Integrating mathematics and technology

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Introduction

According to Silis (1991), integrating two or more curriculum areas not only allows for skills and strategy development that will enable students to transfer knowledge and experience from one area to another, but also provides quality experiences that stimulate and enrich the studied involved. Technology study is excellent for this purpose as it links to many other curriculum areas.

Begg (1994) points out that mathematics and technology have much in common, and that this commonality needs to be considered when viewing the school curriculum. Technological activities can include such mathematical processes as surveying, graphing and decoding trends; collating and interpreting statistical information; estimating, measuring, and calculating quantities, time and costs. The current emphasis on communication, problem-solving and reasoning in mathematics is similarly reflected in technology. Begg also argues that the technology curriculum provides many meaningful contexts for learning mathematics and believes that both subjects are likely to prosper if developed together.

While it is suggested that mathematics and technology can be integrated for learning purposes (Begg, 1994; Olsen, 1995), a question needs to be asked about how this can be done, how the children respond to a unit constructed in this way, and whether their knowledge is developed in both curriculum areas at the same time. This paper reports on a small study which investigated these questions.

The integrated unit

We constructed a mathematics and technology unit which focussed on design and construction. It included the mathematical strands of measurement, geometry and problem-solving, alongside the technology strands of implementation and production of technological solutions, and communication and presentation of strategies and outcomes. These were taken from Level 3 of the respective curricula.

The theme for the integrated unit was the design and production of 'Kitso Designer T-Shirts'. The children were told that a clothing company Kitso Designer T-Shirts was looking for new T-shirt fashions for the 1996-97 summer season, and had invited the children to participate. They required

- a design of the proposed T-shirt,
- a life-size paper model of the T-shirt made according to the design, and

- original patterns on it.

The unit was developed within a social constructivist framework which emphasises the extension or restructuring of the present ideas held by the children by encouraging them to link their new experiences and thinking, gained partly through interaction with others, to things they already know about. We also made use of humanistic learning theory in our teaching approach. This emphasises that significant learning occurs through doing and experiencing activities which the learners perceive to be relevant.

The Children

We planned the unit for a group of Standard 2-4 (8 to 10-year-old) children, but in the event worked with eight 7 to 8-year-olds. (Fortunately our unit was still appropriate for the slightly younger children.) We worked with the group weekly for three quarters of an hour over a three-week period.

Our role and data collection

We were participant observers during this study. As well as providing the children with the challenge (e.g. to transfer their upper body measurements to a diagram) and guidance (e.g. how to use a tape measure, and how to create tessellating patterns) they needed to engage in the various learning activities involved, we tracked three to four children each through each session by observing what they were doing and discussing with them what they were thinking and the processes they were using. At the conclusion of each session we had the whole group reflect on the session, including positive and negative aspects. We kept field notes of these observations, discussions and reflections, including children's comments and any interesting mathematical and technological developments that occurred among the children.

The children were given considerable autonomy in designing their T-shirts. They chose their own methods of solving the problems they encountered and recording their data.

What happened

We report on what happened in terms of (i) what the children revealed about their prior understanding, (ii) the problems they encountered and solved, and (iii) what they seemed to gain mathematically and technologically from the experiences.

Children's prior understandings

During the first session it quickly became apparent that the children's engagement with the designer T-shirt context provided us with many insights into their present ideas and strategies. For example, they had very limited understanding of sewing procedures, sewing patterns and construction. Mathematically, they had some basic knowledge of metric units but had never used a sewing tape measure before, and had no prior knowledge of tessellations although they did seem to understand the idea of patterns that repeat.

Problems encountered and solved

The children faced a number of difficulties which they eventually overcame - sometimes with our help (such as how to use a sewing tape measure, mentioned above).

Recording upper body measurements: The problem here was how to record their measurements so that eventually they could be transferred to life-sized paper. Some simply listed their measurements initially while others tried intuitively to make scale drawings. Eventually we suggested to one child that drawing a picture or diagram of the T-shirt, with the measurements written on the appropriate parts, might be worth trying. We noticed that it wasn't long before all the children adopted this approach.

Is a hem needed? When the children began working with the life-size paper one child soon raised the issue of whether extra paper was needed around the edge of the patterns so that the T-shirt would still fit when sewn up. We discussed this as a group and the group decided that hems were indeed needed.

How do you make tessellating patterns? When the children were puzzled about this, we showed them the cardboard stencil method as one possible approach to creating a tessellation. Some children adopted this method while some chose to use their own simple, but quite effective, tessellations using for instance squares or triangles.

What the children seemed to gain from the experiences

On reflection, the children recognised that aspects of measurement, geometry and number were involved in the unit. They all improved their measuring skills considerably, increased their estimating ability by using newly acquired referents such as the length of their arm and a 30cm ruler length, recognised the need to be fairly accurate in measuring, learned how to record measurements carefully, and gained some understanding of tessellations.

From a technological perspective, the children learned that individual ideas and methods can be incorporated into a design as well as ideas gained from others (such as teachers), that a design must take into account real issues, that construction requires care, and that creating a product can result in considerable satisfaction. All children worked enthusiastically throughout the three sessions and, at the end of the last session, two of the children who had completed their paper T-shirts wanted to keep them on to wear home in the bus!

Conclusion

Although this was only a small study with just eight children, our experience with it was such that we feel positive enough about the potential of integrating mathematics and technology to want to incorporate this approach into our regular class programmes as one that is useful.

References

Begg, A (1994) Mathematics and technology: Integrating the curriculums. Paper presented at the Mathematics Education Day of New Zealand Mathematics Colloquium, University of Waikato.

Olsen, J. (1995) MSTE *News,* 3, 2, p.1 Mathematics, Science and Technology Education Group. Kingston, Ontario: Queen's University, Faculty of Education.

Silis, G. (1991) A practical approach to the process of integrating technology and mathematics using a problem solving, inquiry learning mode. In J. O'Rielly and S. Wettenhall (esd) *Mathematics: Ideas.* Parkville, Victoria: Mathematical Association of Victoria.