POPULAR MATHEMATICS

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Popular mathematics seems to be not very popular in either schools or society at large. In this paper, we briefly explore the meaning of popular mathematics, and consider some of the ways in which it might be of value to mathematics education in schools, particularly secondary schools. Various kinds of popular mathematics are identified and briefly illustrated, and the prospects for supporting and complementing the school mathematics curriculum discussed.

Introduction

In this paper, a brief introduction to the idea of popular mathematics is offered, recognising that encounters with mathematics ought not be restricted — although they frequently are — to the formal school curriculum or even to schools themselves. It is suggested that mathematics continues to have an image problem in Australia, if not elsewhere, and that the public understanding of mathematics is not always helpful for the learning of school mathematics. The paper does not claim to treat this broad topic in detail, but rather to suggest some of the ways in which popular mathematics and mathematics education in schools might be connected, and offering some advice on productive ways of doing this.

What is popular mathematics?

There does not seem to be general agreement (or even debate) on the meaning of the term “popular mathematics." Indeed, a Google search produces mostly examples of popular mathematics things (such as popular mathematics books, where the meaning is to refer potential customers to books that are purchased or borrowed from a library by many people). Turney (2008) refers to “popular science” in relation to “an attempt, in some medium, to make scientific ideas accessible to non-professional audiences” (p. 5). Following Turney, this paper is concerned with published attempts to engage non-specialists with aspects of mathematics.

There are many kinds of attempts to do this, including:

• books written for the general public;
• film and television features;
• the Internet;
• newspapers and magazines;
• incidental mathematics, such as that in museums.

We will exemplify and discuss the merits for school purposes of each of these.

Budd and Lim (2004) have summarised some useful discussion on the broader issues associated with “public understanding of mathematics” in the report of a discussion group at the International Congress on Mathematics Education in Copenhagen. While the ideas presented are sound, and worthy of action at a range of levels, the present paper is focussed on the more immediately manageable activities in a school setting.

Popular mathematics books

As for science, printed books are the most widespread source of popular mathematics materials and hence potentially the most accessible. This species of books comprised very few members until comparatively recently. Early examples, deservedly much-acclaimed, included Courant and Robbins’ What is Mathematics?, the work of superb writers such as Warwick Sawyer (e.g., Mathematician’s Delight), Martin Gardner (with various off-prints from Scientific American magazine) and the four-volume compendium, The World of Mathematics, edited by James R. Newman. The last of these was issued to many schools in the 1960s when the federal government first began providing direct support for schools, albeit in oblique ways, through libraries and science laboratories.

In recent years (the past thirty years or so), a large number of books have been published that might be regarded as popular in the sense that they are written to engage in some way an audience of non-specialists (at least, non-specialists in a particular field of mathematics). Many of these are potentially of considerable benefit to secondary school mathematics education, although it seems that only a few of them ever find their way into secondary schools. Amongst the sub-categories of such books might be:

• general introductions to mathematics or particular mathematical topics, e.g., Sardar, Ravetz & Van Loon (2005);
• glossy coffee-table books, lavishly produced in beautiful colours, e.g., Bentley (2008);
• books highlighting the role of mathematics in everyday life, e.g., Eastway & Wyndham (1999);
• books directed at younger readers, e.g., Stewart (2006);
• books offering historical perspectives on either ideas or the people associated with them, e.g., Mankiewicz (2000);
• books focussed on puzzles or problems, e.g., Enzensberger (2000);
• mathematics books, aimed at mathematically literate readers, but not specialists in the relevant field, e.g., Odifreddi (2004).

This list includes a good example11 in each category, although in each case there are many members in good standing available in today’s catalogues. Figure 1 shows a sample of recent popular mathematics books.

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11 Lest readers think otherwise, it is important to note that these few examples in no sense exhaust the very many good examples that might have been included here. The constraints of this paper, with the need to include a reference list well in excess of the allowable paper length, have meant that only examples can be given.
No claim is made here that a better taxonomy of categories cannot be devised. Nor is it suggested that the categories are mutually exclusive. (In fact, they are not.) With the possible exception of the last category above, however, books of these kinds have the potential to provide students with significant opportunities to engage with mathematical ideas and to improve their sense of the nature of mathematics — provided of course that the books find their way into the hands of younger readers. They also have the potential to significantly affect students’ career aspirations at the very time when they are making educational decisions of lasting significance to their lives. Devlin (1995) provided an interesting set of opinions from notable successful popularisers of mathematics (including Ian Stewart, John Allen Paulos and William Dunham as well as himself). It is clear that the academic world does not usually regard the writing of such books to be entirely respectable, although the authors themselves regard it as an important part of their work. As Ian Stewart, a very successful popular mathematics author, noted: “[M]any still do not appreciate that unless somebody tells the public what mathematicians are doing, support for the subject (and I mean appreciation rather than money) will dry up” (Devlin, 1995).

