

**How can I improve the numbers of pupils attending an after-school club for Mathematics, using my enjoyment of the subject as a motivating factor and thereby hope to improve the results of children at the end of KS2?**

**By**

**Margaret Parks**

This is based on my original question, which had to be changed due to time tabling alterations.

## Background

During the years that I have been teaching, my interest has been with children that have problems with learning<sup>1</sup>. My previous Headteacher probably saw my affinity with these children and I was teaching the bottom group in maths for Years 6,7 and 8 for several years.

When I was asked to put in a bid for funding by BPRS, I immediately thought about my interest in Maths and children that require help in achieving a Level 4 at the end of KS 2. The target group were the children that had not reached Level 4 and were now in Year 7. My project was to be based on the belief that I would be teaching this group. However when the timetable was written I had to teach Year 6 bottom group and not teach Year 7 at all. I then had to rethink about the Bounceback project.

The school governors had agreed that the day would stop at 3 o'clock and that after-school clubs would run. This would be an ideal way for me to still be in contact with those children that needed help and would also be a way for them to learn Maths using fun-based methods<sup>2</sup>.

There are several aims when working on mathematics with groups of children. They should:

1. Enjoy mathematics;
2. Become confident in their ability to learn mathematics through planned activities;
3. Discuss their findings with their peers and their teacher;
4. Understand the mathematical concepts that they use;
5. See mathematics in action and realise why they need to memorise number facts and carry out calculations;
6. Appreciate that mathematics is concerned with patterns and the communication of these patterns in simple language.

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<sup>1</sup> I have no qualification with SEN children, although my youngest child had problems at school, especially when it came to exam time and he had to remember information. We practised tables while travelling to and from school, have quizzes in the car and tried to find various ways to help him remember information, particularly in Maths, as this was my subject when training.

<sup>2</sup> My over-riding aim is to help the children become more confident in their own ability to learn mathematics. They will be given mathematical activities to do, many of which will be new to them. Materials and equipment are available but they might not need to use them. I want to find out which activities they enjoy and whether they find them too easy, too hard or just right. In this way it helps me with what I am trying to teach both after school and also in daily lessons in the school day. It is stimulating to find out what really interests children in mathematics. I approach teaching with a positive frame of mind giving encouragement for their achievements; ensuring a measure of success; providing attractive activities and games for them to enjoy; getting them to talk about what they have done; and making sure that they also enjoy the experience.

## Ideas for a Maths Club

There are no hard and fast rules for a Maths club. I started my club solely for Year 7 pupils but that did not attract the numbers that I needed to make a successful club. After Christmas the club was opened up to others. It was not just for the high flyers but for any pupils that wanted to increase the breadth of their mathematical knowledge. I also didn't want to teach work that they would meet the following year – these skills are best left to the Scheme of Work and covering the work early may cause disappointment at the time, and further disenchantment when the topic is then visited in lessons the following year.

## What is the problem?

There has been, over the last few years, intense public debate and concern about the teaching of mathematics in school. It has been claimed that standards of numeracy are inadequate and that teachers do not know enough mathematics. Many have argued that the solution is to go back to more traditional forms of teaching<sup>3</sup>.

'Read the question carefully' is a statement that I say to many pupils in lots of subjects. This is obvious advice, but it is frequently neglected. Not only is information ignored, but also the rush to get going on the question often means that the real question is misunderstood or missed altogether. The impact of many jokes, riddles and puzzles relies wholly on upon a tendency to misread as illustrated by the following classic:

As I was going to St. Ives  
I met a man with seven wives  
Each wife had seven sacks  
Each sack had seven cats  
Each cat had seven kits  
Kits, cats, sacks and wives  
How many were going to St. Ives?

Calculations are unnecessary if you read carefully to find the direction of travel of the parties. Another favourite is

How much dirt is there in a hole 1.06m wide, 1.42m long and 2.01m deep?  
Many people start multiplying the numbers together<sup>4</sup>.

We now, of course, have the use of calculators and microcomputers to 'help' with calculations. Should we be teaching children how to use a calculator<sup>5</sup> and computer? Should we still teach basic skills as a learning tool to encourage mathematical exploration?

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<sup>3</sup> 'The teacher's role in mathematics is to demonstrate, explain and question, to stimulate children's interests, invite predictions and interpretations of what is displayed and ask individual children to respond' from the National Numeracy Strategy dfes page 30

<sup>4</sup> Some people are so eager to begin that they jump at the first idea which comes along and rush into a full scale assault without first taking time to survey the scene and assess what is involved. If the question fails to succumb to the initial onslaught (often because it has not been understood) then it is necessary to start afresh. Consequently it is worthwhile learning to begin effectively.

