# MAKING MASKS FOR MAUI: KEEPING THE MACRO TASK IN MIND

Judy Moreland and Bronwen Cowie
Centre for Science and Technology Education Research, University of Waikato



## ABSTRACT

New Zealand primary school children in technology lessons often design and create an artifact in response to a scenario that relates to their interests and experiences. Usually the task is undertaken over several days. In this paper we draw on data generated within the INSiTE study, a three-year study exploring the nature of effective student-teacher interactions around science and technology ideas. The teacher in this paper planned for her children to create a mask for their forthcoming school production: 'How *Maui* found the secret of fire'. As the children worked on the macro task, that of designing and making a mask, meso and micro tasks emerged. The teacher assisted the children to identify and resolve these, bearing in mind that the ultimate aim was their successful participation in the school production. When teachers assist children to maintain a focus on the overall or macro task goals their artifact fulfils the specifications of the scenario and children's technology understandings and skills are fostered.

**Keywords:** macro, meso and micro tasks, technology education, student-teacher interactions

## CONTEXT OF TECHNOLOGY EDUCATION IN NEW ZEALAND

The general aim of technology education in New Zealand is to develop student technological literacy. This is achieved through the development of three inter-related strands: technological knowledge and understanding, technological capability, and an understanding and awareness of the interrelationship between technology and society (Ministry of Education, 1995). The inter-related nature of the strands emphasises a holistic approach to developing technological literacy. Seven technological areas are specified in the curriculum to represent the diversity of technological practice in New Zealand. The areas are materials technology, information and communication technology, electronics and control technology, biotechnology, structures and mechanisms, process and production technology, and food technology. Schools develop their technology learning programmes within the technological areas, across the strands, and with achievement objectives from all three strands. The programmes also include a variety of broad, overlapping contexts such as personal, home, school, community, environmental, energy, business and industrial.

For teachers to achieve the best possible learning outcomes for their children, and for children to develop a broad understanding of technology, teachers' classroom programmes reflect a combination of strands, achievement objectives, technological

areas and contexts. When they plan, teachers construct specific learning outcomes in particular technological areas and contexts from the curriculum achievement objectives across the three strands. They then generate the tasks that the children will be engaged with that are likely to foster achievement of these specific learning outcomes. Of note is the teachers' intention to integrate the technology learning outcomes. Learning outcomes are not taught in a piece-meal fashion, with one following the other, in order. Rather they are positioned and thought of holistically, with the whole more important than the constituent parts. The macro task they devise for the children, and often with the children, is reflective of the integrated learning outcomes and is necessarily complex in order to accommodate opportunities for children to achieve all the learning outcomes in an integrated manner. This then means that the macro task may take some time to complete. Because of the complexity, magnitude and longevity of the task, teachers and children can struggle to maintain a focus on the overall, macro task.

## MACRO, MESO AND MICRO TASKS

The long-term nature of the macro technology task that young children engage with poses particular issues for teaching and learning. These include maintaining children's focus on the overall goals of the technology task, teachers and children sustaining interest and engagement over time, and effective ways to build connections between tasks and lessons. When they plan, teachers first define the macro task, that is, the overall task for the technology unit. This macro task is inclusive of the specific learning outcomes. Then teachers arrange a series of inter-related sub-tasks, meso tasks, which are mutually important for achieving a solution to the macro task. Micro tasks are more localized tasks, embedded within meso tasks, and may also be planned by teachers. The macro, meso and micro tasks form a connected network (Roth, 1998), one that provides structure, support and direction for children's learning.

Teachers play a crucial role in assisting children to maintain their focus, engagement and interest on the overall goals of the macro task over time and between lessons. When teachers of young children have children working across days on their technology task, teachers need to foster ways for children to work iteratively when designing, making and testing (Stables, 1997). To help children work iteratively, teachers need to encourage children to think reflectively and projectively about the tasks they are undertaking (Kimbell, et al., 1991; Kimbell, Stables & Green, 1996; Stables, 1995). Often in technology classes the design process is treated as a series of steps (McCormick, 2000). The steps can become ritualised with lessons structured around each step so that children undertake the process in a stepwise fashion, giving rise to a veneer of accomplishment (Hennessy, McCormick & Murphy, 1993; Lave, 1988). Children need to work iteratively between developing 'thought' skills and 'action' skills so that they are able to sustain learning across time (Anning, 1993; Benson & Raat, 1995; Kimbell, et. al., 1996).

