"I've never had such a long conversation with him" Video as a Means of Gaining Access to Elementary Children's Engagement With Mathematical Processes.

Joanna Higgins
Wellington College of Education
Te Whanau o Ako Pai ki Te Upoko o Te Ika

This paper discusses the potential of video as a means of discovering young children's explanations of mathematical tasks. This is illustrated with an observation made as part of a larger study into promoting mathematical processes in New Zealand junior classrooms. It highlights the potential power of video as a means of providing the teacher with an insight into the thought processes of young children doing mathematical activities independently of the teacher.

The value of talk in mathematics classrooms has been well documented by various commentators (Cobb, Wood, Yackel & McNeal 1992) and has been highlighted in current curriculum documents. The New Zealand mathematics curriculum document (1992 p.11) states

> Learning to communicate about and through mathematics is part of learning to become a mathematical problem solver and learning to think mathematically. Critical reflection may be developed by encouraging students to share ideas, to use their own words to explain their ideas, and to record their thinking in a variety of ways, for example, through words, symbols, diagrams, and models.

The purpose of talking about mathematical ideas for the student as a means of explaining their thinking to others, as well as challenging and questioning the thinking of others is suggested in the above quote.

This paper will focus on the potential of student talk from the teacher's point of view as an indication of students' progress. There has been an affirming of school based assessment of children's learning by informal rather than formal means in recent curricula and policy documents in New Zealand (Ministry of Education 1992, 1994a). In a guide to the *Beginning School Mathematics* resource (Ministry of Education 1994b p.20) provided at a national level in new Zealand to junior classrooms, it is noted that, "By observing and interacting, teachers can gain a great deal of information on each child's progress". It is suggested that this information can be used to plan further learning. *Assessment Policy to Practice* (Ministry of Education, 1994a p.17) states that, "Observation can range from the informal (for example, casual monitoring of an aspect of student behaviour) to the more formal (for example, using a standardised observation schedule)."

However, many junior teachers have reported difficulties in accommodating observation in their mathematics teaching and learning programmes typically based on a Piagetian model of child-centred classroom practice (Bennie, Henry & Ratcliff 1990). A usual classroom mathematics session observed, as part of the wider study of which the excerpt in this paper is a part, consisted of children organised into small groups (most often on the basis of stage of learning determined by time at school). After a brief introduction the teacher worked with one of the groups while the other groups worked on self selected exploration from a range of equipment or a mathematical game or activity chosen from a teacher selected range, or a group task set by the teacher of either a collaborative or individual nature. For most sessions the children could choose whether they would work alone, or in a pair or as part of a small group of typically three, four or five children from within their teacher designated group. The teacher's role in such typical sessions is constrained by the classroom social arrangements of three to four group; the teacher working intensively with a small group,

albeit two groups in total over a single mathematics session, giving limited opportunity to observe children's talk as they work on the self-directed tasks.

The following excerpt from Ruby School illustrates how a teacher inadvertently finds out the processes that Campbell, whom she regarded as reticent, was using when engaged in a mathematical task - building a structure. The children observed were 5 to 6 year olds in their first year of school. Each mathematics session was observed and these observations were recorded using field notes and audio-tape. In addition a video camera was positioned on a tripod and left to run unattended. The excerpt that follows traces Campbell's progress as he works on a self-directed activity while his teacher is working with another group. It then presents Campbell's and the teacher's response to a videoed classroom sequence, played back a week later, of Campbell making the model.

Observation Notes Taken at the Time

Campbell, Stan, Alister and Amber are sitting at a table. All of Campbell's group have chosen to work by themselves on different tasks using mathematical equipment. On other occasions they chose to work together on group tasks, such as a game, or the construction of a model. They are each working with different pieces of equipment - Stan with the interlocking cubes, Amber with the seriated tubs and Alister with the counters and balance. Campbell is using flat interlocking triangular blocks to build a large structure. He has to work out ways of balancing the pieces as he extends the model upwards and outwards.

Campbell: *I'm having a bit of trouble doing this.*
(He is trying to fit the interlocking triangles together.)

