Classroom Dialogue in Technology

Wendy Fox-Turnbull
Senior Lecturer
School of Sciences and Physical Education
College of Education
University of Canterbury
PB 4800
Christchurch
New Zealand

Email: wendy.fox-turnbull@canterbury.ac.nz

Abstract

This paper investigates the role that classroom conversations and dialogue play in learning in technology education. It reviews literature in this area. It argues that to enhance our understanding of how children learn in technology it is necessary understand the impact clearly focused conversations of children, amongst themselves and between children and their teachers while undertaking technological practice has on advancing thinking and understanding. This will enhance understanding of how learning occurs in technology and how interaction with peers and teachers advances thinking around technological concepts and components of practice and give teacher insight into children's understanding of technological knowledge and concepts. It gives early insight into what directed conversation with students can reveal. It also asks the questions: "What defines a quality conversation in technology? What can conversation do to facilitate, develop and enhance children's learning in technology education?.

Key Words

learning conversation, technology education, dialogue

Introduction

In 2007 New Zealand released a new national curriculum which includes a new national statement for technology education (J.R. Sharrat, 1991, cited in Ministry of Education, 2007). The statement advocates a holistic approach to the development of technological literacy through understanding of and participation in authentic technological practice and situated understanding of technological knowledge and the nature of technology. These aspects; technological practice, technological knowledge and the nature of

technology form the newly identified strands which contribute to the development of technological literacy for students.

There is clear evidence due to the practical and socially situated nature of technology education in *The New Zealand Curriculum* that it is based on a constructivist paradigm. Conversation with peers and 'experts', about learning is an integral aspect of socially situated constructivist learning. Evidence emerging from recent literature suggests that focused conversations and quality interactions between children and their peers or their teacher greatly enhances learning.

This paper reviews the recent literature on technology education and quality interactions in the classroom to argue that to further enhance learning in technology teachers need to facilitate and develop quality conversations about technological practice and knowledge and the nature of technology. This study gives some insight into learning for children in technology education and how the use of conversations and dialogue can best enhance that learning.

Technology and Constructivism

Technology is described in *The New Zealand Curriculum* (2007) as intervention by design: the use of practical and intellectual resources to develop products and systems (technological outcomes) that expand human possibilities by addressing needs and realising opportunities. It gives students challenging and exciting opportunities to build their skills and knowledge as they develop a range of outcomes through technological practice. They bring together practical and intellectual resources in creative and informed ways to engage with the many technological challenges of today's world and of those in the possible future (Keith, 2007).

Technology must be introduced to children within a meaningful child orientated context (Fleer & Jane, 1999, p. 13) and it explicitly deals with technological processes of investigating designing, making and appraising technological solutions to identified problems or recognised opportunities within any given social and cultural context (Fleer & Jane, 1999, p. 73). Compton and France (2006) recognize that technology is increasingly interdisciplinary and requires technologists to work in an integrated manner. Quality technology education programmes that use authentic learning offer an excellent model for inquiry-based learning because they allow integration of numerous curriculum areas (Fleer et al., 2006). In the classroom technology topics can become 'vehicles' for learning from which students can engage in 'worthwhile exploration of meaningful content that relates to and extends [their] life experiences and understanding of the

world' (Murdoch & Hornsby, 2003, p 19). Within this sphere of learning, and within technology education, students are given authentic opportunities to measure, speak, discuss, write reports, and consider all manner of issues (Turnbull, 2002).

Undertaking technological practice has shown to provide students with the opportunity to collaborate with others and make a difference to their own lives and developments in their immediate community. This results in high levels of student engagement and allows students to take increasing ownership of their learning and to feel empowered to make decisions regarding the nature of their outcomes. This collaborative approach with children taking ownership of their learning and technological outcomes clearly situates quality technology education programmes within socially constructed or constructivist learning.

