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mathematical

Relevance and Context in

Recently, I participated in a professional development session where the theme was 'communication.' The first exercise of the day was to consider the person sitting in the middle of the group, and to describe what we knew about her based on our observations. We were sitting in a roughly elliptical shape and the person under consideration was placed approximately where the major and minor axes of the ellipse intersected. I began to estimate the distance of the person from where I was sitting, her placement relative to others in the group, and the relationships among the positions of various people around the ellipse. When we shared our descriptions it was evident that none of the people present, many of whom were talented teachers of students in the middle years, had considered using mathematics to describe what they knew. When we were asked what would change about our descriptions if the object of our scrutiny was a vase of flowers, only the mathematics remained unchanged. The social context had changed, from a person to a vase of flowers, but the mathematics remained identical. The point is that, in a circumstance where the instruction was simply to 'describe what we knew,' mathematics provided a useful, and relevant, means of demonstrating the commonalities across situations.

Teachers are often exhorted to make learning 'relevant' or to teach mathematics in 'context.' There is little indication, however, about what this means in practice. For those teachers who work with young adolescents, relevance can seem a somewhat limiting concept: sport, cars, food, music, and the opposite sex, although not necessarily in that order. Context can become equally marginal: 'Maths in the Supermarket,' developing a budget, or designing some artefact such as a patchwork quilt or a house. Attempts to combine these notions have led to 'rich tasks' such as International Trade or Pi in the Sky (Education Queensland, 2001a). All of these ideas are worthwhile in themselves but can, unless planned with great care by knowledgeable and talented mathematics teachers, trivialise the mathematics to the point that deep understanding of the mathematical concepts is lost.

I would like to suggest that relevance comes from the importance of the mathematical understanding and its use in diverse situations. Mathematics is a powerful way in which we can describe our world, and, unlike many other meaning-making systems, provides a structure that can be transferred across contexts. So what about context? Are we limited to the social ideas that I suggested above? I propose that contexts are of two kinds: the mathematical context and the social context, and that both have their part to play in mathematics teaching and learning.

Let's follow this train of thought into the mathematics classroom. Students have to come to terms with both procedural and conceptual aspects of mathematics in order to use mathematics strategically. Procedures include, for example, processes of computation, solving equations, and determining distances and angles through direct measurement or indirectly through techniques that make use of underlying mathematical relationships, such as trigonometric ratios. These procedures provide useful tools for solving problems in social contexts—indeed many of the common processes that we teach in mathematics classrooms arose out of a social need.

There is also, however, a mathematical context within which these procedures operate. Such contexts are related to the underlying structures of the mathematical ideas: the conceptual aspects of mathematics. Having a conceptual understanding of a straight line, for example, opens many doors, in both social and mathematical contexts. We can describe a line geometrically (one dimension), as an equation ($y = mx + c$), trigonometrically, as a locus, as a distance, and perhaps more. Each mathematical context leads to a complex web of associated ideas. I call such connections 'mathematical gossip.'

The notion of 'gossip' in mathematics was introduced by Devlin (2000). He suggests that