Children's successful negotiation of a technology task requires skill because as they work problems emerge. These problems may be 'dynamically constructed, reconstructed, resolved and abandoned' (Roth, 1995, p. 372). Problems may not be foreseen by the children, and therefore need to be dealt with 'on the spot'. While developing designs for

macro problems (the overarching task), children frame other problems to which they need to find solutions. These frames are meso problems because they themselves entail more complex, but yet undetermined, sets of actions. As children pursue projected solutions for meso problems, new problems at a more local level (micro problems) arise. Often, dealing with the issues in the micro problems leads to dealing with the meso problems, which may then lead to a successful solution for the macro-problem. How teachers deal with the emerging problems children face as they engage with the task at hand, be it at the macro, meso or micro level, impacts on children's learning. Hence, how teachers' structure lessons strongly affects how children undertake technological processes.

## THE STUDY

This paper draws on data generated within the Classroom InSiTE study, a three-year study exploring the nature of effective student-teacher interactions around science and technology ideas. An interpretivist methodology and multiple methods of data collection and analysis are used. Methods include case studies of classroom interactions, student and teacher interviews, and classroom observations involving field notes, digital photography and video and document analysis including teacher and student work. The study is taking place in 12 primary classrooms in six New Zealand schools during 2005, 2006 and 2007.

The case study, used as the focus for this paper, is of Year 2 to 4 children and how they, and Ellie (the teacher), went about the macro task of planning, making and appraising masks for their school production 'How *Maui* (Mäori mythical character with supernatural powers) found the secret of fire'. It explores how Ellie (teacher and student names are pseudonyms) structured the task and the impact that had on the children experiencing technology in their classroom. The small class of 12 Mäori boys is in a bilingual room (at least 50% of instruction is in Mäori) in a low decile city school. Ellie is in her tenth year at the school, and her twentieth year of teaching. The arrangement of Ellie's classroom has a free space at the front reserved as a place for children to gather 'on the mat' for activities such as class discussions. Designated areas include a mathematics area, an art area, a reference book area, a library area and a computer area. Desks are arranged in three groups. Mäori charts, books, vocabulary and artifacts are prominently displayed throughout the classroom reflecting the bilingual nature of the class.

## A NETWORK OF TASKS

Ellie's technology unit involved her children in five sessions organised around the macro task of designing and making a mask for the 'How Maui found the secret of fire' end-of-year school production. Ellie chose the topic because her class was part of the school production and her children were expected to create some aspect of their costuming. Further the topic would promote children's general understanding of the nature of technology, and also particular understandings and skills related to structures and materials. Personal and school contexts addressed relevancy issues. As she said 'they

enjoy making stuff for themselves and they're excited about the production'. She planned several meso tasks to help the children achieve the macro task. Within these meso tasks she also planned and organised micro tasks. Table 1 shows the networked relationship of the tasks.