Constructivist theorists such as Vygotsky(1978), Bereiter, (1992), Bruner (1996), Blythe (1998) and Murdoch (2004), claim that people construct knowledge through interaction with others in the sociocultural environment. Technological knowledge is socially constructed (Compton & Jones, 2004; Pacey, 1983) because the social and cultural values of particular groups of people influence the technological advances made at any one time. Technological activity accordingly is embedded in the 'made world' and is influenced by social, cultural, environmental, economic and political influences.

Theories of Language and Interaction

Language and social interaction are vital components of working collaboratively and therefore fundamental components of learning in technology. There are two opposing tendencies that may be seen as characterising social interaction. These are 'Intersubjectivity' and 'Alterity'. Daniels (1996) suggests both are always at work within social interaction. Vygotskian accounts have tended to focus on Intersubjectivity which is the dialogue between the novice and the expert working towards a shared definition of a situation and to move the novice from a state which performance can be carried out independently (Daniels, 1996, p. 119). This means an expert is guiding the novice from the interpsychological plane of understanding to the intrapsychological plane. The idea of two planes of learning suggests that initially interaction appears between the child and another person as an interpsychological category and then within the child as an intrapsychological category (Daniels, 1996; Lave & Wenger, 1996; Vygotsky, 1978; Wertsch, 1981). Fleer (1995) gives an example to explain the interpsychological and intrapsychological planes.

> Vygotsky also argued that children participate in social activities without necessarily understanding what they mean. A further example is that of a toddler participating in hand-washing after visiting the toilet

> or before eating. This ritual is practiced by the child's family and hence is apart of accepted behaviour patterns known to the child. However the child may not necessarily fully understand what this action means. Vygotsky termed this social behaviour as occurring at an *interpsychological* level of functioning- at a social level of functioning without understanding. It is when the child understands why she/he is washing her/his hands that the child is said to be operating at an *intrapsychological* level of functioning. Learning occurs when the child moves from one level of functioning to another (Fleer, 1995, p. 21).

Alterity occurs when discrepancy or conflict of opinion or perspective between one's own and another's view sparks cognitive development. Alterity is concerned with the distinction between self and others, within thought generating tendencies (Resnick, Levine, & Teasley, 1991). The listener perceives and understands the meaning and simultaneously takes an active response to it, either agreeing or disagreeing, partially or completely; augments it, applies it and prepares for its execution. Any understanding of live speech is imbued with response and elicits it in one form or another.

With interaction between people as a central aspect of cognitive, social and cultural development within a constructivist paradigm it stands to reason that language is more than a way of expressing ourselves (Burr, 1995). As people interact they are constructing their worlds hence the justification for language to be considered a form of action. Wertsch et al. (1999) report in their study of joint problem solving that debate is a major force in cognitive development and occurs through the interaction with socioculturally defined tools. Language provides both the process and the product for cognitively focussed interactions.

Bakhtin (1986) coined the phrase 'utterances' as the real unit of speech communication. He stated that speech exists in reality only in the form of concrete utterances of individual speaking people. Bakhtin (1986) states that behind each text strand lies a language system and that all text is repeatable and reproducible. Everything that can be given outside the text (the given) conforms to the language system but at the same time each text (utterance) is different and unique as it is revealed in a particular situation and in a chain of texts. Burr (1995) suggests there is multiplicity of meanings inherent in any piece of text or speech. As communication takes place people are involved in the process of constructing and reconstructing themselves. Language is not a system of set meanings which everyone agrees with. Single utterances can mean different things to different people implying that there is potential for conflict and disagreement (Burr, 1995). The significance of any given utterance is understood against the background of language and its actual meaning is determined against a background of other utterances

and actions (Bakhtin, 1981). Habermas (1970 cited in Cohen, Manion, & Morrison, 2000) also argues that utterances are never simple and their meaning derives from a social context. He also suggests that any utterance has a double structure: propositional content - 'what is being said' and performatory content -'what is achieved through the utterance'.

