

Introduction

This is a book written for busy teachers who want to make mathematics more exciting and more demanding for the able students they teach. The photocopiable activities are suitable for use inside the classroom on a regular or occasional basis and the materials also provide useful enrichment tasks for after-school clubs or master classes.

Creativity is making a comeback on the educational stage, and for those who wish to know more, the opening chapters give an introduction to the topic and offer ideas on the education of the more able.

The target-driven culture within which you, as a teacher, are obliged to operate is not going to go away, but at least there is a growing awareness among those in power that creativity raises self-esteem, prepares pupils for life and enriches their lives. (*National Curriculum Handbook*)

The script remains the same but producers are being encouraged to be more innovative; this book is designed to facilitate that process. The creativity that is being encouraged may not be innovative when compared with that of da Vinci or Einstein, but for any individual young mathematician represents the beginnings of originality of thought.

This book has grown out of research undertaken while teaching full time in a comprehensive school. The area for research emerged in discussion with gifted and talented students themselves, who felt unable to express their creativity within the mathematics classroom, and their teachers, who felt constrained by the demands of the mathematics syllabus. These classroom needs led me to develop materials which are challenging and fulfilling for the student while not putting heavy demands on the teacher.

Terms such as 'gifted' and 'more able' have been, and will continue to be, used as interchangeable terms throughout this book as the label is not in itself important. What matters is meeting student's individual needs.

My intention is to support teachers, who feel restricted by the rigidity of the syllabi, to provide opportunities for the most able mathematicians to demonstrate what Torrance and Goff (1990) refer to as 'that special excitement' experienced when being creative. Coursework used to permit students to expand their knowledge but it is now so time limited that the bell sounds before the situation can truly be explored. To me there is a need to encourage students to maintain high levels of curiosity and playfulness as they use and extend their subject-specific expertise, while developing the communication skills relevant in our technological age.

My research findings convinced me of the need to include more opportunities for students to develop their creative skills, and I modified my own teaching accordingly. There was, and is, no doubt in my mind that, when teaching the most able, I could and should take more risks and allow them to take greater control over their learning. In a way the research gave me permission to adjust my approach as I had evidence to support the change.

Not all teachers have such a professional development opportunity and in today's classrooms the teacher of mathematics may or may not be a specialist. Diverting from the straight and narrow of any imposed curriculum requires greater risk-taking on the part of the teacher, and it is more difficult to take such risk if one lacks confidence in knowing all the possible avenues that gifted students might explore and in one's ability to follow the footsteps.

My intention is to support a move away from the view of teacher-giver and pupil-receiver model towards a teacher as facilitator approach – to me an inevitable step if mathematically gifted students are to reach their potential. Such a move does not require the teacher to have all the answers but to have strategies for finding them. The situation is then less threatening to the teacher, as there is no requirement to know all there is to know. In a democratic classroom atmosphere there is an acceptance that every individual has a part to play in reaching a solution.

The book is in two parts that may, if preferred, be read independently. Reading Part A does, however, help with understanding the nature of the tasks in Part B. Part A is an introduction to some of the background literature, considering what is meant by the term 'creativity' and how teaching attitudes might impact on its development. Part B contains photocopiable activities that may be used within the classroom or as enrichment activities primarily for students aged 11 to 14 years. While most activities have been designed for small groups of able mathematicians, it is possible to use many with the whole class or with individuals. Activities are planned so that progressively more control may be handed over to the student. How much or how little mathematical freedom is given to the student is a choice made by the teacher through considered selection of the activity.

Early chapters in Part B offer structured activities and leave the control with the teacher, but as the book progresses more and more control is handed over from the teacher to the student.

Teachers' notes give guidance on the use of the materials but the main recommendation is that examples towards the end of the book should not be used with students who have had no previous experience of freedom over the direction of their mathematical work.

The notes allow the teacher to consider in advance:

- necessary existing knowledge using the National Curriculum progress information website at www.ncaction.org.uk/subjects/maths/progress.htm
- lesson objectives (The open-ended nature of the activities means that there may well be some learning outcomes which have not been anticipated!)
- grouping
- equipment
- minimum time
- suggested outcomes.

Those teachers who use the activities frequently will notice some repetition of information, but this is unavoidable if each task is also to be accessible on a stand-alone basis.

Activities are not differentiated by year group or age because any activity could be suitable for any group. The range of ability within the 'most able' is such that you, as a teacher, are best placed to decide whether or not any particular task is appropriate.

The activities should generate their own extension activities: students will get caught up in the ideas and make their own highly creative suggestions for follow-on activities. Teaching notes include some possibilities and, in some cases, descriptions of how students have extended the material.

Students are offered the opportunity to present their findings in a variety of mediums but with a strong emphasis throughout on talk as a means of clarifying thought.

As mentioned above, the activities are designed to appeal to the able 11 to 14-year-old learner but there is really no age restriction on their use. Where the student is at mathematically, not chronologically, is the most important factor. You may decide that students significantly younger or older could benefit from a more creative mathematics experience. The bar chart in Figure 1.1 provides an indication of likely suitability across the range, but may of course be extended in both directions remembering that it is 'mathematical' age that is the most important.

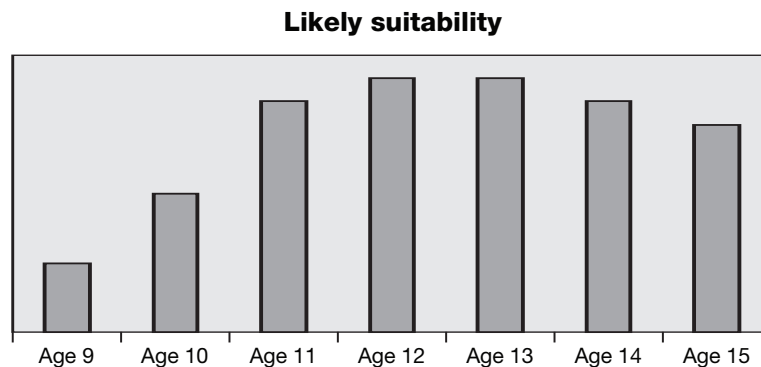


Figure 1.1 Suitability

A colleague of mine, an English teacher who would describe herself as an average mathematician, says that she now views mathematics differently having worked with me. My approach is multidisciplinary, allowing students to bring together a range of creative responses.

That is not to say that there will not be hesitancy when considering the tasks. It is likely that teachers will feel uncertain about the merits of presenting mathematics in a different light. Students, too, might need some encouragement to dip a first toe in the water but this uncertainty will be rapidly replaced with excitement in generating ideas and pride at reaching illuminating mathematical solutions. Commitment will come about naturally, as the tasks are intended to be intriguing such that the able mathematician is motivated to explore and to discover.

As Goethe is reputed to have said, 'Whatever you can do or dream you can, begin it. Boldness has genius, power and magic in it: begin it now'. The message to both teachers and students is, enjoy the challenges, the risks are worth taking, have fun and learn!