Campbell: *Look at that.*
(Campbell has now connected several of the triangles.)
A few minutes pass.

Campbell: *Look at this.*
Stan, look at this. Arrows.
(He has made arrow shapes with the triangles.)

(Campbell continues to comment to Stan as he builds.)

Campbell: *I made even longer than this [sic]. Longer than this room. Over to the windows and under the tables.*
(After a few more minutes.)

Campbell: *Look at that. I'm going to make it even bigger.*
(A few more minutes pass.)

Campbell: *I'm going to make it even bigger.*
(Stan puts away the interlocking cubes.)

Campbell: *(to himself) Guns. Facing out.*

Alister: *I want that one to win and that one to lose.*
See that one losed [sic].
(Alister is loading up the different sides of the balance. He is trying to make one side touch the table while the other side, with very little on it, is up in the air.)

Campbell: *Put that in.*

Campbell: *No, put that one there in.*
(Campbell holds up the model so Alister can attach one of the interlocking triangles underneath.)

Alister: *I'll make that one win next time. (He places another piece on the balance.)*

(Campbell keeps putting the blocks together.)

Campbell: *(to Amber) Be very careful [of the model].*

Amber: *I'm not going to knock it down.*

(Alister puts away the counters and balance.)

(Amber and I have a conversation.)

Campbell: *Stan look at this. I think it's going to take up the whole table.*

(After a few minutes)

Campbell: *Can I just move it over there a little bit more?*

(Campbell lifts the whole model and repositions it on the table.)

Amber: *Look. I did it. I did it.*

(She holds up the stacked seriated tubs.)

For the next few minutes the boys go on working with the equipment in silence while Amber is more interested in continuing to interview me about my life. After some time of working in silence, Campbell comments to Alister about what he has built.

Campbell: *This is the back of it.*

The initial impression is of procedural comments in the main such as Campbell's opening comment, *I'm having a bit of trouble doing this*, comments to the other children of *Look at this* and comments relating to the positioning of the blocks, such as *No, put that one there in.* Other comments, relating to themes of "bigness" and "winning", as the children worked at their different activities reflect the peer cultural context in which they were working. (Higgins 1995). For instance, the focus on "bigness" is evident in Campbell's comments throughout this excerpt such as *I made even longer than this [sic]. Longer than this room. Over to the windows and under the tables.* Alister picked up the theme of "winning", this time applied in relation to the balance, when he talked about, *I'll make that one win next time.*

A fascination with balance is reflected in the way in which the boys, in particular, approach these activities. Campbell's model was finely balanced particularly as new pieces were added. On other occasions the boys were again observed to be experimenting with balance. For instance, when building towers with the rods Alister and Tom discussed which rod at the bottom of the tower they would need to pull out to make it fall down. On another occasion, Campbell shifted an interlocking triangle from the bottom of the structure to the side without threatening the balance. He commented to Tom, *Look at that, Tom. Look at that. I even took out the bottom one.*

The Response to the Video

Amber reminded me on numerous occasions throughout the series of observations that I promised I would come back and show the class one of the videos of their maths session. The day before the last day of the school year I went back for the screening. Despite Amber having insisted that I come back, throughout the screening she appeared to be more interested in playing with the hair of the girl who was sitting in front of her.

However, what was unexpected to both the teacher and to me was the way other children in the class responded to the video. In contrast to Amber's response Campbell, who was usually very reticent, became animated in his response to the sequence of his model building. The teacher commented that she had never seen him like this before - he was quite different to what the teacher had thought. Overall the teacher was surprised by those who were engaging with the video and those who were distracted and restless. Several of the children participated in the videoed discussion as if they were having the discussion again.

The teacher commented that she was amazed that the children could remember so much about the maths session.

The following is an excerpt of the running commentary that the children gave in response to their actions on the video.

Alister: (to me) I moved over there cos I wanted you to look at me too.

