'Community' Mathematics

Elsie Kinavai and Fred Biddulph

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The mathematics curricula of both Papua New Guinea and New Zealand stress the importance of meaningful contexts for learning in mathematics. For example, in Papua New Guinea, the elementary curriculum (for the first three years of schooling) is based on the local community and culture, while at the primary level (the next six years) "...teachers are encouraged to use good local resources and deal with important local issues." (Kinavai, 1997, 3). *Mathematics in the New Zealand Curriculum* (Ministry of Education, 1992) emphasises that, "...mathematics is best taught by helping students to solve problems drawn from their own experience." (p.11) and begins each statement of objectives with the words, "Within a range of meaningful contexts..."

In some respects these curricula mirror the realistic mathematics approach developed by the Netherlands (Carr and Treffers, 1996). "Realistic mathematics emphasises the large role that *context* plays in the world of mathematics." (p.113) The importance of meaningful contexts in mathematics has also been recognised by the Mathematics Education Research Group of Australasia who devoted their 1993 conference to this theme (Atweh, Kanes, Carss and Booker, 1993).

At the same time, however, it must be acknowledged that some contexts can be problematic in helping children develop mathematical understanding. For example, Taylor and Biddulph (1994) found that children construed some probability activities as games in which the major goal was to win, thus diverting their attention completely from the mathematics involved. In another activity involving a mini-lottery context, two children were unable to participate for religious reasons.

Nevertheless, there are many community contexts that teachers have found are rich in mathematics and provide very meaningful mathematical learning for children. This paper explores the dimensions of what we call 'community' mathematics, provides examples from Papua New Guinea and New Zealand to illustrate the possibilities, and discusses several issues related to a community mathematics approach. In doing so, we wish to make it clear that this is simply one approach to mathematics education. National or international issues or events, children's literature, or even pure number could also act as springboards for meaningful mathematical investigations.

Dimensions of 'Community' Mathematics

It is possible to consider 'community' mathematics in several different ways. Five that come to mind are (i) investigating the mathematics in community ways of doing things, (ii) investigating community issues, (iii) investigating community artefacts and other phenomena, (iv) making things that are part of community life, and (v) using knowledgeable community people as resource people in mathematics.

Community ways of doing things

Many activities that are part of community life have mathematics potential. For instance, there is much number and measurement involved in organising a feast or wedding. If children investigated these, then statistics would also play an important part.

Community issues

Frequently there are issues that arise in a community that have to be addressed. These can provide very real mathematics contexts. For

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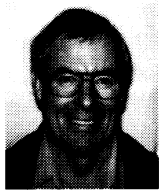

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example, a long spell of dry weather can put serious pressure on water supplies. This could trigger an investigation of how much water we use in our daily lives, which in turn may lead to suggestions of how water may be conserved or extra supplies obtained. The likes and dislikes of people in the community can also be investigated mathematically.

Community artefacts and other phenomena

Many things in the community which are made or kept by people can be investigated mathematically. These range from numbers on letter boxes and the number of various domestic animals, to the patterns on cultural designs, through to geometrical properties of houses. Natural phenomena in the community, such as the bird, insect or fish population in particular locations, the flow of a river, weather patterns, or the rise and fall of tides can be investigated as well.

Designing and constructing community artefacts or systems

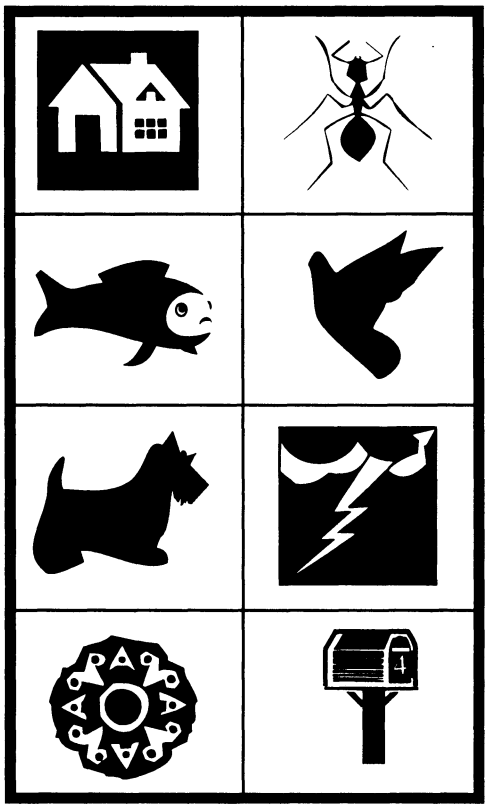
If children have the opportunity to design, make and test artefacts or systems similar to those found in the community then considerable mathematics learning can occur. Such artefacts and services could range from making hats, kites or baskets to organising a trip, mini sports event or festival involving a number of teams or groups.

Community resource people

Various people in the community use mathematics in their daily work. They could be invited to talk with children at school about how mathematics is necessary to their livelihoods. Some of these talks could lead to mathematical investigations by the children - as we illustrate in the next section. (With professional guidance, parents and others in the community can also directly help children with their learning in mathematics, but we see this as a separate issue from 'community' mathematics and do not address it in this paper.)