Bakhtin (1981) suggests that when in everyday dialogue the speaker regularly considers the listener and his or her response giving the speaker insight into perceived discourse (variability of meaning in language with a focus on identity, selfhood, personal and social change and power relations). When the response is aligned with that of the speaker's understanding of discourse the conversation is enriched. On the other hand when perceptions of discourse differ the speaker can sense resistance. Discourse informs ways of thinking and therefore consideration of situated means and how social languages are constructed influences the way participants use language to represent themselves (Young, 2004). It is the beliefs, values and attitudes held that inform the way people act, read and what they say and how they interact; they are not static and may change as people read, experience, observe and adapt to new situations.

Dialogue is 'the discussion that takes place during the course of education activities'(Mercer & Littleton, 2007, p. 1). It can be described as much more than talk, it is complex and dynamic and often involves very different cultures, perspectives, ideas and people. generally involves the use of words and requires engagement with people (Mercer & Littleton, 2007; Shields & Edwards, 2005). Shields and Edwards (2005) suggest that dialogue can bring moments of intense connection with another person with feelings of remarkable openness, deeply affirming moments which can be highly exhilarating. Mercer & Littleton (2007) and Shields & Edwards (2005) agree as to the importance of dialogue in learning. Mercer & Littleton (2007) suggest that the place of dialogue in learning is considerably more important than has been demonstrated in schools in the past. "A sociocultural perspective raises the possibility that educational success and failure may be explained by the quality of educational dialogue, rather than simply by considering the capability of individual students or the skill of their teachers"(p. 4).

When people work together in problem solving situations they do much more than just talk together. They "inter-think" by combining shared understandings, combining their intellects in creative ways often reaching outcomes that are well above the capability of each individual. Problem solving situations involve a dynamic engagement of ideas with dialogue as the principle means used to establish a shared understanding, testing

solutions and reaching agreement or compromise. Dialogue and thinking together are an important part of life and one that has long been ignored or actively discourage in schools (Mercer & Littleton, 2007). There are very clear implications here for technology given the collaborative nature of problem solving required to develop technological outcomes.

Conversations between Children and Adults

It is argued that teachers need to engage in quality dialogue with students and parents to help them make sense both cognitively and experientially of the world in which they live and work (Mercer & Littleton, 2007; Shields & Edwards, 2005). Mercer and Littleton (2007) found ample evidence that teachers make a powerful contribution to the way children think and talk. Teachers convey powerful messages about thinking by the way they structure classroom activity and talk to the children. To increase children's ability to use language as a tool for both collective and solitary thinking they need to be involved in "thoughtful and reasoned dialogue" (Mercer & Littleton, 2007, p. 56). This type of teaching Bakhtin (1981) termed 'dialogic teaching'. When teachers model and scaffold useful language strategies to extend thinking and dialogue with adults and peers and children are given ample opportunity to practice using language to reflect, enquire and explain their thinking to others children are then able to seek and compare points of view and use language to compare, debate and reconcile questions which takes their learning beyond a level that requires only answers to teachers factual questions. Language provides both the process and the product for cognitively focussed interactions, it can therefore be said that learning is a social process and takes on a theoretical perspective of *socially constructed learning* (Fleer, 1995). Spoken language is one of the tools children use to make sense of the world and is a teacher's main pedagogical tool (Mercer & Littleton, 2007).

Many people have tried to describe quality interaction between adult and child. There is no one ideal way of interacting with children. Interactions are context bound and specific to the immediate situation (Fleer, 1995). Fleer (1995) found that in many cases children are not given time to think about what they are doing in relation to the wider situation or previous learning and experiences. Mercer and Littleton (2007) suggest that many children are not taught useful ways of using spoken language as a tool for learning and working collaboratively. High quality interaction is best exemplified when teachers engage the philosophy that all children are unique individuals. Teachers need to engage children taking into consideration their special interests and temperaments (Fleer, 1995).

Interactional patterns between adults and younger children vary greatly. Research has shown that a great deal of adult interaction with children in about management rather than learning (Fleer, 1995) and as a result many learning opportunities are lost. Social construction learning theory can help empower teachers by introducing more than just practical implications but offering assistance in understanding critical theoretical assumptions relating to interaction between children and teachers (Fleer, 1995) .