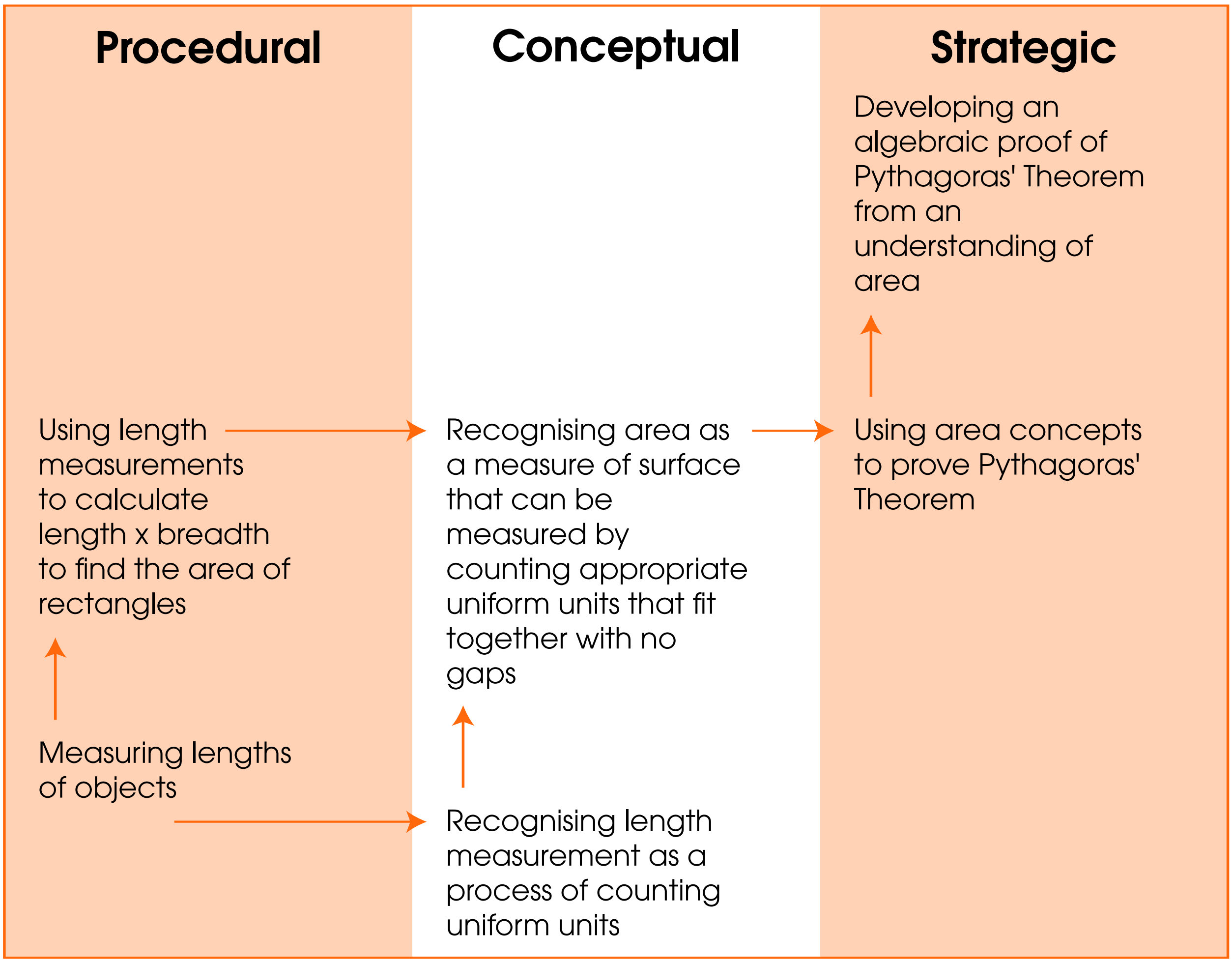

Figure 1. Mathematical gossip in mathematical contexts.