Whilst it appears obvious that books can have no effect unless someone tries to read them, it is worth noting that many students seem to have relatively few opportunities to do so in most situations, for a range of reasons, to do with prevailing circumstances of school libraries, school mathematics curricula and commercial bookshops.

Good data seem not to be available, but informal evidence suggests that many school libraries contain few, if any, popular mathematics books of the kinds described above. Reasons for this are unclear, and doubtless relate to practices at individual schools, but they probably include the limited knowledge by librarians of what is available, a general reluctance of mathematics teachers to suggest acquisitions for the school library and, possibly, limited personal knowledge of what is available by mathematics teachers themselves. While these are speculations, they are supported by considerable personal
conversations with librarians and teachers, as well as students. Readers are invited to examine the collection of mathematics materials in the school library they know best, in order to test these hypotheses against some local data.

School mathematics curricula in Australia do not generally seem to be constructed on an assumption that students might be expected to read about mathematics anywhere much except their textbook, often tightly written to match the course at which it is aimed. (Indeed, close inspection of many textbooks gives an impression that students are not expected to read much at all.) Thus, it is rare that students are invited to seek information elsewhere, such as a library, an encyclopaedia, or in the media and equally rare that they are encouraged to look elsewhere for extra material to follow up on interesting ideas that have arisen.

Finally, many bookshops do not even recognise popular writing in mathematics as a field of publishing at all. While there are (a few) exceptions, many bookshops accessible to the general public do not have an identifiable named section that clusters together popular mathematics books. A fairly common practice is to have a section concerned with “Science” or “Popular Science,” which might include a few stray examples of popular mathematics, such as those shown in the photograph in Figure 2, which shows books on measurement, chaos and the invention of the number zero, among others. While these are unquestionably good examples of popular mathematics books, only an avid explorer would be able to find them in a typical non-specialist bookshop.

![Figure 2. Popular mathematics as a branch of science.](image)

Apart from the linguistic problem (that is that, although it is of very considerable value to scientific work and study, mathematics is most certainly not a branch of science), this practice has a number of unwanted side-effects: anyone looking to purchase a popular mathematics book will have some trouble finding one; the fact that there is no category of mathematics books in many bookshops reinforces the existing impression (even amongst shop assistants!) that no such books exist; people are most unlikely to purchase a popular mathematics book as a gift for a child (or an adult), although the purchase of books is a popular means of gift-giving in our society. The commercial world relies on turnover for its practices, of course. The self-fulfilling
prophecy that there is little demand for mathematics books is effectively reinforced by practices that make sure that none are available for perusal. The situation seems to be a little better in many local government libraries, at least in Western Australia. Perhaps because there is a conscious effort to provide for a wide readership and perhaps also because there are well-known Dewey classification numbers (starting with 510) with a consequent expectation that there are some members in good standing on the shelves, students might be better advised to go to their local library instead of their school library in search of popular mathematics books. It might also be that purchasing practices for a state library system routinely add recent popular materials to the catalogues as a public service, unlike schools, which may be systematically more reliant on recommendations from school staff.

Film and television

We are surrounded by the modern media of film and television. Large-screen televisions are already popular in affluent Australia, and there are very few Australian households without television at all. Our youth are immersed in a television culture of enormous and pervasive influence. To date, however, these media have had relatively little effect on the popularisation of mathematics: indeed, mathematics is scarcely visible in these environments.

Films and television programmes have so rarely involved mathematics that it is almost possible to list the examples of the last decade:

- **Films**
  - *Good Will Hunting*
  - *A Beautiful Mind*
  - *Proof*
- **Television series**
  - *Life by the Numbers*
  - *Numb3rs*
  - *The Story of Mathematics* (BBC)

While things may not be much better in other learning areas, they are in fact better. Our collective societal passion for fiction over non-fiction has meant that English and drama are very well served by these media, where science and mathematics are not, for the most part. Looking beyond fiction, however, it seems that most non-fiction in the media of film and television does not have a mathematical focus. There are many programs on science, history, travel and other cultures, and a wealth of sporting programs, but mathematics is conspicuous by its absence. Even on subscription television, the situation is not much better. There are channels dedicated to science (such as *Discovery* channels), geography and nature (*National Geographic*), history (*History Channel*), travel channels, health channels and others, but only rare mentions of mathematics and the people behind it.

As Budd and Lim (2004) suggest, one of the difficulties of finding mathematics in the media, or at least positive images of mathematics in the media, is the widespread view that mathematics is made up mostly of numbers and symbols. Another difficulty is

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12 As an example, I recently scoured a very large shopping centre in Perth's northern suburbs and found a total of only two mathematics books in bookshops, leaving aside mathematics school textbooks.