<sup>5</sup> Cockcroft committee argued that as calculators will be increasingly used in employment and in everyday life, children should be taught how to use them. At the same time, it stressed that using a calculator in no way reduces the need for mathematical understanding on the part of the person using it. (para. 378)

These issues are important to all that are concerned with the education of children. They are also relevant to any attempt to understand how children learn about number.

The Cockcroft Report: *Mathematics Counts*, published in 1982, found little evidence that standards of numeracy were declining, although it was difficult to compare one era with another. It said that the children are leaving school with a negative attitude towards mathematics. This is still true today. Most of mathematics being used in everyday life is problem solving.

Mathematics is only ‘useful’ to the extent to which it can be applied to a particular situation, and it is the ability to apply mathematics to a variety of situations to which we give the name ‘problem-solving’. However, the solution of a mathematical problem cannot begin until the problem has been translated into the mathematical terms. This first and essential step presents very great difficulties to many pupils – a fact which is often too little appreciated. (Para. 249)

The use of calculators emphasises rather than diminishes the need to understand what calculations are required, to make a reasonable estimate of the answer, and to think carefully about the implications of the answer. To increase our understanding we need to:

- find out what is involved in applying mathematical skills to practical situations.
- find out why this kind of mathematical understanding is difficult for some children.
- know which methods can be used to help children attain this wider mathematical understanding.

In his book *Children’s Arithmetic*, Herbert Ginsburg (1977) asks the following question and supplies his own answer (p 125):

Why do children have so much difficulty with written mathematics? Perhaps part of the answer is this. Children’s early and self-invented arithmetic mainly involves counting procedures applied to real objects. They usually count on their fingers to get a sum. Methods like this work easily and well. Next, children are taught various written procedures for accomplishing the same purposes. Unfortunately, they often fail to understand the necessity or rationale for written methods. Nevertheless, they are imposed on them and in school they are required to use them. The result is not only a bizarre written arithmetic, but also a gap between it and the children’s informal knowledge.

## **Problem solving<sup>6</sup>**

Children have to be taught problem solving skills; I cannot assume that this has been ‘picked up’ automatically. Computer simulations help here. Each solution can be discussed, and a consensus can be reached about which is the best. Children analyse the problem, work out a strategy, arrive at a solution and compare their solution with others. Later, more complex problems would be introduced that involve balancing a greater number of variables.

## **Use games rather than sums**

Much time is spent in school doing written exercises in the basic operations of addition, subtraction, and so on. The main justification given for this is the need for children to practise arithmetical skills. While there is a need for this practice, the effect of carrying out so many purposeless calculations must be questioned. Games, such as – using dice, dominoes, board games – can provide just as much practise in basic skills, but are both enjoyable and meaningful.

As I feel that children learn a lot through play I decided that the sessions at the after-school club for mathematics would be based on play, using games and problem-solving questions. In the school we have a variety of board games<sup>7</sup> that can be used. We also have a marvellous network of computers that the children can use to work on maths programs (from the Internet or ones that have been purchased by the school<sup>8</sup>).

At the beginning of the series of after-school clubs I decided that it would be best to stick to one subject and spend all the time thrashing out one idea. This didn’t work. Children find difficulty in spending too long on one subject. They, nowadays, flit from one thing to another. The sessions would be based on the 3-part lesson that we have as part of the Numeracy project. This would consist of a mental starter, an activity and then a plenary.

- The starter would be something to whet the appetite – to get the brain into gear.
- The main activity would be the bulk of the lesson, where the pupils would be filled with knowledge through play.
- The plenary would be the sweetener at the end. This has developed into using the computers to consolidate the main activity.

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<sup>6</sup> ‘One of the big misapprehensions about mathematics that we perpetrate in our classrooms is that the teacher always seems to know the answer to any problem that is discussed. This gives students the idea that there is a book somewhere with all the right answers to all the interesting questions, and that the teachers know those answers. And if one could get hold of that book, one would have everything settled. That’s so unlike the true nature of mathematics.’ Leon Henkin 1981

<sup>7</sup> What’s the Time Bingo, Intermediate Number Cruncher, Tune into Tens, Percentages, decimals and fractions (Matching and Calculating), Double or Halves, Mathematical Advanced, Mathematical Beginners, Remainders.

