Creative Electrics for Juniors: What a Buzz

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The New Zealand Primary Curriculum

The 1990s have been a time of on-going curriculum reform within New Zealand. In 1991 a new national curriculum was introduced and the publication of *The New Zealand Curriculum Framework* (Ministry of Education, 1993) gave expression to this educational philosophy by providing a framework for the education of all students from years 1-13 (ages five to seventeen).

In this document the principles, essential learning areas, essential skills, attitudes and values are described. The principles are based on the premise that 'all young people in New Zealand have the right to gain, through the state schooling system, a broad, balanced education' (Ministry of Education, 1993,p.5). The seven essential learning areas are: Health and Physical Education, The Arts, Social Sciences, Technology, Science, Mathematics and Language and Languages. These learning areas are inter-related and the essential skills of communication, numeracy, information, problem-solving, self-management and competitive skills, social and cooperative skills, physical skills, and work and study skills are developed across all curriculum areas. Attitudes and values along with knowledge and skills are considered to be an integral part of the New Zealand curriculum.

National curriculum statements continue to be developed for each learning area. These describe the expectations for development of knowledge, understanding, skills and attitudes through achievement objectives which are expressed at eight progressive levels and provide a tools for measuring students' progress. Assessment for national monitoring focuses on the national system rather than the individual school and involves a light sample of students at ages eight (year 4) and twelve (year 8).

Primary education in New Zealand covers years 1-8 (ages five to twelve) with a tradition of years 7 and 8 being taught in Intermediate Schools.

Primary schools may achieve a balanced curriculum by allocating specific time blocks to each learning area by using an integrated approach or by using a topic or thematic approach. The non-prescriptive nature of each curriculum document allows schools to design programmes to reflect the unique learning needs of their students with the principles of equity, individuality and the unique position of Maori in New Zealand society being recognised and valued.

References

Ministry of Education (1993) *The New Zealand Curriculum Framework*. Wellington: Learning Media

Abstract

Technology education in the New Zealand provides a vehicle for students to develop technological literacy. The goal of technological literacy involves students developing technological knowledge, technological capability and an understanding and awareness of the relationship between technology and society (Ministry of Education, 1995, p.8).

This paper analyses the concept of technological literacy and its implementation in a junior primary classroom programme and identifies the classroom management style and teaching strategies that this teacher employed to realise this goal.

Electrical circuitry provides the context where year 2 and 3 (6 and 7 year olds) were required to develop circuitry board games for an interactive museum display.

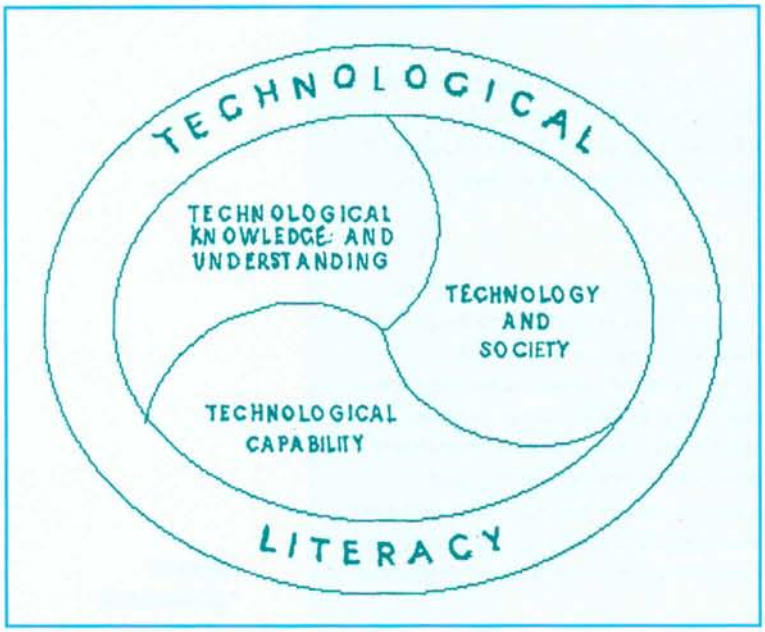

Figure 1: The components of technological literacy (Ministry of Education, 1995, p.8).