TABLE 1: NETWORKED RELATIONSHIP OF MACRO, MESO AND MICRO TASKS

| ***Macro task*** | ***Meso tasks*** | ***Micro tasks*** |
|---|---|---|
| *To design and make a mask for our ' How* Maui *found the secret of fire' production* | *1. Building on ideas about masks* | *1.1 Class discuss masks they have seen*<br>*1.2 Listen again to story 'How* Maui *found the secret of fire' to think about a character for a mask*<br>*1.3 Set up the exploring masks task: class examine mask books and masks to find out their component parts*<br>*1. 4 Class discuss features our masks require for the production* |
| | *2. Make sketch of mask* | *2.1 Link decorating of mask to production theme*<br>*2.2 In groups examine books and masks to decide on character for mask*<br>*2.3 Create our mask sketch: draw our character*<br>*2.4 Class share sketches* |
| | *3. Create specifications for mask* | 3.1 Class review of what a sketch is<br>3.2 Introduce 'specifications' - class discussion - use real masks to ascertain features<br>3.3 List ideas for our mask specifications - fit our faces; have fronts, eye holes, a fastening (stay on with straps); must be suitable for singing, talking and dancing |
| | *4. Draw plan of mask* | 4.1 Refer children to sketches from previous day<br>4.2 Draw front and back plan views of mask they will make including shape, materials for mask, method of joining strap to front, position of eye holes<br>4.3 Individuals check plan for specification match<br>4.4 Class discussion 'do plans meet specifications?' |
| | *5. Create action plan for making mask* | 5.1 Class recap yesterdays work 'drawing plans'<br>5.2 Class discus requirements for making mask – equipment and materials<br>5.3 In groups decide on materials and equipment needed for making masks<br>5.4 In groups record ideas<br>5.5 Groups report to class about their requirements |
| | *6. Make mask* | *6.1 Class discuss groups' action plans from yesterday*<br>*6.2 Show children places for equipment and materials*<br>*6.3 Give children plans and sketches*<br>*6.4 Children make mock up of mask* |
| | *7. Test mask* | *7.1 Put mask on – check fit*<br>*7.2 Perform* haka *(Maori war dance) – check usability* |
| | *8. Reflect on process* | *8.1 Class discuss how well masks worked*<br>*8.2 Individuals complete worksheet about making masks* |

Ellie derived eight meso tasks from the macro task to be undertaken over five days. Meso tasks 1 and 2 were planned for Day 1; meso tasks 3 and 4 for Day 2; meso task 5 for Day 3; meso tasks 6 and 7 for Day 4; and finally, meso task 8 was for Day 5. Micro tasks were then derived from the meso tasks. Meso tasks 1 and 2 were designed as foundation activities for the macro task. Ellie's reading of the *Maui* story, the children's exploration and group discussion of mask-making books and masks, and their subsequent sketching of their chosen mask reflected Ellie's perception that technological solutions draw from, and incorporate, the salient features of existing technology. Creating the mask specifications, drawing a mask plan and creating a plan-of-action for making (meso tasks

3, 4 and 5) reflected the value she placed on developing the children's understandings about technology processes being planned construction processes. Constructing a mock-up of their mask, then testing it by wearing it when performing a *haka* (meso tasks 6 and 7) reflected her view that technological artifacts needed to be functional and useful. Evaluation tasks at the end of the process (meso task 8) demonstrated the value she placed on children's involvement in technology as a process requiring evaluation and reflection.

Though Ellie had constructed the overall plan for networking the different tasks, she also designed opportunities for the children to negotiate some task aspects, as she believed that when children were involved in making decisions about learning their learning is enhanced. For example, micro task 1.4 required the class to discuss and decide on the mask features. In micro task 2.2 children needed to choose a character for their mask.

## TEACHER FACILITATION OF MACRO, MESO AND MICRO

It is important for teachers to develop children's technological capabilities in a structured, rather than haphazard way (Anning, 1994). This study backs this claim, as Ellie worked to ensure the children understood the purposes of the macro, meso and micro tasks and their inter-relatedness. She reiterated the macro task each day, discussed meso and micro task goals for the day and helped children to link tasks.

### Keeping the macro in mind

To maintain an overall common direction Ellie opened and closed lessons with discussions related to the macro task of making the mask. These scaffolding conversations provided the glue to hold meso and micro tasks together and for keeping the macro in mind. The conversations cued children to transfer ideas and practices from one day to the next. Though there was flexibility for the children to make many of their own decisions, there was cohesion and connectivity in-built to help them progress towards the macro task.