13 I am unable to comment on the situation elsewhere in Australia in this respect.
that the place of mathematics in the modern world is mostly hidden, as observed by Keith Devlin (1999), in the (perhaps unfortunately titled) PBS television series, also published as a book, Life by the Numbers. Indeed, a major motivation for this particular series was to highlight the ways in which mathematics "makes the invisible visible".

While there are few major media productions of these kinds, they do not necessarily even get an airing in Australia. Of the three television series referred to above, only Numb3rs was shown on free-to-air television in Australia. Life by the Numbers was not shown at all, and The Story of Mathematics has (to date, at least) only been shown on subscription television.

A consequence of these observations is that students seem unlikely to encounter much evidence of mathematics in films or television, and the associated learning, both affective and cognitive, unless steps are taken by the school and by mathematics teachers to seek out suitable materials. Unlike the situation elsewhere in the school curriculum, mathematics in film and television will only be seen by students if we make an effort to find and use good examples of them.

The Internet

The Internet offers fresh opportunities for mathematics to be made available to a non-specialist audience, including the audiences of students and their parents, as well as the more mathematically aware audience of mathematics teachers themselves. Indeed, Kissane (2009) has suggested that "reading interesting materials" is one of the categories of Internet use likely to be productive for students, and offers a number of examples of suitable publicly available materials of this kind.

![Figure 3. A recent issue (49) of Plus magazine (Millennium Mathematics Project, 2008).](image)

Perhaps the best of these to date is Plus, an Internet magazine produced five times a year by the excellent Millennium Mathematics Project team at Cambridge University in the UK. A recent example is shown in Figure 3. This magazine contains a variety of...
short articles in each edition, together with searchable archives, up-to-date mathematics news and lately even downloadable podcasts and posters. The articles typically include both expository articles regarding the applications of mathematics, the nature of mathematics, mathematics in wider society and interviews with people for whom mathematics is an important part of their career. Although relatively sophisticated, the articles are generally accessible to senior secondary school students and to a broadly educated public. The site continues to be available without charge because of sponsorships from various organisations, including government agencies, which presumably recognise the importance of improving the image and public understanding of mathematics.

As well as magazines, other kinds of written materials intended for a popular audience are available on the Internet, several of which are referred to by Kissane (2009). These include mathematical columns of various kinds (such as might be found in magazines, but written expressly for the Internet) and mathematics posters.

While much good material is available on the Internet, and hence technically in the "popular" domain, students are unlikely to encounter these materials and to gain from using them, unless they are explicitly brought to their attention in some ways. These include linking via school web sites, specific recommendations for accessing sites, project work that directs them to websites or the use of elements from the websites in teaching.

Newspapers and magazines

There seem to be no magazines for a popular audience whose main focus is mathematics, although some science magazines have occasional mathematical components in them. (An outstanding example was the Mathematical Games column in *Scientific American*, edited for many years by Martin Gardner; however, this column no longer exists). A consequence of this omission is that students will rarely encounter mathematics (directly, at least) when browsing in a newsagency or in other places where magazines are found, such as doctors’ waiting rooms, fish-and-chip shops, and so on.

Some magazines and now essentially all daily newspapers do contain mathematical elements in the form of puzzles, however. One example is the weekly *BrainTrainers* column in the *Weekend Australian* newspaper, frequently containing small mathematical puzzles or puzzles which require mathematical thinking. In the wider community, the remarkable rise to fame of *Sudoku* is the most visible recent example of popular mathematics: in a few short years, it has become a conspicuous part of most daily newspapers in Australia, as well as those of most other countries, attesting to the drawing power of elementary mathematical logic. This puzzle in particular offers opportunities for the mathematics classroom, based on the deductive reasoning required to complete the grids involved, and some have offered ways of doing this with lower secondary students.

Incidental mathematics

While mathematics or its effects are indeed pervasive, they are frequently not noticed, as Keith Devlin has observed, and take some effort to extract. The modern world contains extensive evidence of everyday mathematics, which alert observers will notice in supermarkets, buildings, timetables, architecture, sport, households and many leisure
activities such as games. Unfortunately, students are not naturally “alert” in this sense, and energy must be spent helping them to see the mathematics in activities and situations that are not presented in an overtly mathematical way.

Some public institutions, such as museums, offer glimpses into the world of mathematics, although these are rarely accessible easily to most school classes. Throughout Australia, there are a small number of “science” museums, which typically contain some mathematical elements, but these are accessible mostly to city children and their families. More widely, evidence of mathematics is sometimes seen by tourists, perhaps the most spectacular examples of which are the Alhambra in Southern Spain, the pyramids of Giza in Egypt and the archaeological ruins of the ancient European worlds around the Mediterranean Sea. Examples of incidental mathematics can be seen in many mosques, in which wonderful patterned tiles are to be seen, such as those in Figure 4, from the Islamic Arts Museum in Kuala Lumpur, Malaysia.

