History of Mathematics Resources for 11 to 16 year olds

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Abstract
The paper presented introduces a project which has been developed as part of the Gatsby Teacher Fellowship (The Gatsby Teacher Fellowships programme was established in 1998 by the trustees of the Gatsby Technical Education Projects, one of the Sainsbury Family Charitable Trusts, UK www.gtf.org.uk), which I have been awarded for the 2004-5 academic year. Its principal aim is production of resources from the history of mathematics to supplement teaching of mathematics to 11-16 year olds.

Introduction to the Project
The project grew out of the practice of teaching mathematics in the context of its history in the secondary St. Edmund's Catholic School in Dover, England. Its aim is to produce an ICT based resource base in the history of mathematics with worksheets and practical guidance to place Key Stages 3 and 4 (11 to 16 year olds) mathematics topics into a wider historical context and therefore reinvigorate the interest in the subject.

The prevailing modern view of mathematical ability is one which entails creativity and transcends the more limited concept of technical ability. There is, however, little widely available material which, in a simple and accessible way, introduces the secondary school age children to the world of 'creative' mathematics. The approach adopted will hopefully inspire young mathematicians to recognise this creative nature of mathematical enquiry and to gain an insight into the various techniques of research, analysis and synthesis of mathematical thought through the study of the subject's history. This would be achieved through producing the material on, firstly, reoccurring topics in mathematics through history, and secondly, development of mathematical techniques relevant to KS3 and KS4 mathematics.

Existing resources
In order to produce material and to link it with the existing resources, a study and an evaluation of these was needed in the first instance. There is a wealth of resources in the history of mathematics currently being posted on the World Wide Web. The problems that secondary school teachers and children both face, however, can be defined as:

- majority of the current resources are aimed at university and post-graduate level students; neither of which is wholly suitable for either secondary school teachers or pupils
- some resources can be used by teachers, but they would require combination of time dedicated to do original research, simplification of the material, and finally time, energy and skill to produce 'digestible' learning resources for their students

- there is no way of telling the accuracy of the material on the internet because of the lack of peer assessment, although this is probably the fastest diminishing problem as number of professional organisations now offer guidance on the matter through links and reviews.[1]

Apart from these initial difficulties, one can however venture into the ever expanding universe of the World Wide Web. There are easily distinguishable groups among the existing sites in the history of mathematics:

- **Primary resource sites**

  are sites with the primary historical material, such as that of Gallica and the Cornell University Library. Material presented on these sites is of most value as it does not become obsolete at any point.[2]

- **Accumulative sites**

  are such as that of the famous University of St. Andrew's History of Mathematics site, which is not only ever more growing in terms of added topics, but also of the internal links and references.[3]

- **Mutating sites**

  are the least reliable and most ambivalent, although at times interesting, as they may introduce a view of a mathematical topic, or an application to it which may be of interest to the age group at which the project is aimed. These may be sites such as those which deal with 'seasonal' mathematics – giving links and advice on topics such as cryptography for example as a cipher breaking code challenge approaches.[4]

- **List sites**

  can be very helpful as they inevitably contain some links that one has not seen before, and at the same time offer guidance, and often professional assessment of the site's accuracy.[5]

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[1] For English speaking peoples, the BSHM and CSHPM sites are the most useful in this respect http://www.bshm.org/ and http://www.cshpm.org/.

[2] http://gallica.bnf.fr/ Gallica, part of the Bibliothèque National, Paris; http://historical.library.cornell.edu/math/ Cornell University Library Historical Math Monographs; and the Götiinger Digitalisierungs-Zentrum University of Göttingen http://gdz.sub.uni-goettingen.de/en/index.html. The Jahrbuch Project, is an Electronic Research Archive for Mathematics (ERAM) http://www.emis.de/projects/JFM/.

[3] Others certainly worth mentioning are http://mathworld.wolfram.com/, part of the Wolfram Research sites. David Wilkins, Trinity College Dublin http://www.maths.tcd.ie/pub/HistMath/; and of course, the famous MacTutor History of Mathematics archive http://www-gap.dcs.st-and.ac.uk/~history/.

[4] Good example is Simon Singh's site and the www.simonsingh.net/, in particular historical background to cryptography linked with past and currently running competitions.

[5] The Math Forum @ Drexel University is an excellent example of this http://mathforum.org/; as is the Mathematics Archives site at http://archives.math.utk.edu/topics/history.html.

- **Purpose made sites**

  Made for existing courses, sometimes developed because of a special interest or expertise of the owner.[6]

Principles of the project

There have been many papers and books written on the benefits of teaching mathematics through its history.[7] The purpose of this paper and of the project which it describes is, conversely, to employ the benefits, rather than to describe them once again. It is however important to take into account the principles by which the project is guided and which have originated from my teaching practice:

- Bringing international dimension to mathematics through teaching and learning about its history
- Aiming to initiate and enhance an understanding of different cultural approaches and encourage comparison between these
- Employing an interdisciplinary approach, in particular in relation to visual and literary arts [8]
- Demonstrating mathematics as one of the most creative human activities
- Encouraging the study of 'old masters' (offering a safe environment for self-discovery and self-identification in the context of the history of mathematics)
- Nurturing intellectual fascination with mathematical concepts
- Schematising mathematical progress
- Finally, de-trivialisation of mathematics.

Examples from practice

Some of the practical principles, which have so far been incorporated in my teaching and will be transferred through the guidance notes into the project, are based on the following strategies:

- Mathematics, as well as any other human activity, is partly dependent on story-telling. This gives mathematicians a context in which to work, it entails a social as well as a personal platform whereby mathematics is both related to and helps explain other human activities. The more sophisticated the society is, the more complex the story-telling becomes, but the primal need for understanding the simple, archetypal stories remains strong nevertheless. In children this need is the strongest as they strive to understand the world around them – mathematics is no exception.
- Familiarity with a topic need not finish the work on the topic. By taking possession of it, students are able to pass the message on to younger pupils, therefore doing the right thing twice over: the first time when they strive to understand the topic themselves through the historical context and then by teaching (and thereby learning more of it) the same to the next generation of

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[6] Most sites made by individuals would fall into this category as they support the work of the academic in question; they are very useful in the area of expertise of the web site author. An example is Archimedes site @Drexel http://www.mcs.drexel.edu/~crorres/Archimedes/contents.html.

[7] See in particular Baumgart et all [1969], Fauvel and Barrow-Green [2000], and Stander [1987].

[8] Simplest examples would be studying Escher's art and Lewis Carroll's (aka Charles Dodgson) children's literature.

students. This is most useful and successful when there is a practical task attached to the problem, as it involves some logistical questions to be inevitably resolved which gives more opportunities for taking ownership of a particular topic.

- Rather than a large number of projects, the students are better off with a limited number to cope with during the year. This gives them opportunities to explore topics in depth and in relation to all the principles of the project as listed in the previous section.

Conclusion

The project runs throughout the 2004/5 with a view of being further developed after the Fellowship has ceased. The project is available at www.mathsisgoodforyou.com. For further information you may get in touch with the author at snezana@mathsisgoodforyou.com.

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