Ellie kept the macro task in the foreground and was mindful of connecting meso tasks across different days. Ellie set up class conversations at the beginning of lessons to look back at what had been achieved and to introduce the meso and micro tasks for that day. End of lesson conversations were also set up so that meso and micro tasks of that day were reviewed. They talked about what might come next. For example, in the following on the mat conversation at the beginning of Day 3 Ellie asked the children to recall the Day 2 meso task and she introduced the next meso task:

**Ellie:** Today we are going to carry on with our ideas about masks. Can you tell me about your sketching from yesterday? What does it mean?
**Tama:** It doesn't need to be good.
**Paru:** It's fast and quick pictures.
**Ellie:** *Aye* (yes). So what did you sketch?
**Tukai:** We sketched pictures of the mask we are going to make.

**Ellie:** *Aye, kapai* (good). You did sketches of the masks you will make, so you could decide on what you might make a mask of and how they might look. Today we're going to go on from there and take a look at the specifications your mask will need to have. We'll talk about specifications now. What do you think this big word might mean?

Conversations like this guided the children to see how meso tasks linked and contributed to the macro. Children were being encouraged to work backwards and forwards between planning, making and testing. The conversations assisted iteration and built a sense of connectedness and continuity, as the children were led to think ahead to next steps, to think back to what had already happened, and to think of changes they might make in the light of review.

Another instance showed that on Day 1, Ellie checked that the children understood the meso task (2.2) and how it contributed to the macro task. We hear Ellie first explaining the meso task, which was to discuss the sort of mask. She then asked Kauri to reiterate this twice to ensure that everyone had heard. Finally she retold the task to the class and added that she would come to check their decision-making.

**Ellie:** In your groups you are to discuss what sort of mask to make and why we are doing it. What is the first thing you are doing?
**Kauri:** We gotta (sic) decide what we're going to do a mask on.
**Ellie:** Listen to Kauri again.
**Kauri:** We gotta (sic) discuss what sort of mask we're gonna (sic) make.
**Ellie:** Aye, what character to do; might be *Maui*; might be a *taniwha* (monster). I'm going to come around and see what character you decide on.

This class interaction sequence was typical of how Ellie checked that everyone knew how the meso related to the macro. In this instance the children moved to their tables in groups of two or three. Two boys had this conversation:

**Tama:** We have to talk about what we're going to make.
**Rakai:** Do we both have to have the same?
**Tama:** I think. I'm doing a warrior.
**Rakai:** I'm doing a *taniwha.*
**Tama:** Nah, we gotta (sic) do the same.
**Rakai:** Let's look in the books and get a (sic) idea to choose then.
**Tama:** Yea.
[*The boys got a mask book and looked through it together. They were very taken with the patterns on an African mask.*]
**Tama:** Look at that.
**Rakai:** Yea.
[*Ellie joins the boys to check their progress.*]
**Ellie:** What have you got there?
**Tama:** Patterns on a mask.
**Ellie:** Oh, it says here [*pointing to the text*] this is an African mask. It looks a bit like *moko* (traditional Mäori facial tattoo).
**Rakai:** Let's do a warrior then. They can have that.

**Tama:** OK. (*Enthusiastically*)
**Ellie:** That's good. Now I'll give you some more books to get some ideas for making a warrior mask.

In the first part of their conversation Tama tells Rakai that they needed "to decide on a character to make a mask of". Tama was sure, but Rakai unsure, whether they needed to make the same. Tama suggested they get a book to help them choose. The decorated African mask drew their attention and it was at this point that Ellie entered the conversation. She had been listening in the background and was aware the boys had not yet reached a common decision. She inquired about the illustration and then gave them new information "this is an African mask". She related the mask patterns to the boys' cultural experience of *moko*. This prompted Rakai to change from making a *taniwha* mask to making a warrior mask because he knew that Mäori warriors could have *moko*. Ellie praised the boys for reaching their decision and then helped them to move to the next aspect of their task, which was to think about ways of making masks. With this directive she kept the macro task goals to the fore for the boys and she helped them move on to the next meso task.