![Figure 4. Ceramic tiles of Islamic origin.](image)

Of course, incidental mathematics of these kinds is directly accessible to only a privileged few Australian students, so that realistic alternatives to international travel are needed. The Internet offers some opportunities to explore incidental mathematics of this kind, once students know what search terms to use. For example, using search terms such as “Islamic,” “art” and “mathematics” together leads to many websites allow students to be virtual tourists or even to engage in producing mathematical materials themselves.

![Figure 5. Islamic star pattern, generated with Topiats (Kaplan, 2003).](image)
In the latter category, the Snapdrags software (Kaplan 2003) allows students to generate some kinds of Islamic patterns for themselves, such as that shown in Figure 5. As well as helping students to see that others have found mathematical patterns to be pleasing to the eye, such activity might encourage students to appreciate that mathematical activity has a creative side, and is not concerned entirely with the “correct” use of symbols and numbers.

**Potential benefits for mathematics education**

The biggest potential benefit of some attention to popular mathematics would seem to be the possibility that students might be helped to see mathematics as an intrinsic part of their culture, rather than something that is confined to the school mathematics classroom. In an age in which students are attracted in many directions, many of which are away from mathematics, some attention to increasing the popularity of mathematics might be worth the effort involved. Some of that attention might well be directed not only at students, but also to their parents and to the wider community.

It is not clear whether mathematics is not visible in the popular world because it is not popular, or whether mathematics is not popular because it is not visible in the popular world; indeed, this seems to be a version of the chicken and the egg argument. However it seems plausible that some attention to popularising mathematics, both within school and outside it, may be worth the trouble involved, especially if it helps to generate more awareness of the nature, significance and intrinsic interest of mathematics. This paper has suggested some possible ways of starting out to do this on the small scale of a school, recognising that larger scale efforts, such as those summarised by Budd and Lim (2004) will also be an important part of the exercise of making mathematics more popular and thus mathematics education better.

**References**


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MATHEMATICS: IT'S MINE
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The twenty-second biennial conference of The Australian Association of Mathematics Teachers is appropriately titled *Mathematics: It’s Mine*.

This theme proclaims the importance of both students and teachers working confidently with mathematics across the range of settings represented in various ways at the conference. These settings include early childhood, primary and secondary schooling, as well as teacher education, professional development and the wider community. In suggesting that such a proclamation about mathematics ought be made, the theme aptly reminds us of the significance of mathematics in our society and our culture, and reflects our collective aspiration that Australians will come to share this perspective, with our help. The theme also suggests that it is important to encourage people to take ownership of their own mathematical learning. Indeed, many of the conference presentations are directed at student engagement, both inside and outside the classroom, that will help students be able to say: *Mathematics: It’s mine!*.

Mining is an important part of the economy of Western Australia, the site for this event. The 2009 conference has brought together teachers, mathematicians, teacher educators, researchers and other professionals from all states and territories of Australia and from other countries to demonstrate a variety of facets and perspectives of teaching and learning mathematics. In the best spirit of the new world of “data mining,” the theme also suggests that the conference has been able to mine some of the extensive expertise in mathematics education of which the Australian Association of Mathematics Teachers is justly proud.

This publication, comprising papers presented at the conference as keynotes, major presentations, and seminar or workshop offerings, shows the range, nature and quality of the work which many of our colleagues have been prepared to share with us all. We are grateful to them for this.

**Editors:** Chris Hurst, Marian Kemp, Barry Kissane, Len Sparrow and Toby Spencer
REVIEW PROCESS

Presentations at AAMT 2009 were selected in a variety of ways. Keynotes and major presentations were invited to be part of the conference and to have papers published in these proceedings. A call was made for other presentations in the form of either a seminar or a workshop. Seminars and workshops were selected as suitable for the conference based on presenters’ submission of a formal abstract and further explanation of the proposed presentation.

Authors of seminar and workshop proposals that were approved for presentation at the conference were also invited to submit a written paper to be included in these proceedings, with the possibility of the paper being subjected to peer review. Papers for which peer review was requested were scrutinised blind by at least two reviewers. Reviewers were chosen by the editors to reflect a range of professional settings. Papers that passed this review process have been identified in these proceedings as “accepted by peer review.” Other papers that were submitted to the proceedings without peer review were accepted as suitable for publication by the editors.

The panel of people to whom papers were sent for peer review was extensive and the editors wish to thank them all:

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