Other theories that give insight into the interaction between teachers and children and between children include: Symbolic Interaction, Sociocultural Conflict theory and Grounded Theory. Symbolic Interactionism makes a significant contribution to the understanding that knowing, thinking, believing and notions of self have origins in social interaction and that the mind is inseparable from the social process. Consider whether how an individual thinks ands act is determined by others and the roles that are predetermined for them or just their predetermined roles. Socio-cognitive conflict, originally based on Piagetian theory sees conflict as an essential ingredient of any joint involvement to bring about cognitive change. Doise and colleagues (Doise & Mugny, 1984) have demonstrated that children working in pairs solve problems at a more advanced level than those working by themselves (regardless of the ability of the partner). These studies reveal that when coming up against an alternative point of view (not necessarily the correct one) solving forces the child to coordinated his or her own viewpoint with that of another child. The conflict can only be resolved if cognitive restructuring takes place and therefore mental change occurs as a result of social interaction. Thus the social interaction stimulates cognitive development by permitting dyadic (people working in pairs) coordinations to facilitate inner coordinations. Technology education typically involves children in problem solving situations which are done collaboratively and cooperatively with their peers and key adults and naturally involves the discussion of conflicting thoughts and ideas.

For two people to communicate both participants need to contribute to the conversation. To be able to do this both must have common understanding of the exchange that is taking place or is about to take place (Clark & Brennan, 1991). This common understanding is call *grounding,* its purpose is to ensure “what has been said had been understood” (Clark & Brennan, 1991, p. 128). Grounding is defined by Clark and Brennan (1991) as a collective process by which participants try to reach a mutual belief of understanding about what a contributor means. Clark and Brennan (1991) suggest that grounding is a basic component of and essential to communication and all other collective actions and is shaped by two main factors, *purpose* and *medium*. People engaged in conversation normally establish a collective purpose for the conversation.

To do this a number of techniques are employed which typically change according to the purpose and content of conversations. There are many different media used for communication some of which are constantly changing: telegraph, telephone, video, email, fax, post-it notes, personal face-to-face communication, teleconferencing to name a few. Techniques employed to establish clear purpose must differ according to the media used. One technique discussed by Clark and Brennan (1991) is the technique of "least collective effort" which suggest that people do not like to put in any more effort than required. This means that exchanges are brief and often lead to short cuts when communicating. The use of the term "okay' is a technique often employed in 'face-to-face' conversation and telephone conversations to ensure the speaker does not say more than necessary-as it indicates that the listener has enough information for understanding however this technique is not often used in keyboard teleconferencing as it is difficult to time its addition without interrupting the typist's flow of conversation.

Socially shared cognition is critical in the direct interaction between two people. Shared understanding of what went before and what actions lie ahead determines the viability of the interaction between participants (Schegloff, 1991). This intersubjectivity is not always a smooth process however talk can be organised and strategies developed that contribute to the shared understanding between participants.

This Study

This paper reports on a small component of a PhD study and was undertaken in a primary school within the mid socioeconomic decile range in urban New Zealand. The aim of the study was to gain insight into children's learning in technology through an analysis of children's conversations with their teachers and peers while participating in technology education. Two classes participated, one Year 2 class (six years old) and one Year 6 class (10 years old). Over the period of a year, two technology units were taught in each class. The units were designed and planned by the classroom teachers in conjunction with the researcher taking the needs of the school into consideration. Both units were taught at both levels and used *The New Zealand Curriculum* (Ministry of Education, 2007).

The purpose of the first round was to enable the researcher to gain a rapport with the students and teachers to increase the likelihood of rich conversations during the second round. The main data gathering phase occurred in Round Two during the teaching of the second unit in each class. In this unit the children designed and developed props for their class item in the school production. At this time six children from each class

became research participants and all children were given a camera to record their technological practice. They were instructed to photograph the things they that thought might help them design and build their technological outcome. The researcher also observed and audio recorded participants while they worked collaboratively in groups of three. The research had a clear focus on the actions and interactions of the children and their teachers. Data gathered included researcher observations, participant interviews, recorded and transcribed child/child and teacher/child conversations and child work samples and student interviews using autophotography. The researcher's role was clearly understood by all participants and she was clearly present in the classroom during data gathering, undertaking ongoing conversations with the children as they worked.