**Linking meso and micro**

Meso tasks subsume a number of micro tasks. For example, a meso task of drawing a plan may include the micro tasks of drawing front and back views, drawing to scale, specifying measurements, specifying construction instructions and specifying materials (see meso task 4 and the micro tasks listed in 4.2). Teachers may assist children to negotiate the macro through being explicitly open about the links between meso and micro tasks. Ellie employed a number of pedagogical approaches to help children create links between meso tasks and micro tasks nested within. For example, she introduced new skills such as how to draw mask plans by showing front and back views illustrated in mask design books. She described different techniques such as drawing around a pair of glasses to get good eye shape and spacing. She discussed, and listed for display, how mask plans should include several criteria. "Your plan will show: The mask you are going to make; The materials you will use; The right size; The eyeholes and mouth-hole; How you will keep it on; and, That you can sing and move with it on". Listing and displaying the criteria on a chart meant that the criteria were public and readily available for use. Ellie also reminded the children of previous activities and how these activities were related to the current activity. For example, she handed out the children's mask plans before they made them, reminding them "these are your plans to follow for making". Finally she discussed ideas and tasks with the children. For example, how well their plans met the specifications.

**Talk is a resource for linking and achieving tasks**

Ellie fostered classroom talk on the technological ideas embedded in meso and micro tasks such as sketching, designing, specifications, testing products, stretchiness of materials, attachments. This talk encouraged children to focus on the technology understandings and skills necessary to undertake the macro task. Ellie introduced and used technological vocabulary. She encouraged the children to incorporate this vocabulary in their conversations and written work. Technological ideas were evident through the children's talk and actions. In the following conversation Ellie encourages Rakai to think and talk about the elastic fastening for his mask.

**Ellie:** Is that your fastening? [*Rakai nods affirmatively*]. What's your fastening made of?

**Rakai:** Oh, that string. Mmmm, that stretchy stuff. [*Points to the elastic*]

***Ellie:*** *Then you need to write that down, what it is, and how you're going to join it on. It's called elastic, e-last-ic. Say it.*

***Rakai:*** *Elastic.*

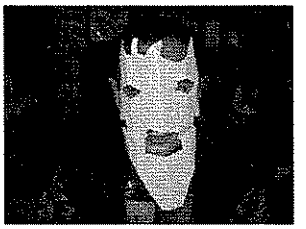

Figure 1

**Ellie:** Good, now write it, e, l, a, s, t, i, c [*As Ellie spells it out, Rakai writes it on his plan*]. Remember to say how you are going to join the elastic on. [*Rakai nods affirmatively*]

As well Ellie assists Rakai to think of his next step of how to join the elastic to the mask. The functionality of the elastic fastening withstood testing (Figure 1).

**Managing the micro**

Sometimes the children encountered micro problems that stalled their progress. A number of micro problems were technical. For example, Ellie showed them how to tie knots when their mask-holding straps came undone because they did not know how to tie knots. When she saw the children unsuccessfully attempting to poke a hole in their mask using scissors, she demonstrated how to use the punch, as a one-step method for making holes. When required, Ellie gave direct instruction to help children manage micro tasks.

## CHILDREN NEGOTIATING THE NETWORK OF MACRO, MESO AND MICRO TASKS

The macro task is constituted in and by meso tasks, just as meso tasks are constituted in and by micro tasks. Each task is defined relationally and constitutes a somewhat arbitrary division of the complexities within the macro task (Roth, 1998). In practice, children's successful negotiation of the macro task is influenced by their accomplishment of micro tasks in combination with meso tasks. In this negotiation children may encounter problems and outcomes that have not been foreseen.

**Collaborating to accomplish a meso task**

Three boys (Hemi, Tukai and Jay) decided to make fire masks. Initially Tukai and Jay were unable to begin their concept sketches Hemi advised them to "look at what I'm doing and do it like this". But Tukai said he could not "draw very good flames". The following conversation ensued:

**Hemi:** I'm doing it soft so I can rub it out easily.

**Tukai:** It's too hard to draw.

**Hemi:** Just do it soft and try and work it out.

**Tukai:** I know about a skeleton [*The group had a mask book with a skeleton mask plan and finished product which they were examining – Figure 2*].