<sup>8</sup> Smile programs (graphing, numeracy, sense of number), Key Stage 2 Maths, Bounceback 7, Developing Numbers (complements, numbers, tables) ,Graphplot, Calculightning

## Organisation

Questionnaires<sup>9</sup> had gone out to all the pupils about all the After-school clubs that were running on various evenings. All the children knew about the Springboard 7 club was its name and that it had something to do with Maths for Year 7, aimed at children that had not achieved a level 4 at the end of KS2. Even so there were 4 names on the list to start at the beginning of the year. I could manage with those numbers as it gave the children a chance to have a smaller teacher-pupil ratio. The lesson was all organised and then it was cancelled due to interviews for the head-ship of the school<sup>10</sup>. I looked on the bright side and thought that I wouldn't have to organise the following 3 weeks' lessons. The following week I was all ready to have my session again, but no one turned up<sup>11</sup>. This was getting very frustrating. I was getting nowhere with my club. I felt that I wasn't helping the children who needed help. I made a point of going around the school and questioned children that had put their names down and all of them said that they would be at the next session as they hadn't realised the sessions had started.

Eventually we started and I felt that we had had a good session. But talking to the pupils after, they wanted to do a variety of different things, although they couldn't tell me what in particular. I listened to their points and changed the structure of the sessions to take their ideas in to account. They seemed happier following the 3-part session, possibly because it was something they were used to in lessons in class.

## Falling numbers

As the term progressed the numbers dropped and I was left with just 2 boys. There could have been a variety of reasons for this:

1. Competing against football and rugby training
2. Darker nights
3. Cancellations due to Parents' Evening and a counselling course that I had to attend on Thursdays (I made alternative arrangements for the pupils<sup>12</sup>)
4. Boredom?
5. Too narrow a field. Pupils did not know what Bounceback 7 meant
6. More interesting clubs to attend.

This club would run until the end of December and a new one would start up in the new term. I thought about what I would write in the new prospectus for the pupils and planned to open the club up to other year groups and for all abilities. The letter went home 2 weeks from the end of term and I wasn't expecting a huge response as this is a dark time of year and, as one of my tutor group said "You're not running a Maths club, are you, Miss? Why?" and pulled the most peculiar face. I did try to persuade her to come but Computer club was much more enticing.

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<sup>9</sup> See Questionnaire in appendix

<sup>10</sup> See diary 16/9/02

<sup>11</sup> Other groups were similar. Children should have been reminded about when clubs started. Of course, being voluntary I cannot force children to attend. I just have to make it as interesting as possible.

<sup>12</sup> See diary 18/11/02

## Reflections

The most difficult task over the last few weeks of the term was getting over the feeling of ‘failure’. I had not managed to attract the numbers to the maths club that I wanted for it to be successful. It is very difficult to play games with just two people. However with the help of the Westwood group I stuck with it and finished the year thinking of how to improve the advert for the club and how words and advertising are important to attract pupils<sup>13</sup>. Looking back at my diary starting in September it has struck me how determined I was to succeed. I was not going to allow a lack of numbers defeat me. Several other clubs folded due to falling numbers, although the teachers who ran clubs did start up other clubs that children had asked to be run e.g. chess club, girls’ football. I was determined not to be downhearted because I was sure that more pupils should have the opportunity to work at maths if they wanted to.

## January 2003

When the New Year started in January, I was given the list of names of those children that wanted to come and join me playing Maths games or using maths programs on the computer. I was pleasantly surprised at the numbers. I felt quite relieved that the numbers had increased and that there might be some children that really enjoy Maths. There were enough to play 2 separate games in the first session, which kept me busy. I asked them why they wanted to attend a Maths club and there were a variety of reasons:

- “I’m stupid and need help.”
- “ I enjoy Maths and want to do more.”
- “I need help with homework when I don’t understand.”
- “My friend comes so I tagged along”.

Hopefully I will be able to work with all the pupils and keep the numbers up by making it interesting and ‘fun’. The word may spread and others may join later.

The club has to work with and for the children involved. They have also to think about what criteria is needed for a successful club to run.

Reading information about other maths clubs that have run across the United Kingdom I found that the average number of pupils that attend a maths club is 12. I was amazed that the number was so low. Considering the numbers of children and adults who always say that they don’t understand maths and would like to learn more, there is apathy amongst them to improve their minds. Parents maybe don’t insist on children improving themselves and understanding a subject that they themselves had problems with.