Introduction

The classroom was buzzing with electronic noise and lively discussion from 6 and 7 year olds (years 2 and 3) as they explored the possibilities of creating a board game using electrical circuits. The culmination of all this activity and learning was that eight groups of children each produced an electrical circuit board game which they presented to the interactive natural history display at the 'Weird and Wonderful' Children's Discovery Centre at the Auckland Museum in New Zealand. The games survived the rigorous attention of visiting children during the pre-Christmas period and were returned to the school at the end of the year still functioning. The congratulatory letter from the museum that accompanied the return of the games added to this success story.

The development of circuitry board games provided the context for this junior class to develop technological literacy within the technological area labelled Electronics and Control (Ministry of Education, 1995, p. 12). The account is of Megan Chamber's classroom programme and this paper will:

- analyse the programme components that contributed to the goal of technological literacy
- identify the factors that contributed to the successful implementation of this programme.

Programme components contributing to technological literacy

Burns (1997) comments that nowadays literacy involves more than the skill of reading and writing. Likewise, technological literacy is not just computer literacy. A broader view of technology and its use is outlined by Pacey (1983) where he describes the operational view of technological practice as the cultural, technical and organisational aspects that involve both experts and users. If this view is accepted then a technologically literate person will be conversant with all of these spheres and be able to communicate this understanding from a critical and informed perspective (Burns, 1997; Conway and Riggs, 1994).

Technology in the New Zealand Curriculum (Ministry of Education, 1995) is the curriculum document that has been developed for the New Zealand situation which sets the goal of technological literacy using experiences in the following technological areas: biotechnology, electronics and control technology, food technology, information and communication technology, materials technology, production and process technology and structures and mechanisms. Although the goal of technological literacy is expressed as a unified concept, its realisation comprises three parts which are expressed as three inter-related learning strands. The strands are named technological knowledge and understanding; technological capability; and understanding and awareness of the relationship between technology and society (Ministry of Education, 1995, p.8). The relationship and interconnectedness of these three components is illustrated in Figure 1.

The flow chart in Figure 2 describes the lesson sequence and identifies the strands contributing to the development of technological literacy that were given attention in 'Creative Electrics for Juniors'. Megan's programme took place in a typically crowded primary classroom with its furniture arranged in groups to accommodate 32

Making electronic games

(Years 2 and 3 programme comprising 3 weeks science followed by 3 weeks technology)

Lesson sequence	Technological strands
The science of electrical circuits (circuitry, switches, conductivity, predicting and testing)	Science understanding
Investigation of board games (investigating how simple circuitry can be used in board games)	Technological capability
Trip to Children's Discovery Centre (planning and research-game types, focus and popularity)	Technological capability Technology and society
Collation and analysis of research data (clarifying needs and opportunities)	Technological capability
Group representatives visit Hasbro Toys (investigation of game types, packaging and presentation)	Accessing technological knowledge
Planning and designing (selection of topic, circuit type, drawing plan, listing equipment, deciding lay out)	Technological capability
Library research (rep's with buddies in year 6) **Buying equipment** (rep's with parents at Dick Smith's)	Accessing technological knowledge
Construction of games (testing, evaluating, trouble-shooting)	Technological capability
Presentation to parents at school assembly (reflection on process)	Technological capability
Trialing of games at Museum (questionnaire development, accompanying letters)	Technological capability Technology and society

Figure 2: Creative Electrics for Juniors. A lesson sequence developed for years 2 and 3 (6 and 7 years) where the components of technological literacy are identified.

children, its pet rabbit, its walls covered with children's work, its special areas of interest and the usual resource constraints including limited power points and no sink.