Shall we just do a skeleton? It's easy to draw.

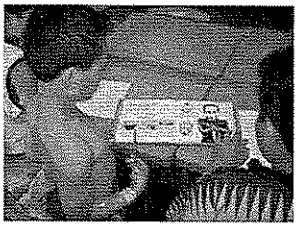

Figure 2

**Hemi:** But I'm drawing flames
**Tukai:** Who cares, I'm just going to do a skeleton.
**Hemi:** Flame eyes, I'm doing flame eyes.
**Jay:** Come on. (*to Tukai*) Let's just do a sketch.
**Tukai:** You can. I'm not.
[After 10 minutes Ellie arrived on the scene. She knew of the stalled progress of Jay and Tukai. She brought the storybook 'How Maui found the secret of fire' and put it on the table by Tukai].
**Ellie:** Have you boys decided on what your mask is going to be?
**Hemi:** Aye; a flame mask.
**Tukai:** [*He looked through the story book and stopped at an illustration of a volcano erupting*]. We don't know how to do flames. Can we do *Maui* and the sun?
**Ellie:** No. That's not our story.
**Tukai:** We'll do the flames then on the volcano.
**Jay:** [*Began to draw flames as hair*].
**Tukai:** [*Started to draw a volcano while looking at the book illustration. Then rubbed it out*].
*[*As other children finished their concept sketches they brought them to Ellie for comment. Kuni was one of these children and had overheard some of the 'drawing flames' conversation*]*.
**Kuni:** Here (*to Tukai*). I can help. Give me your paper. [*He drew flames for hair and an oval shape for the face*].
**Tukai**: Oh, that's it.
**Kuni:** Yea, see the top and bottom.
**Tukai**: Do we do flame edges as well? [*Tukai has taken his paper back from Kuni*].
**Jay:** You can if you want. [*He has copied Hemi and drawn flames across the top and bottom of his page*].
**Tukai:** Now I see. I'm not gonna (sic) do flame eyes, just eyeholes. Do we do eyebrows?
*[*They all drew eyeholes and a mouth. Hemi added flames around the eyes on his mask.*]*
**Hemi**: Does my mask look like a flame mask? [*He showed the others – Figure 3*].

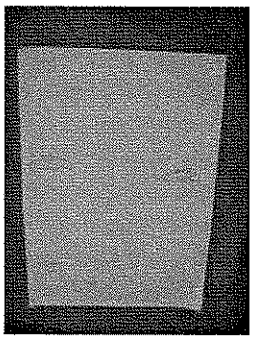

Figure 3

***Jay, Tukai & Kuni:*** *Yea.*
**Tukai**: Look at my mouth. It looks ugly. I want to do it over again.
[*Jay, Kuni and Hemi looked but did not comment. Kuni then helped Tukai draw the mouth again after Tukai had rubbed the first attempt out – Figure 4].*

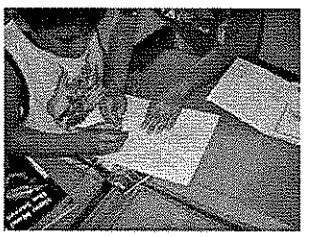

Figure 4

This extended conversation between the boys and Ellie demonstrates how the dilemma with the micro task of drawing flames was resolved. First Hemi exerts Tukai to copy him. Hemi also offered helpful advice to try and help Tukai "just do it soft and try and work it out". Then Tukai thinks of drawing a skeleton as a substitute because "I know about a skeleton. ... It's easy to draw". However, Hemi's comment, "But I'm doing flames" and Jay's urging, "Come on, just do a sketch" thwarted Tukai's decision. When Ellie arrived, Tukai's request to draw something from Maui and the sun was rejected as inappropriate because "That's not our story". It was the volcano image in the Maui book supplied by Ellie that prompted Jay to draw volcano flames as hair and Tukai to draw a volcano (subsequently erased). The image of volcano flames was an idea source for Jay, as was Hemi's drawing. Though the volcano image helped Tukai begin drawing, he did not choose to go on with it. It wasn't until Kuni offered practical assistance and began drawing the outside shape of a flame mask that Tukai had the impetus to carry on. He was then able to draw the eyeholes and make a decision about not drawing flame eyes. He also drew a mouth, but did not like it, erased it and, with Kuni's help, redrew it. Collaboration between the children and the teacher helped in the accomplishment of the meso task.