Data Analysis and Findings

Full data analysis is yet to be completed but early findings from the participant interviews recorded as the participants discussed their photographs show clear insight into students' learning. Interviews were transcribed; all photos and transcripts were printed and matched. The researcher then searched for evidence of insight into participants' thinking and understanding of technological concepts and knowledge relevant to technology in *The New Zealand Curriculum* (Ministry of Education, 2007) The discussion and extracts below show very clear evidence that insight into the participants' understanding of technological practice and knowledge was revealed through focussed conversation with the researcher.

Ryan was able to discuss the link between a real Taiwanese boat which they viewed on video and the need for a realistic Taiwanese boat prop for their class item.

Ry: it's the part of the other boat, of the same boat but we painted it red and white instead of just red
R: Why, was the boat painted red and white?
Ry: Because that's the same colour as the umm, real boat
R: Where was the real boat?
Ry: at Taiwan
R: In Taiwan. Why, are we making things for Taiwan?
Ry: Umm, because we're doing a production about Taiwan

Anna was able to articulate that her group's prop needed to be durable, and seen by the audience. She also recognised that a prop helps with the show, again items taught early in the unit.

An: we've also got some hot dog sticks in the tail so the tail wouldn't flop around
R: Oh, why were they there? You said to flop around, why didn't you want the tail flopping around?
An: Because, then nobody would see the tail

Conversations with the Year 6 children revealed that two of the children were able to put skills and knowledge they had learned from their parents to use during the development of their props. The students were asked to plan their final props to scale. Alex was able to employ a strategy used by his father, of drawing a ruler down by one side of the planning page. Below is the comment Alex shared with the researcher about the photo he requested the researcher take of him (Photo 1). The conversation also indicates that Alex knew that plans had to have considerable detail.

Al: *we put like scale and yeah, just all that sort of stuff*
R: *How did you know to put all that on a plan?*
Al: *Well just because plans have like scales and all that……because I've seen plans that my Dad makes and stuff*
R: *Does your Dad deal with plans quite a bit?*
Al: *He designs….. rally cars and stuff*

Photo 1: Alex drawing the "scale" on one side of his planning paper

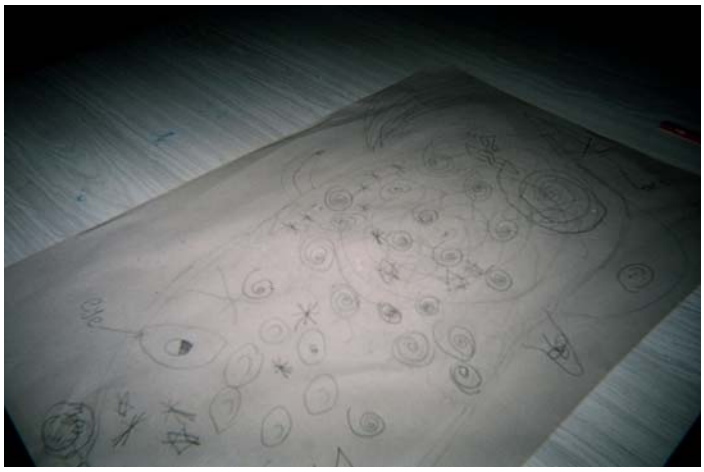
He also used one of his father's terms 'make-shift' when referring to the making of mock-up washers.

Yeah. I basically did the stand. Then that's a bad picture of it standing up again. And then, oh, yeah, that's (pointing to one of his photos) *the practice screws and making a 'makeshift' one, one of the makeshift washers.*

In Year 2Ryan's conversation with the researcher indicated that he has a very good understanding of what a plan was and the purpose of developing a plan. It also shows that he had an understanding of annotations (Photo 2).