Megan taught a science programme for three weeks when the class investigated conductivity and circuitry. When the focus turned to technology education the children were given opportunities to gather knowledge from the community where technology was being practised, for example the Children's Discovery Centre where games were used, a toy manufacturer and an electrical retailer. The class canvassed the community for opinions and ideas about games and spent time researching, discussing and planning and designing their games before the construction stage. The construction period involved children testing, evaluating, trouble shooting to find faults and adapting their games. The finished games were presented to parents at a school assembly before being sent off for trialling at the Auckland Museum in the Children's Discovery. Further investigation and consultation occurred with children developing a questionnaire which accompanied their games to the museum.

Factors contributing to successful implementation

The following account will identify the features of Megan's planning and management style that enabled her class to work through the technological process.

Planning

Sound planning strategies allowed Megan to

- source technological knowledge from a variety of communities
- integrate contributing curriculum areas while keeping a technological focus
- make assessment decisions that enhanced the children's understanding of the technological process.

Sourcing technological knowledge from a variety of communities

The community is a valuable source of technological knowledge. Megan sourced knowledge from a physics teacher who was able to teach her circuitry, an auto-electrician who supported her technical skill development and a toy manufacturer who provided her and her class with information about graphics, illustrations, packaging and the need for clear instructions. Further information on pricing and the availability of electrical components was obtained from Dick Smith's (a nationwide electronics and electrical supplier). She recognised and capitalised on an authentic problem-solving opportunity when she was offered the chance to display the games at the 'Weird and Wonderful' exhibition. In addition the class visit to the museum set standards of presentation as well as focusing the children on a natural history context.

These communities provided Megan and her class with ideas, technological skills and an appreciation of the range of materials and equipment that could be used.

Integration of curriculum areas

Megan chose to teach a science unit on electricity before embarking on this technological programme. The science unit provided knowledge about wire to wire connections, the need for a battery, conductivity in different substances, and the placement of batteries, bulbs and buzzers within a circuit. This unit not only established a framework of scientific understanding for the children but also provided the scaffolding for the development of their technological knowledge during game construction.

Language time was given a technological focus with the first hour of each day allocated to developing language skills. These skills included the introduction of a specialised vocabulary, the identification and development of appropriate questions when accessing information from experts, the sequencing of game instructions, the development of questionnaires and the provision of time for children to discuss, select and organise graphics on their game board.

The development of communication skills was used to enhance the reflective aspect of the technological process. Class and group reporting sessions monitored progress and the construction of a