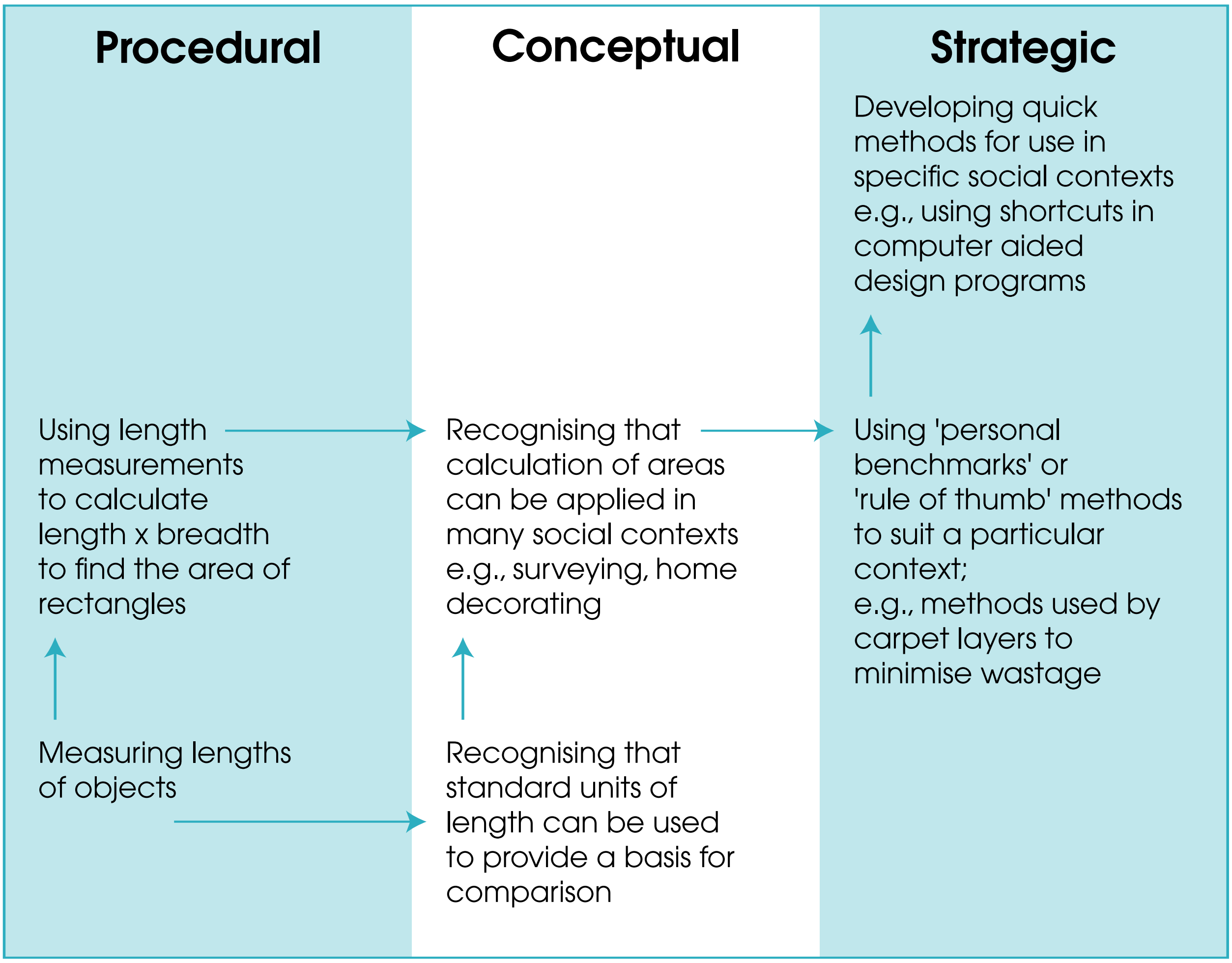

Figure 2. Mathematical gossip in social contexts.

for a mathematician a concept such as pi is like a character in a soap opera. It exists within an abstract web of connections within mathematics, popping up in areas where it may be least expected. In terms of learning, being able to link immediately to a number of different mathematical perspectives through the use of a simple symbol, π, provides access to deep and powerful knowledge. Through gossip, a single idea is extended.

Using mathematical gossip in the classroom allows teachers to expand their students' horizons, and provide pathways to improvement of understanding. The expansion of a simple idea into another mathematical context can enrich a student's learning. In particular it may help to bridge the gap between purely procedural approaches and a conceptual understanding of the underlying mathematics. Having both procedural and conceptual understanding provides a springboard for strategic use of mathematics in both mathematical and social contexts. The connections built through making use of mathematical gossip allow a 'big picture' view of mathematics to be taken, and may improve the ability to use mathematics strategically.

One example of the kinds of connections that can be made is shown in Figure 1. The mathematical gossip is shown by the arrows. Gossip can work both vertically, to develop further procedural skills, for example, and horizontally, to extend understanding. Good teachers intuitively expand their students' horizons in both directions.

Similar thinking can be applied to social contexts. Figure 2 shows how the same procedural knowledge can be expanded to develop further, deeper understanding of the mathematics as applied to different practical situations. Again mathematical gossip is implicated: connections among measurement, number, and spatial ideas are all part of developing strategic use of mathematics in expanding social contexts. It is important to recognise that, as with the mathematical contexts, the thinking is expanding both vertically and horizontally, and may reach sophisticated levels of higher order thinking.

There are, nevertheless, some significant differences between the development of thinking in mathematical contexts compared with that in social contexts. In mathematical contexts, the thinking becomes increasingly abstract and general solutions are sought that can be applied across many social and mathematical situations. In contrast, in social contexts the thinking becomes increasingly situated, grounded in the specialist area that defines the problem. The rule of thumb solutions used by a carpet layer to estimate the amount of carpet needed will be different from those used by a painter and decorator to estimate the area of wall that can be covered by a can of paint. Each will draw on the same underpinning mathematical ideas, but apply these in relation to other specialist knowledge derived from the particular social context.

In the school situation, it seems to me that both mathematical and social contexts are important, and that teachers should intentionally 'engineer' mathematical gossip in both situations. Research from England (Askew, Brown, Rhodes, Wiliam, and Johnson, 1997) indicates that successful teachers of numeracy are those who deliberately set out to make connections in mathematics. New conceptions of curriculum, such as Tasmania's Essential Learnings (Department of Education, 2002) or Queensland's New Basics (Education Queensland, 2001b) tend to focus on social contexts. More traditional curriculum perspectives, such as Victoria's Curriculum Standards Framework (Victorian Curriculum and Assessment Authority, 2001) or the New South Wales Mathematics Syllabus 7–10 (Board of Studies, 2002) address the mathematical contexts. I suggest that connections need to involve mathematical gossip in both social and mathematical contexts in order to establish both the power and relevance of mathematics as a way of making sense of our increasingly complex world.

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