Campbell: *I didn't really know what it was. I made a stand and tried to balance as many triangles as I could on it (He pauses) Soon I had to start standing up cos you can't see my face now.*

Teacher: *(to me) I've never had such a long conversation with him.*

Campbell: *I'm standing up [he had to do this to reach the top of the construction].*

Campbell continued to describe the process of making his model in a way which explained what he was trying to do and the reasons for his actions.

The teacher later commented in conversation with me.

Teacher: *I would never have expected that from Campbell. I wouldn't have thought he would come up with that at all. If it had been a triangle [group] I wouldn't have been so surprised. I feel blown away by the experience. He remembered all the details of what he was doing whereas I would have only looked at the "zen" of the experience. I wouldn't have considered him at this level. Look at the number of decisions he was making.*

Discussion

This commentary on the video revealed Campbell's thought processes in a way that was not evident in the transcript recorded as he completed this task where the nature of his statements were mostly procedural. This sequence, while not part of the planned research methodology, raised many questions for me as a classroom researcher, particularly in relation to statements in recent policy documents highlighting teachers' interaction with students. I was left pondering about the teacher's surprise at the quality and nature of this child's explanation. The rest of this paper will discuss possible reasons as to why this video provided this teacher with an insight into Campbell's thought processes and will identify key factors in realising the potential of student talk as an indicator of progress.

In the policy documents cited at the beginning of this paper varying forms of student talk appear to be absorbed under the broad category of communication or interaction. This is not surprising given the purpose of such documents, but does not provide guidance for teachers on the significance of the type of student talk, various ways of hearing this talk and how they might use talk to judge student progress. Thomas (1995) is critical of the too ready acceptance by mathematics educators of the value of talk between children. In an investigation of the nature of the talk that occurs between children working in groups independently of the teacher, she found that the talk depended on a complex inter-relationship of the nature of the child, the demands of the task and the features of the classroom context. She suggests that there is a critical balance between social and cognitive demands of the task.

So what type of talk does provide an insight into the thought processes of children completing mathematical tasks and under what circumstances might the teacher observe this? Random observation of short duration, such as teachers can realistically manage alongside their direct teaching responsibilities, may give the teacher a limited idea of the nature of the talk between children, even though the teacher's presence may have a moderating effect on its nature and substance. In Campbell's case, it would appear that the teacher would

probably have observed procedural talk in a short random observation. The fact that she thought of Campbell as reticent may relate to the settings in which she observed him, in which he typically said little. Clarke, Clarke and Lovitt (1990) refer to such students as "invisible" and for this and other reasons suggest a systematic approach to informal assessment.

There has been much debate about the links between critical learning processes and private talk. In two recent studies of children's classroom learning Alton-Lee, Nuthall & Patrick (1992) gathered data using remote microphones worn by individual pupils, to investigate the lived culture of the classroom (Apple & Weiss 1983) in relation to children's processes of schema generation. Whilst they caution against over-interpreting these private utterances, they suggest that the utterances may provide the teacher with valuable insights on internal cognitive processing. They suggest three distinct categories of private talk identified according to intended audience as unofficial/no audience, unofficial/ restricted target audience and unofficial/general peer audience. They see the identification of audience as informing an analysis of children's individual negotiations of the lived culture of the classroom. According to these categories the private talk I reported on in this paper would fit `verbalisations accessible to peers but not a public statement' to an unofficial general peer audience.

Palincsar and Brown (1989) working from the Vygotskian tradition see private speech as an aspect of self-regulatory behaviour in the way in which it becomes a verbal directing or self-questioning of the child's activity. They argue that dialogue as an important means of acquiring private speech. In this sense they describe this private speech as being of a dialogical nature, even if the comments are clearly directed at no one. However, Thomas (1995) found few instances of "thinking aloud" in her investigation of talk in junior mathematics. She defined this as a sub-category of reflective talk where the child articulated their reasons for taking a particular action. She notes that this is consistent with Bennett and Dunne's (1992) finding of a complete absence of abstract talk generated by mathematics tasks. In the example in this paper, some of Campbell's comments, such as "Guns. Facing out" would appear to fit her category of "thinking aloud" and be explanations for his placement of the blocks on the model.