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<sup>13</sup> See diary 16/12/02

## Why use ICT<sup>14</sup>?

The key question is: what particular benefit does using ICT offer to making teaching and learning in mathematics more effective or more efficient?

Possible reasons

1. More effective teaching. This may be through demonstration or representing ideas either using a specific program like Smile or through a PowerPoint package.
2. More effective discussion and use of specific mathematical language – using a spreadsheet or discussing number patterns.
3. Pupils learning strategies with the computer enforcing the ‘rules’ of the game.
4. Exposure to multiple examples to identify patterns.
5. Pupils learning how to use mathematical tools (working with spreadsheets or databases or presenting mathematical ideas using tables, graphs and charts).
6. Pupils getting immediate feedback from the computer.
7. Computers providing feedback for the teachers.
8. Pupils working individually and getting practice at an appropriate level.

## The role of calculators<sup>15</sup>

Children need to learn when it is appropriate to use a calculator and when it is not, and the first line strategy is to use mental calculations when possible. For example it is possible to ‘beat’ the calculator if number facts can be recalled rapidly. Also children should understand what calculation should be used and have strategies to check and repeat the calculation if they are not sure whether it is right. This is where the problem solving sessions are important, because mathematical words and their meanings can be difficult for children to understand. ‘What do I do now?’ is often a question that I am asked, because the wording of the question is not clear.

Calculator use tends to be as a fallback strategy, being used as most commonly for executing routine computations and checking answers.

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<sup>14</sup> Taken from the National Numeracy Strategy; ‘ICT is helpful in supporting the development of number as it provides an opportunity to enhance good teaching and can offer a means of demonstrating ideas about number that cannot be done in any other way. Children can discuss and interpret what is shown on screen, they can predict what will happen next, and they can try out ideas and see what happens next ICT provides instant feedback that is not available in other ways.’ Page 34

<sup>15</sup> From bera: Teaching and Learning Primary Numeracy: Policy, Practice and Effectiveness: Findings of extensive use of informal mental strategies by both adults and children led to a suggestion that: ‘With mental methods...as the principal means for doing simple calculations....calculators....are the sensible tool for difficult calculations, the ideal complement to mental arithmetic’ (Plunkett,1979)

## Attitudes

An important, but neglected, ingredient in mental strategy use is self-confidence. Children can have all manner of facts and skills at their fingertips but if they do not have the confidence to 'have a go' or take risks they are unlikely to use these facts and skills to generate an appropriate strategy. It is to be hoped that an emphasis on the teaching of mental calculation will affect a change in the attitude of children and adults towards mathematics. An ethos needs to be developed where people no longer have the attitude of 'I can't remember the method so I can't solve the problem' –discussed in the Cockroft Report (DES 1982)- but instead adopt a more positive attitude of ' I can't remember how my teacher did it, but if I.....'<sup>16</sup>

In order to build up this self-confidence I have to provide a variety of problems that we can solve together and therefore allow the children a feeling of 'have a go' without the threat of being ridiculed by others because the answer is wrong. This has to be done in a sympathetic manner with lots of different ways to achieve an answer. And hopefully there will be one way that a particular child will connect with and remember forever.<sup>17</sup> Using board games allows the use of mental strategies.

It also, because it is a small group, allows me to explain in more depth the solutions and the various ways an answer can be achieved. It saddens me to think that children believe that there is only one way to solve mathematical problems because they have never been allowed to experiment in trying to find an answer. Working with the children after school should increase their self-confidence and self-esteem<sup>18</sup>. Self-confidence is the positive perception of one's own ability and competence. It is associated with self-assurance, and a feeling of certainty regarding one's ability to complete tasks or succeed in a given area. Therefore self-confidence from success at an After-school club can transfer across in to the classroom setting.

One of the aims of the Numeracy Strategy is to ensure children are mentally competent at mental addition and subtraction by the end of Key Stage 2. However 100 years before this, Bidder (1856) declared at an inaugural lecture to Civil Engineers

'I have for many years entertained a strong conviction that mental arithmetic can be taught, as easily as, if not with greater facility than, ordinary arithmetic, and it may be rendered conducive to more useful purposes than that of teaching by rule.....'

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<sup>16</sup> 'That is the teacher's goal – to get the student to "own" the information- to help them learn it well enough to teach it, remember it for all time, and to use it meaningfully, quickly, easily, appropriately, and profitably'  
Dyscalculia: Instructional Techniques from [www.dyscalculia.com](http://www.dyscalculia.com)

<sup>17</sup> Minimum requirement for children is the development of the following

- Secure knowledge of number facts
- Good understanding of the number system – how it works
- The ability to perform accurately the skills underpinned by these understandings
- Confidence to use what they know in their own way to find solutions

<sup>18</sup> The majority of the group suffers from low self-confidence.