Further Examples of 'Community' Mathematics

In this section we further illustrate the points we have made above with possibilities and actual examples from Papua New Guinea and New Zealand.



Community ways of doing things

In villages in Papua New Guinea extensive use is made of the coconut tree. This ranges from the milk and meat of the coconut itself, to trade in coconuts, to weaving the leaf fibres. All these activities are potential sources of mathematical investigations, such as measuring the quantities of milk and meat in the coconut fruit, calculating quantities involved in trading coconuts, and the patterns, shapes and measurement inherent in weaving coconut fibres. In New Zealand, the weaving of flax offers similar possibilities.

With a little thought, teachers could probably also pursue with their children (where appropriate) the mathematics of gardening, fishing, or the market.

Community issues

Talking about funerals, one issue that communities have to face is how to deal with people who die. As space becomes scarce in some communities, cremation is used more often. Many communities, however, still bury their dead. A teacher and her 9 to 11-year-old children in a small community school in Taranaki, New Zealand, worked on a fascinating unit that they called Cemetery Mathematics. They did such things as investigate the proportion of people who died at certain ages, whether more people died in winter than at other times of the year, whether there was any connection between the age of death and gender of the person who died, and whether ex-soldiers generally died at a younger age than others. As you can imagine, the unit was full of statistical data.

Other community issues that can be the focus of mathematical investigation include the supply and amount of water/fuel used by various households, how to keep ourselves healthy (nutrition, hygiene, rubbish disposal and health services), and traffic, transport and means of communication.

Community artefacts and other phenomena

A teacher of 11 and 12-year-olds in a Taranaki school made excellent use of a very popular feature of the natural environment - waves at the beach. He based an entire unit on this. Investigations ranged from calculating the amount of time the children spent in the surf during the summer, to determining whether there was any relationship between the height of the waves and tides or wind, figuring out how much water dumps on you if you get caught in

waves of different heights, to calculating the cost of setting yourself up for surfing in a serious way.

In a Tauranga school, a teacher of six and seven-year-old children quite by chance used toothpaste as the focus of some mathematics investigations. She took an interesting approach and invited the children to say what they would like to investigate about toothpaste. The children raised a number of questions (e.g. How big a line can you make with toothpaste if you squeeze it out? How many toothpaste tops can you put on a piece of paper? How do they make the toothpaste boxes?) which led to meaningful mathematical investigations.

Designing and constructing community artefacts or systems

As part of the toothpaste investigations mentioned above, the children tried making their own cardboard toothpaste boxes and learnt some worthwhile geometry in the process. Another example involving considerable geometry was the cardboard construction of a model of a dome-shaped glasshouse, a task undertaken by 10-year-old children in a school in Morrinsville in the Waikato. Children in Papua New Guinea can learn much about geometry (e.g. spatial visualisation, shape, patterns) by constructing from local materials models of village houses. Constructions such as these can also involve much estimation and measurement, including measurement of angles.

Extensive problem solving and various mathematical concepts can also be involved in the design of systems such as a sports tournament comprising numerous teams, a physical education display or cultural show in which movements need to be choreographed, and the layout for a new garden.

Community resource people

A good example of the use of people in the community to help children in mathematics was the time a Waikato teacher invited several workers into her class to talk to the children about the mathematics in their occupations. Among the people was a post office worker who brought along a pair of scales and lists of charges for sending letters and parcels to various parts of the world. The children ended up making parcels themselves of varying size and weight, deciding on destinations to send them and, with the postal worker's guidance, calculating the cost and making appropriate stamps to stick on their parcels. A considerable amount of number and measurement was involved in this study which, to the children, had a real point to it because it is what grown-ups do.

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Concluding considerations

The community mathematics approach suggested in this paper obviously begins with activities rich in mathematical potential, rather than narrow objectives, and hence provides a greater chance of integrating the various aspects or strands of mathematics. It is important to realise that the activities are not ends in themselves but a means to help develop the important processes and concepts of mathematics. This development of processes and concepts is known in the Netherlands as the 'mathematization' phase (Carr and Treffers, 1996). Of course, in a truly integrated unit, the children may at the same time also be helped to develop for instance health, science or technology ideas and strategies. In this sense, the approach allows for a more holistic way of learning than one labelled as just mathematics.

A community mathematics approach is largely grounded in constructivist and humanistic learning theory. In other words it accepts that learning mathematics involves children reconstructing for themselves, in interaction with the teacher and others, the mathematical ideas and processes that humans have created over the years. And it recognises that children do this best when they have a feeling of control over their learning, when the contexts or experiences are ones that have significance for them, and when the learning makes sense to them.

The approach assumes that teachers are professionals who are capable of being classroom curriculum developers. We recognise, however, that some teachers may need some help or support to adopt this role. In the meantime, we hope that the teacher-created examples that we have included may trigger some ideas for further units based on the community.

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