What teachers need to inform their planning of classroom programmes is an insight into children's thinking. In another study by Nuthall and Alton-Lee (1995) children were interviewed about rote recall questions immediately and up to 12 months after the administration of an achievement test. Their finding that students had strong recollections of the original learning experiences, led them to suggest that the process of recall is "controlled by the students' metacognitive awareness and understanding of their learning experiences, and it is conditioned by the multilayered and fragmentary nature of their memory for those experiences" (p.219).

It would seem that the video enabled Campbell to relive his original learning experience building a model with the triangular blocks. The commentary on his own actions appeared qualitatively different from his commentary to his peers during the activity itself. Although the teacher had found Campbell to be reticent, in my observation he actually said a lot about the task. Yackel (1995) suggests that children change the ways in which they talk about their activity according to the different situations. From a symbolic interactionist framework her argument is that a child's interpretation of a social event rather than the classroom social arrangements constrain the nature of a child's explanations. She sees this constraint as being reflexively linked to the obligations and expectations that a child associates with a particular social setting. Campbell's response to the video of explaining his actions may well be a result of the expectation and obligation to explain himself that he associated with this setting. In doing so he revealed some of the thinking and decision making that in the other settings was not evident to an observer, be it teacher or classroom researcher. It would seem that the use of video may be one of a number of strategies that can be used to gain insight into children's thought processes as they complete mathematical tasks.

References

Alton-Lee, A., Nuthall, G., & Patrick, J. (1992). Reframing classroom research: A lesson from the private world of children. *Harvard Educational Review*, *63* (1), 50-84.

Apple, M., & Weiss, L. (1983). *Ideology and practice in schooling*. Philadelphia: Temple University Press.

Bennett, N., & Dunne, E. (1992). *Managing classroom groups*. Hemel Hempstead: Simon and Schuster Education.

Bennie, N., Henry, E., & Ratcliff, B. (1990). *Beginning school mathematics. A study of the implementation.*. Wellington: Research and Statistics Division, Ministry of Education.

Clarke, D., Clarke, D., & Lovitt, C. (1990). Changes in mathematics teaching. Call for assessment alternatives. In *Teaching and learning mathematics in the 90s*. Reston, Virginia: NCTM.

Cobb, P., Wood, T., Yackel, E., & McNeal, B. (1992). Characteristics of classroom mathematics traditions: An interactional analysis. *American Educational Research Journal, 29*, 573-604.

Higgins, J. (1994, Apr.). *Promoting mathematical processes in the junior classroom.* Final report to the Ministry of Education. Wellington College of Education.

Higgins, J. (1995). *Promoting the learning of mathematical processes through independent group work.*. Paper presented to the annual meeting of the American Educational Research Association, San Francisco.

Ministry of Education (1992). *Mathematics in the New Zealand curriculum*. Wellington: Learning Media.

Ministry of Education (1994a). *Assessment policy to practice*. Wellington: Learning Media.

Ministry of Education (1994b). *Beginning school mathematics. A guide to the resource.* Wellington: Learning Media.

Nuthall, G., & Alton-Lee, A. (1995). Assessing classroom learning: How students use their knowledge and experience to answer classroom achievement test questions in science and social studies. *American Educational Research Journal, 32*, 189-223.

Palincsar, A., & Brown, A. (1989). Classroom dialogues to promote self-regulated comprehension. In J. Brophy (Ed.), *Advances in research on teaching* (Vol 1). Greenwich, Connecticut: JAI Press.

Thomas, G. (1995). *Discussion in junior mathematics. Helping one another learn.* Unpublished Dostor of Philosophy thesis, Otago University.

Yackel, E. (1995). Children's talk in inquiry mathematics classrooms. In P. Cobb & H. Bauersfeld (Eds.), *The emergence of mathematical meaning: Interaction in classroom cultures*. Hillsdale, N.J.: Lawrence Erlbaum Assoc.

The author acknowledges the support of the Ministry of Education, Division of Research and Statistics, for this project.