**An individual pause for thought**

The 'over days' scenario gave the children a 'pause for thought' aspect to their designing and making. The gap between lessons provided space to dwell on ideas, to linger over what had already happened, to deliberate on ideas that were developing, and to generate new ideas. It is important that children are 'able to prospectively prepare for what is coming up and retrospectively reflect on what has just happened' (Jordan and Henderson, 1995, p.64). The intervals between meso and micro tasks allowed room for the children to ponder and have time to think about the macro task. For example, when Maia drew the back view of his mask with string as the strap (4.2 on Day 2) he had wondered if the string would stay tight. On Day 3 when discussing plans of action (5.3, 5.4) for making, Maia replaced string with *harekeke* (flax). Ellie asked him his reason for changing. Maia replied "cos it would be a bit more stretchy than string and it will fit better". He had had time to think. However, on Day 4 when Maia came to make his mask (6.4) using *harakeke* gathered from plants growing in the school grounds, it was a wet day. As a consequence, *harakeke* could not be used, as harvesting *harakeke* during wet weather is against traditional Mäori practice. Elastic had been introduced as a suitable strap material by Ellie at the beginning of the making session (6.2) on Day 4 and was being freely used by several children. Ellie reminded Maia that he would not be able to harvest *harakeke* and asked him what he would now do. This is the exchange that occurred:

***Maia*** *I'll use elastic now.*
**Ellie** *Tino pai* (very good). Why elastic?
**Maia** It will be very stretchy and it will fit good.
**Ellie** *Aye.*

This example provides evidence that Maia had used the time between lessons to think about making his mask fit tightly because he had changed his mind about his strap material between days 2 and 3. Circumstances required him to change the material again on day 4. Elastic was a viable alternative to harakeke because it met the same criteria of stretchiness to ensure a good fit. The over days scenario had afforded him opportunities

to prospectively prepare for what was coming and retrospectively reflect on what had happened.

## DISCUSSION

Technological tasks in the New Zealand context are often multi-faceted and so require sustained involvement over a period of days. Teacher planning for children's technology learning requires that they take into account the requirements of the macro task and its inter-related meso and micro tasks. The achievability of the macro task is determined by the successful fit of meso and micro tasks. Teachers may structure their planning to nest meso and micro tasks within the macro task. Attention to the relationships of the tasks at the planning stage ensures that teachers are cognisant of how the various tasks are connected and how they might foster continuity during teaching. Paying attention to how children might successfully negotiate the macro task will influence how teachers interact with the children while they accomplish micro and meso tasks. In this negotiation children may encounter problems and outcomes that have not been foreseen. Teacher explicit and ongoing management of the tasks and their inter-relationship is important to ensure success and to foster children's technology learning. With Ellie encouraging the children to keep in mind the macro task, the children maintained focus on the overall goals of mask making as a technology activity. Their interest was sustained over time and they appreciated the connected and nested relationship of meso and micro tasks. The children's cognisance of the relationship between the macro, meso and micro tasks framed how they developed their ideas and went about the tasks. The children exhibited flexibility in framing and re-framing their ideas and their process was not linear (Roth, 1995). The contexts of the school production and a familiar traditional story helped the children bring and give meaning to the task (McCormick, 2000; Murphy, 1995). The children's ideas could also not be understood in isolation; they must be seen in the context of their bilingual class community, as this impacted on the way they carried out their technology task (Anning, 1993; Jones & Carr, 1993; McCormick, Murphy & Hennessy, 1994).