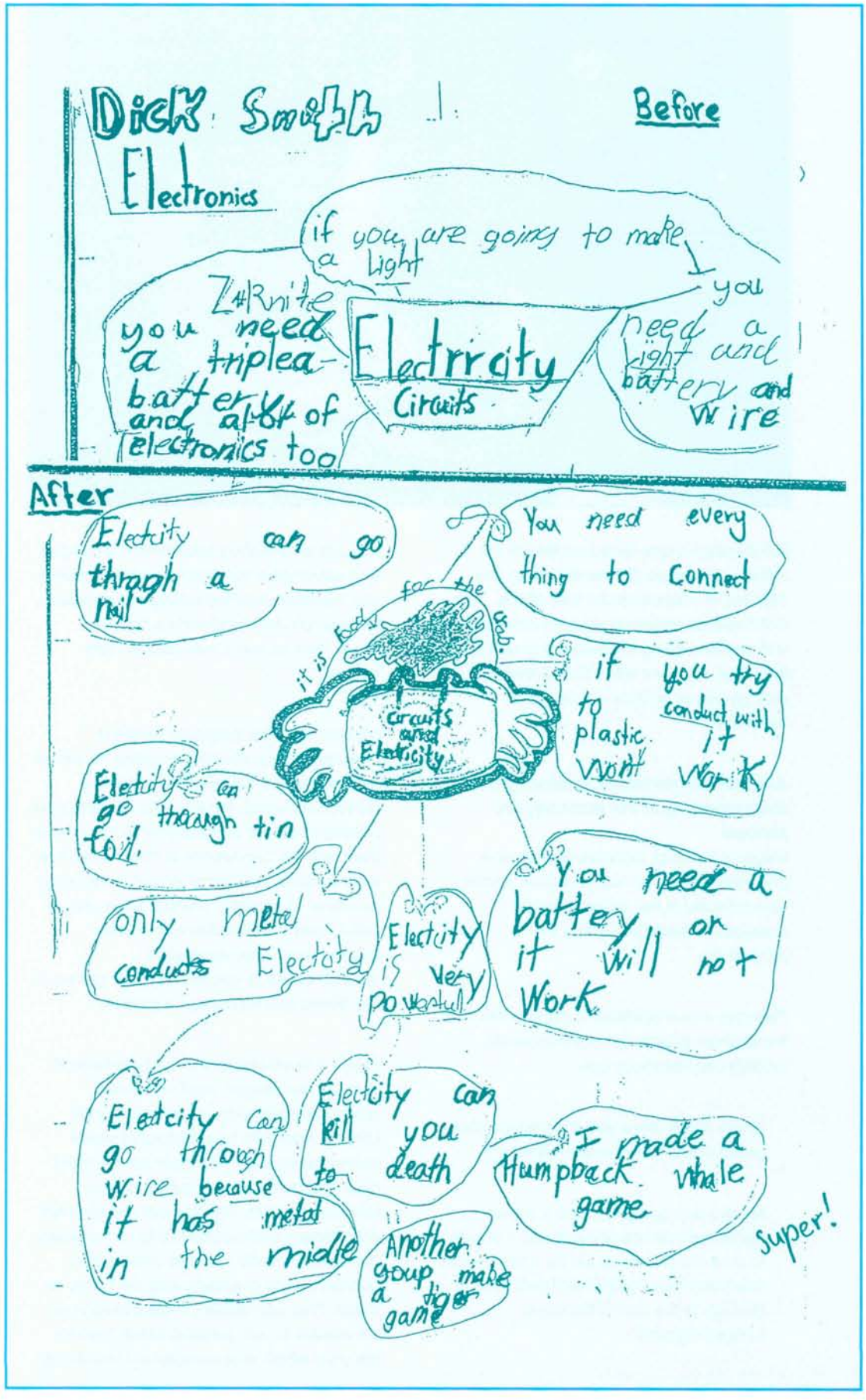

Figure 3 Assessment example: Andrew's developing views on circuits and electricity

Will Mary conduct electricity?

collaborative class diary maintained the reflective focus as did the recording and collation of information on wall charts. This emphasis on reflective analysis continued, with children being encouraged to reflect on their final solutions when they presented their games to parents at a special assembly.

Assessment decisions enhancing the understanding of the technological process

Megan's focus on developing children's understanding of the technological process was reflected in her organisation of assessment strategies within this programme.

Planning was embedded in the process and it was given expression in the following formative assessment task.

> Share some ideas about the game your group would like to make. (Teacher)

> My group is going to make a maze game, and we are going to use a board to do it on, and there will be a start and a finish and they have to find their way through to the end of the maze (J aged 6 years).

Her use of formative assessment strategies also occurred in the practical sessions when she modelled troubleshooting techniques: for example how to identify a break in circuit, how to test a bulb, buzzer and battery.

Integration of the language sessions provided time to develop on-going formative and summative assessment within the reflective process, for example recording the children's named contributions to the shared diary and the opportunity to make anecdotal records when children took part in reporting sessions. In addition, children were able to self-assess the effectiveness of their solution when they developed questionnaires to accompany their games to the 'Weird and Wonderful' exhibition.

Figure 3 is an example of an assessment strategy that Megan used to monitor children's developing understanding of circuits. Andrew's (a pseudonym) views before the task did acknowledge the need for a light, battery and wires in a circuit. However the later assessment revealed his appreciation of the conductivity of materials, the need for metal to metal connections, and the linking of circuits with the game he made. This was evident in his inclusion of the answer to the question about 'food for the crab' which was included in his drawing.