Ry: *The plan. This is the plan, it would tell you what it looks like*
R: *what else would it tell you?*
Ry: *How big and how long.*
R: *What is this?* (Researcher points to mark on the photo)
Ry: *That's is part of the fish, it's the eye*
R: *What's this word here?*
Ry: *Eye*
R: *Why have you got that word written there?*
Ry: *Well, we write 'eye' there and then we do a point to where the eye is.*

Photo 2: Ryan's' group's plan with 'annotated' eye



Millie, Year 6, stated that the mock-up was something that she could refer back to, to assist her design process. Alex recognised that experience from the first technology unit aided his practice, "it's ok to change designs as you go". Maddie recognised that one of the features on her mock-up was not needed in her final technological outcome and Tullan's interview revealed that he understood the importance of planning for his practice and referring to it as a guide through the development phase.

Tu: Yeah, the timeline….was important because I had to remember what to do and remember what I had to put into my props
R: Why was the timeline important?
Tu: Umm, because otherwise you could have as long as you want and it, it, you might sort of forget about it….or you might sort of, I don't know how to explain it, but sort of a deadline where you sort of have to have it done.

While talking to the researcher Millie happily acknowledged that her early design was not from the correct era- their prop needed to reflect the era of the 1900-1936 Olympic Games, this response indicated a clear understanding of the need to meet the established criteria for the project. When discussing the project she used the term 'specifications' correctly and that their identification was an important part of the design process. She also recognised that they could be referred back to. Millie's recall also indicated that she understood that materials may impact on functionality and design and her mock-up guided her practice.

Conversation with Maddie revealed that she recognised the importance of specifications and she used 'mock-up' correctly, and that she was aware of role in the design process. She recognised that plans needed to have scale; detail and be from different aspects. Maddy also revealed that ideas don't always go to plan and that she was able to modify her ideas to fit cost and availability of materials.

Ma: that's cutting out the wire for the speaker and it wasn't, the speaker wasn't really big enough so we had to cut out another one

R: Explain that to me a little more. Why didn't you just make this bigger?
Ma: Well we couldn't really because it was just a cut-off that Miss D [classroom teacher] *had got for free because otherwise she would have had to pay for more.*

Jiyong also Year 6, understood the purpose of the plan and the need for accuracy. He also used mock-up in context and the researcher was able to determine that he recognised initial research influenced final design and that materials are sometimes selected for ease of use. Jiyong's interview also revealed that materials influenced the authentic appearance of the prop his team were developing, "These were our speakers and yeah, we did that on wire and we got, that card and we hot glue gunned them, it looks more like a radio and it kind of brings the message" and"Yeah, it looked, like an old radio". Insight was also offered into Jiyong's understanding of the need for his technological outcome to meet the established criteria, "then we've got to put a bit of cardboard over the top of it to make it strong and durable". Tullan photographed a list of criteria needed for his prop, this was what he said about that photograph, "I was trying to remember ….all of the things that the props need to go by, like durable, safe, ergonomically designed and the era and stuff". From this statement we can see he clearly understood the significance of criteria to his practice.

Conclusion:

It is clear from listening to the conversations these research participant had with the researcher that they understood a number of critical aspects of technology knowledge and process. A constructivist curriculum does not necessarily have its primary focus on content knowledge, but rather to promote a way of learning or teaching process as an integral part of the programme leading to autonomous thinking and reasoning.(De Vies & Kohlberg, 1990). In technology content and process knowledge are taken very seriously. Learning begins with the child; thinking about how they think and constructing their understandings within their social and cultural context of the specific content and procedural knowledge to be taught (De Vies & Kohlberg, 1990).

This paper reviews literature in a number of communication theories to determine the influence interaction with peers and teachers has on a child's learning. It also discuses the very practical nature and constructivist foundations of technology education and therefore allows us the draw the conclusion that quality interactions between teachers and learners and between learners is critical for the development of quality technology in our schools. It presents us with the challenge of determining what quality conversations look and sound like, when they are most effective and how we can teach our children to

not only engage in, but initiate interaction with peers and teachers that will most enhance their learning in technology. It leaves us with the questions: *"What defines quality of conversations in technology? and What can conversation do to facilitate and develop to best enhance learning for children in technology education?.*

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