Continuity and connectedness are important in all teaching and learning. When a teacher and a group of learners are working together, the talk and actions in one lesson can be thought of as one part of 'a long conversation' that lasts for the whole of their relationship (Mercer, 1995, p. 70). Conversations draw meaning from earlier lessons and tasks. Any learning carries with it echoes of the conversations in which it was created. Children need to appreciate the connections between 'what they did last time, what they are doing now, and the goals they are pursuing' (p.71). The social context of the classroom (Lave & Wenger, 1991), and encouragement of the children by the teacher to find their own solutions are key factors in technology learning. When teachers assist children to maintain a focus on the macro task children are more likely to pursue meso and micro tasks to produce an artifact that fulfils the technological intent of the scenario and children's technology understandings and skills are fostered. This study illustrates that young children can successfully work over days on a complex technology task.

## REFERENCES

Anning, A. (1993). Learning design and technology in primary schools. In R. McCormick, P. Murphy & M. Harrison (Eds.), *Teaching and learning technology.* (pp 176-187). Wokingham: Addison Wesley.

Anning, A. (1994). Dilemmas and Opportunities of a New Curriculum: Design and Technology with Young Children. *International Journal of Technology and Design Education, 4,* 155-177.

Benson, C. & Raat, J. (1995). Technology in primary education: Examples of technology lessons in Europe. Delft: Technon.

Hennessy, S., McCormick, R. & Murphy, P. (1993). The myth of general problem solving capability: Design and technology as an example. *The Curriculum Journal,* 4(1), 74-89.

Jones, A.T. & Carr, M.D. (1993). *Towards technology education.* Volume 1: Working papers from the first phase of the learning in Technology Education Project. Centre for Science and Mathematics Education Research, University of Waikato, Hamilton, New Zealand.

Jordan, B. & Henderson, A. (1995). Interaction analysis: Foundations and practice. *The Journal of the Learning Sciences,* 4(1), 39-103.

Kimbell, R.A., Stables, K. & Green, R. (1996). *Understanding practice in design and technology.* Buckingham, UK: Open University Press.

Kimbell, R., Stables, K., Wheeler, T., Wozniak, A. & Kelly, V. (1991). The assessment of performance in design and technology – the final report of the APU design and technology project. London, SEAC/COI.

Kress, G., Jewitt, C., Ogborn, J. & Tsatsarelius, C. (2001). *Multimodal teaching and learning: The rhetorics of the science classroom.* London: Continuum.

Lave, J. (1988). Cognition in practice: Mind, mathematics and culture in everyday life. Cambridge: Cambridge University Press.

Lave, J. & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation.* Cambridge, UK: Cambridge University Press.

McCormick, R. (2000). *Theoretical and empirical issues of technology education research.* AAAS Technology Education Research Conference 2000. http://www.project2061.org/technology/McCormick/McCormick.htm

McCormick, R., Murphy, P. & Hennessy, S. (1994). Problem solving processes in technology education: a pilot study. *International Journal of Technology and Design Education, 4*(1), 5-34.

Mercer, N. (1995). Guided construction of knowledge: Talk amongst teachers and students. Multilingual Matters Ltd: UK.

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

Murphy, P. (1995). Sources of inequity: Understanding students' responses to assessment. *Assessment in Education*, *2*(3), 249-270.

Roth, W–M. (1995). From 'Wiggly structures' to 'Unshakey towers': Problem framing, solution finding and negotiation of course of actions during a civil engineering unit for elementary children, *Research in Science Education*, 25(4) 365-382.

Roth, W–M. (1998). *Designing communities*. London: Klewer Academic Publishers

Stables, K. (1995). Discontinuity in transition: Pupils' experiences of technology in Year 6 and Year 7. *International Journal of Technology and Design Education, 5(*2), 157-169.

Stables, K. (1997). Critical issues to consider when introducing technology education into the curriculum of young learners. *Journal of Technology Education, 8*(2), 1-17.

## AUTHORS

**Judy Moreland**, Centre for Science and Technology Education Research, University of Waikato, New Zealand. Email: j.moreland@waikato.ac.nz

**Bronwyn Cowie**, Centre for Science and Technology Education Research, University of Waikato, New Zealand. Email: b.cowie@waikato.ac.nz

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