Theme: Mathematics

Real-world connections in secondary mathematics teaching

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Introduction

While the mathematics education community has placed a great deal of emphasis on the need to connect mathematics in the classroom to the real world, there is evidence that in practice this happens infrequently. Research shows that teachers often:

- regard issues around behaviour and learners' poor reading skills as obstacles to discovery learning
- have difficulties in recognising the mathematics that arises in the workplace, and
- only introduce real world connections in a cursory way rather than as an integral part of the curriculum materials and activities.

However, while there is a consensus in the findings of researchers investigating this topic, the actual volume of research is rather sparse.

The author of this study conducted a survey of 62 secondary mathematics teachers to find out about whether and how they used real-world connections in mathematics lessons. The author then explored the findings from these interviews by observing teachers making real-world connections in the classroom and comparing the outcomes from the survey with the observations.

Contents

What kind of real-world problems did mathematics teachers employ?

From the survey results, the study identified three main types of real-world problem commonly used by teachers. There existed several other types in the answers given, but these did not occur frequently enough to indicate that they were standard practice.

These three types can be split into:

- **student-solved "word problem"** - a mathematics problem with a realistic context, posed either in writing or orally. These were either taken from a textbook or created by the teacher, for example: "You are a pants maker. In Year 2 of your business you made 6 million dollars. In Year 6, you made 8 million. How much will you make in Year 13?";
- **planned example or reference in teacher presentation** - the teacher makes a connection while presenting mathematical information, either by demonstrating or just describing an application, but gives no indication that students need to solve a problem. In one example a teacher used the diagram of an automobile headlight to illustrate the use of a parabolic curve; and
- **project or lab** - an extended activity that goes beyond solving an algorithmic problem and takes up the majority of a given lesson, or more than one lesson.

What did the study reveal about the use of real-world problems?

The researcher drew several conclusions from the study findings:

- Teachers valued contexts which they believed would interest their students; these rarely seem to connect to careers. Whether this is due to lack of knowledge about use of mathematics in other careers or a belief that students are uninterested in career connections is unknown
- Teachers mainly got their ideas for real-world connections from their heads, and many feel hindered by a lack of resources, ideas or training for making connections. This suggests that teachers are willing to make more connections
- Teachers tended to view their task primarily as imparting mathematical skills. This meant they incorporated real world connections into lessons as a way of motivating learners, or helping them master concepts, rather than to develop learners ability to apply mathematics to real life problems.

- While some teachers value tasks that require critical thinking or promote literacy development, a larger number fear that complex, ill-structured or language-intensive tasks will overwhelm students.

The overall conclusion of the study is that, in general, teachers worry more about over-challenging their students than about under-challenging them. The author suggests that further investigation of how pervasive this kind of view is amongst teachers is needed to find out how to overcome this attitude.

How was the study designed?

The study consisted of two connected elements: a survey of mathematics teachers followed by several sessions observing teachers in lessons which were likely to involve real-world connections. For the first part, the author asked all mathematics teachers in two middle schools and two high schools within two California school districts to take part in a written survey. In three of the schools the surveys were distributed in department meetings, while in the fourth they were distributed by in-school mail.

Teachers were only observed if they had indicated they were happy for this to happen in the written surveys. Of the 19 who were willing to be observed, the author selected five for classroom observations, based on whether their surveys indicated significant use of real-world connections, where they taught and whether they were middle or high school teachers so that a reasonable mix could be achieved. The author observed a lesson by each teacher having arranged with the teacher beforehand that the lesson would contain real-world connections.

What are the implications?

In completing this digest the author began to ask the following questions about implications for practitioners:

Most of the real-world connections teachers used were planned in advance or taken or adapted from a text-book, but some teachers were able to work with comments by students that they overheard into the lesson. Could you find a way to use students' own experiences into your lessons more often? If it is hard to do this on the spur of the moment, you might consider planning an activity which encourages your students to relate the topics you cover to their own experiences, and use their responses for planning the next session.

In addition the author began to ask the following questions about implications for school leaders:

Many teachers reported feeling constrained by a lack of training for making connections, as well as a lack of resources and ideas. How could you work to provide this sort of training and/or support within your school? As most teachers reported that they got their ideas from their heads, how could you help to provide them with a starting point to including more and better real-world connections in their lessons? You may have examples from your own

practice experience, or you may be able to identify members of staff who do this well and could take a lead helping other teachers develop their practice.

The study explored several teacher beliefs about learning; in particular teachers felt that students should master mathematical concepts before connecting them to the real world. The evidence indicates that everyday experiences provide a strong foundation for learning mathematical ideas. Are there ways you can work to bring this culture into your school? One useful starting point might be, for example, the Realistic Mathematics Education theory which many textbooks in the Netherlands are based on.

Where can I find out more?

The National Centre for Excellence in the Teaching of Mathematics (NCETM) website hosts a range of resources and ideas for developing context and topic based teaching and learning: www.ncetm.org.uk

Other digests

Getting engaged: possibilities and problems for home-school knowledge exchange
Feiler, A., Greenbough, P., Winter, J., Salway, L., & Scanlan, M. Graduate (2006) Educational Review Vol. 58 (4), pp.451-469. Available in digest form at:
www.standards.dcsf.gov.uk/research/themes/parents/homeschool/

Building mathematics skills in a vocational context
Stone, J., Alfeld, C., Pearson, D., Lewis, M., & Jenson, S. National (2005) Research Center for Career and Technology Education
[ORIGINAL TITLE Building academic skills in context: testing the value of enhanced maths learning in CTE.]

Other research

Further examples of linking learning to real world contexts are available in a QCDA review of curriculum design research: http://www.curee-paccts.com/files/publication/1248873146/Year%201%20Literature%20Review.pdf

GTC Research for Teachers summary: Which aspects of mathematics teaching promote effective student learning and which tend to prevent it? Available at:
www.gtce.org.uk/teachers/rft/math0905/

National Teacher Research Panel summary: Maths is good for you: Teaching mathematics in a historical context. Available at:
http://www.standards.dcsf.gov.uk/ntrp/lib/pdf/lawrence.pdf