more positive response towards mathematics at key stage 2 in all pupils, particularly girls include:

- Use of girl-only groupings (whole class or small groups) to differentiate teaching styles, allowing more time for discussion and decision-making; adapt pace; and raise confidence in girls through greater participation in the absence of boys.

- Facilitate paired observations with teachers focusing on each other’s use of pupil-pupil talk and the attention given to girls.

- Make increased use of pupil-pupil interactions, thus improving the quality of dialogue to develop thinking and advancing learning rather than simply getting correct answers (Bagnall, 2009).

- Integrate learning resources such as the outdoor classroom, maths games and ICT into everyday planning for maths lessons.

- Use carefully selected classroom tasks which involve pupil questioning and cognitive stimulation to underpin understanding of mathematical concepts, for example, primary cognitive acceleration in mathematics education (www.cognitiveacceleration.co.uk) or the Bowland Maths project (www.bowlandmaths.org.uk), adapted for key stage 2.

- Minimise the use of high stress-weighted language when presenting challenge.
Professional Development Impact

Involvement with the project has increased my understanding of the difference in preferred learning styles of girls, with their greater need for time to consolidate and understand the core concepts behind mathematical methods. In future, I will strive to incorporate this into planning. I have always adopted an interactive approach to teaching mathematics. Research for this project has reinforced the necessity of such an approach to engage learners, both boys and girls.

The impact upon the school has been to raise awareness of direct questioning within maths lessons. The study revealed discrepancies in the attention given to girls. Teachers are much more aware of girls in the maths classroom and consciously attempt to question even the quiet girls who may previously have “fallen under the radar”.

The importance of pupil – pupil talk on the quality of learning has also been realised. A greater emphasis is now put upon discussion and collaborative learning in all years. More use is made of small group work in mathematics. The school is interested in pursuing development of this, possibly through training in the primary Cognitive Acceleration in Mathematics Education initiative.

References


Goleman, D. Emotional Intelligence: Why it can matter more than IQ London, Bloomsbury (1996)

Bagnall, B. “What’s All the Talking About?” http://nrich.maths.org (2009)

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