## **Out of School Hours Learning**

Enjoyment is a key term for pupils and for schools. Enjoyment of after-school activities is closely linked to its voluntary nature. Pupils enjoy the activities not only because they have chosen the activity as something that interests them, but also because other pupils too, are there because they want to be there. This makes the club environment one of co-operation and the pursuit of a common goal. This has improved during this term because of the increase in numbers.

Motivation is the enthusiasm that pupils have for particular projects or activities they are engaged in. Pupils show commitment by turning up every week, even when the teacher has had to go away on a course.<sup>19</sup>

There should be a positive attitude to school following the start of after-school activities. Pupils who take part in these very often show greater levels of participation in curricular activities. Hopefully this will lead to an improvement in attitude to school, for some, and the subject of Maths.

The range of different activities pupils have a chance to participate and succeed in gives them the opportunity to feel successful. Pupils are able to be successful in different areas. Those pupils that do not succeed in class have the opportunity to experience success in other spheres. Academic research has shown a strong link between high self-esteem and high achievement. Conversely, low self-esteem is linked to a sense of helplessness and failure.

After-school clubs allow pupils to widen their experience of different peer relationships – including cross-age/year/ability/social groups. They also have contact with teachers and adults in new, informal ways. This encourages the development of deeper and more personal relationships between pupils and teachers/adults.

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<sup>19</sup> See diary 18/11/02 and 2/12/02

## Learning outcomes

A wide range of learning outcomes has been observed<sup>20</sup>. These include knowledge building and subject related learning, as well as basic and key skills, which include literacy as well as numeracy, life skills and thinking ‘how-to-learn’ skills.

This club offers children the time to find out more; to build upon knowledge and to review, reinforce and practise the skills and knowledge required by formal curriculum. The club allows pupils more opportunities for one-to-one help and teacher attention, without the class time restrictions.

*‘In the class, you sometimes do things you really enjoy but you just brush over them. You don’t do them often. And after school you can like, concentrate’ – pupil*

ICT has been noted as a key activity for attracting pupils and I used this as part of the blurb when writing about the club that I wished to run in the spring term<sup>21</sup>. There were already computer clubs running in the school so I don’t think it was just that which attracted pupils to the maths club.

In addition to acquiring and improving knowledge, which is directly relevant to the curriculum, the Maths club expands their knowledge in areas not directly covered, e.g. board games<sup>22</sup> and the rules, maths games on the computers.

The two favourite games have been Percentages, Decimals and Fractions and Mathematics Advanced. The year 7 at the time were working on percentages at the time they played the game, so they wanted to supplement their knowledge. Other games have been played and once the rules were explained, (this was the hardest part for the group to understand) they seemed to enjoy most of them. The least favourite was Tune into Tens. I believe this looked too easy for the pupils, the title certainly sounded easy. The older pupils didn’t want to choose something that they believed they ought to be able to do easily, and maybe look a little silly, especially in front of younger pupils.

Of course, maths skills are not only acquired in programmes that formally address this issue. Sports activity in particular is an area where students are actively encouraged to use their number skills, such as when working with league tables and anticipating results.

Because I am using board games the children have to work as a group. There has to be a feeling of co-operation, as well as a little competition. They have to have social and personal skills and this is easier to develop in a smaller group setting. By providing pupils with a range of new and varied approaches to learning, they can focus on new kinds of learning techniques, such as mind-mapping and brain gyms. When working in small groups, or participating in team activities, pupils may learn new ways of interacting while learning together.

*‘I think we all learn when we play games to be good natured and it is not the winning that matters but the taking part’ –pupil*

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<sup>20</sup> ‘Research has shown that children don’t always learn what we intend them to, but that what they do learn can be just as valuable. We often underestimate what children can do and understand. If we can provide opportunities for them to try out their newly acquired skills on a fairly regular basis, in non-threatening situations, then perhaps some of the magic that has been lost from teaching and learning can be rediscovered.’ Article written by Marjorie Gorman in TES November 22 2002. See complete article in appendix

<sup>21</sup> See After-school Activities sheet in appendix

<sup>22</sup> Games include What’s the Time Bingo, Intermediate Number Cruncher, tune into Tens, Percentages, Decimals and Fractions-Matching and Calculating, Double or Halves, Mathematics-Advanced and Beginners, Remainders

Giving opportunities for pupils to work on their own on computer programs gives pupils the chance to work at their own pace, and to focus on issues and activities of particular interest to them.