Construction underway

Many aspects of his increased technological knowledge are not apparent in this diagram but have been recorded in the teacher's anecdotal reporting of his achievements. For example, his ability to identify breaks in the circuit, his understanding for the necessity of using metal conducting materials and his placement of the components within the game. An understanding of the nature of switches was transformed into technological knowledge in that the correct answers connected the circuit and the switch was the lack of connection. The completed game demonstrated that Andrew's group was able to translate a planned circuit into reality and ensure that the connections and breaks in the circuit were appropriate to the questions and answers.

Management strategies

Classroom management also contributed to the technological focus of the programme. The management strategies that were particularly significant included the:

- careful organisation and monitoring of groups
- time allocation for developing technical skills
- utilisation of parental help
- recognition that the technological process needed to be worked through in manageable stages.

Organisation and monitoring of groups

Megan organised equal ability groups to promote total participation and down-play the adoption of 'learned helplessness' attitudes amongst some children. Individual roles were assigned and groups were given the responsibility to select representatives for their community visits. Each group was expected to make many decisions that included choosing their subject matter and game type, selecting the electrical components and deciding on their organisation, organising the graphical layout and deciding how the encasing structure would be made and presented. More specifically, children were required to list the equipment they needed and send a representative to buy these materials.

The organisation of equipment also fostered an independent attitude amongst her class. The equipment was stored in clearly labelled containers and children were delegated to monitor its use. Megan maintained this independent learning style by setting up a buddy system with year 6 partners which enabled children to carry out library research for suitable questions.

Even though independent learning was encouraged, Megan continually monitored the children and intervened to help struggling groups. The flexibility of the programme meant that she was able to

spend time with groups when required as well as allocate individual groups more time to finish tasks.

Skill development time

Children were encouraged to develop technical skills on a 'need-to-know' basis. They learnt how to strip wire, make connections and select appropriate components. This skill development resulted in the groups being able to follow a trouble-shooting routine when they wished to analyse their circuits to find the trouble spots.

She also provided time for children to develop computing skills so they could produce appropriate graphics for the game format.

Utilising parental help

Megan capitalised on the high level of parental interest by requesting their help in community/industry visits. Parental support meant that small groups could visit a range of industries and free her for classroom work with the remaining children. Parents supported the teacher within the classroom in many ways. For example, a grandparent helped the children with soldering when they realised that they needed more permanent connections in their circuits.

Working through the technological process in manageable stages

Although *Technology in the New Zealand Curriculum* (Ministry of Education, 1995) emphasises a holistic view of the technological process, the teacher decided that these young children needed to approach the problem in manageable stages. However, she was mindful of the necessity of keeping the whole picture in view and this occurred during discussion and reporting times.

This emphasis on children's planning provided opportunities for Megan to monitor each stage of the process. Not only were the children expected to explain their ideas during group conferences and class-reporting sessions but this data provided Megan with information that allowed her to monitor the pace of the process and identify when each stage needed to be introduced.

As a consequence Megan was able to maintain the holistic integrity of the project by keeping the endpoint and dimensions of the project in front of the children. At the same time she presented tasks that were manageable within the time frame.

Discussion

In summary, this teaching programme enabled children to realise a technological endpoint with the production of circuit board games that were used in the interactive display at the Auckland Museum. Megan's programme planning and management skills allowed children to work through the technological process and gain some understanding of the dimensions of technological literacy. The links to the community gave the programme an authenticity by providing children with an achievable and worthy goal.

The buzz could be heard beyond the walls of this classroom as the classroom community was given access to this exciting learning situation.

References

Burns, J (1997) 'Access to technology education through historical and cultural studies' in J. Burns (ed.) *Technology in the New Zealand Curriculum. Perspectives on Practice.* Palmerston North: The Dunmore Press.

Conway, R and Riggs, A (1994) 'Valuing in Technology' in F. Banks (ed.) *Teaching Technology.* London: The Open University

Ministry of Education (1995) *Technology in the New Zealand Curriculum.* Wellington: Learning Media.

Pacey, A (1983) *The Culture of Technology.* Oxford: Basil Blackwell