### **Collecting data**

The ideas I collected from Jean McNiff from her book *Action Research Principles and Practice* were helpful, and I had used some of them before on other Research projects.

- Keeping a diary has been the most effective way I have of remembering what has been happening over the past few months. As soon as I read what I had achieved on a particular week my memory replays all that happened on that particular day, including feelings.
- I have used the camcorder that the group has purchased, but I am very aware now of the problems associated with the filming of pupils. Even if the camera is focussed on me, children will still look into the lens or walk past. It seems a great pity that we cannot use footage because children love to see themselves on the 'TV'.
- I have interviewed children about the maths club but only in an informal way. I had to find out what they wanted to do in the club. I didn't want the sessions to be 'teacher led' all the time. I need feedback to make the club a success in future years.

### **Future action**

I am looking forward now to the start of the summer term when the emphasis will be on KS2 SATs. The club may have to change again to cater for revision and booster maths for the exams that the children have to take in the middle of May. I will have to talk to colleagues about the criteria for a club in the summer term. It may be possible to run a club that caters for two sets of pupils although that would involve a lot of preparation.

## Summary

### Sustaining mathematical thinking

Thinking mathematically is not an end in itself. It is a process by which we increase our understanding of the world and extend our choices. Because it is a way of proceeding, it has widespread application, not only attacking problems that are mathematical or scientific, but more generally. However, sustaining mathematical thinking requires more than just getting the answers to questions, no matter how elegant the solution or how difficult the question.

Increased awareness does not just happen. It has to be fostered and built upon in a conscious way. Whether the focus of questioning is practical and related to the material world, or more abstract dealing with number, patterns and structure, resolving brings a sense of pleasure and confidence<sup>23</sup>.

Playing mathematical games and working together on problem solving should help to gain that sense of pleasure and each time the pupils play their confidence should grow.

I have learned that variety helps with children's learning, wording of advert can influence, and I have to be flexible to children's needs. I may be prepared for a club but because the children involved have specific needs I may have to change my plans to fit in with some of them. As long as they feel that they are learning something and they occasionally get the 'Aha' factor when they understand something that has been bothering them, then I feel that I am succeeding.

Perhaps, the most important outcome for me is the professional development and new skills that come from being involved in learning in a different way.

As a result:

- I have increased my knowledge about individual learning and the need for promoting study skills,
- Experimented with new materials and ideas,
- Enjoyed opportunities to teach without emphasis on formal assessment.

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<sup>23</sup> "Maths enables you to land on the moon, make films such as Jurassic Park, and have a mobile phone. But while Bob Winston makes people excited about medicine, and David Attenborough does the same for small, furry animals, nobody is telling us how exciting maths is," says Professor Adrian Smith. An article written by Philippa White in the TES on December 6 2002. See complete article in appendix

## Bibliography

bera (2001) *Teaching and Learning Primary Numeracy*

- Ken Ruthven, University of Cambridge *British Research on developing Numeracy with Technology*
- Julia Anghileri, University of Cambridge *British Research on Mental and Written Calculation Methods for Multiplication and Division.*
- Ian Thompson, University of Newcastle upon Tyne *British Research on Mental and Written Methods for Addition and Subtraction*

Biggs, E (1985) *Teaching Mathematics 7-13* NFER- Nelson

Bidder (1856) *Minutes of Proceedings of Civil Engineers*, Vol. XV, 1856.

Houssart, J. *BCME 4 – Research Report.htm Dear Diary: Misconceptions in Primary Mathematics* Open University

Hughes, M (1986) *Children and Number; Difficulties in Learning Mathematics* Blackwell

McNiff, J (1988) *Action Research: Principles and practice* Macmillan Education Ltd

Mason, J et al (1985) *Thinking Mathematically*: The Bath Press, Bristol

National Numeracy Strategy: dfes

National Numeracy Strategy (2000) *Using ICT to support mathematics in primary schools* DfEE

Plunkett, S. (1979) *Decomposition and All That Rot, Mathematics in School 8*

Thompson, I *Issues in Teaching Numeracy in Primary Schools* Open University Press. Buckingham 1999

[www.dyscalculia.com](http://www.dyscalculia.com) *Dyscalculia: Instructional Techniques*