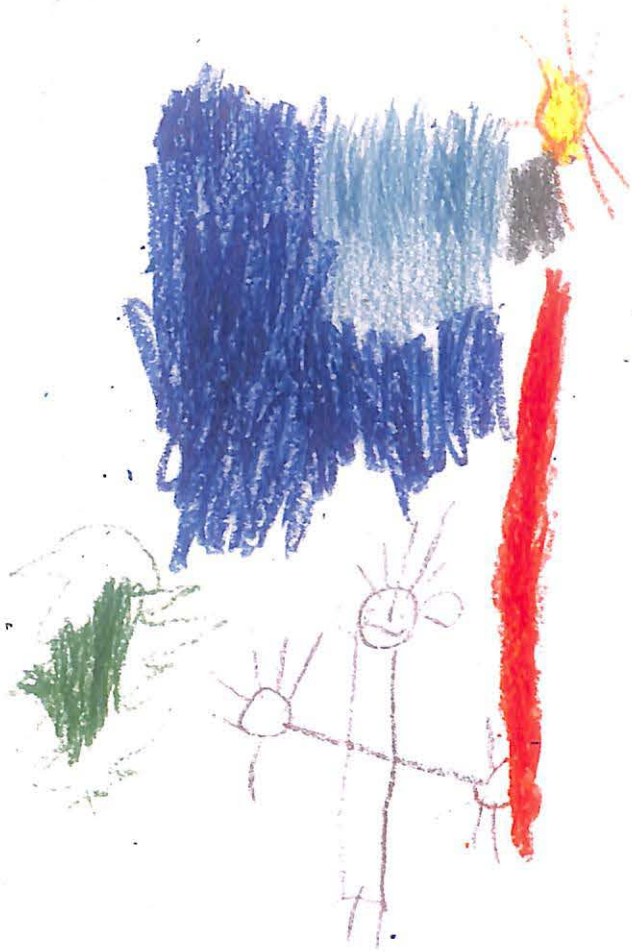

The World Makers: One Centre's Approach to Technology Education with Infants and Toddlers.

Anita Mortlock

Contents

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Infants and toddlers are surrounded by technology. They observe and explore technological artefacts and the uses of them on a daily basis. Despite this, there is little research to guide teachers about what the technological interests, understandings and capabilities of infants and toddlers might be and how they might be supported and extended. Technology education is a relatively new curriculum area and it has not yet been included in the literary discourse about infant and toddler educational programmes. This study aims to examine what the teachers at one childcare centre identify as the technology interests, understandings and capabilities of a small group of infants and toddlers. Video footage was taken of the infants and toddlers at work and play and segments were then shown to individual teachers during interviews. The children's assessment portfolios were examined and the teachers and families were invited to contribute further information. The sum total of this data was used to analyse and reflect on particular episodes of video footage. The technological interests, understandings and capabilities of both the children and the adults were seen to be integrally linked to the temporal, physical and interpersonal environments of the centre.

Chapter One:
Introduction

As citizens of the world we live in, we are immersed in technology everyday (Fleer & Jane, 1999; Malcolm, 1998). There is a strong association with the word "technology" as being synonymous with computers; however, technology can be seen in most facets of the ordinary and the mundane features of Western culture (Fleer & Jane, 1999; Wright, Yates & Sarcella, 2003). The children of today's Western societies are immersed in technology from utero with the very first ultrasound scan of a foetus. Our babies are surrounded by technology such as mobiles, bottles, nappies or routines.

Fleer & Jane (1999) assert that technology plays a powerful role in the daily lives of the very young, yet there is an alarming lack of research to illustrate how adults might engage in technology education with infants and toddlers. A literature search conducted by the researcher in 2003 yielded only one technology article (by Visser, 1999) specific to infants and toddlers. 'Technology' as a subject is noticeably absent in the discourse about infant-toddler education programmes. As teachers we often experience difficulty in defining technology education (Fleer & Jane, 1999; Wright et. al., 2003) and we do not really know what capabilities are being developed, missed or even misdirected (Fleer, 1999, 2000).

The focus for this project was on teacher-behaviour in regards to technology education. A qualitative case study (Creswell, 1994; Bouma, 1996) was undertaken in one centre with a small group of infants and toddlers and had a focus on:

•the kinds of things that "counted" as technology education from the teachers' perspectives,

•the documentations and assessments that occurred and

•the responses that the teachers made to progress and extend the children's technological knowledge, skills and interests.

Data was collected through video-footage and still-photographs of teachers and children working technologically. Selected children's portfolio books were examined and informal individual interviews were held with teachers. All data was collected by the researcher as participant-observer and a qualitative case-study was developed. Fuller details about the research methods are provided in chapter two.

The centre was chosen specifically because the teachers and some of the centre parents had existing understandings about technology education. Mawson asserts that the "key factor in recognising children's technological learning is the development of personal knowledge and understandings of technology by early childhood teachers" (2002, p15).

The data yielded a philosophy and pedagogy that embraced the notion of working technologically *with* infants and toddlers. Philosophy was interwoven with the teachers' working definitions of technology education and provided the emerging picture of the technology education context at this centre. Added to this were the references that individual teachers made to the technology work of the children in relation to the physical, temporal and interpersonal environments. The technology work of children was

seen to have effect upon the three environments. This was enabled by teachers who were sensitive to the individual children's interests and intentions. One example included a small group of toddlers who developed a ritual at afternoon tea that involved each child taking off their bib. Not only did the children negotiate the 'workings' of their bibs and influence their mealtime routine, but they developed something that 'spoke' about group cohesion and cooperation. Multiple effects became visible upon the three environments. Added to the relationships between the children's technology work and the environments were the teachers' own abilities as technologists. Some of the ways that the physical equipment, the centre routines and certain interactions impacted upon children's learning was actively discussed and appraised among the teachers. Modifications were frequently resultant in order to support children's work and play.

The teachers highlighted certain teaching and learning episodes as being indicative of technology education. These included times when the children explored and used structures such as cardboard boxes; mechanisms, such as zips; and materials, including those that might be found on a collage table. Self-directed exploration and guided exploration were seen as being essential in enabling children to follow through on their interests and develop technological understandings. Other common technology episodes involved the children's technological capabilities such as developing specific skills, such as connecting. The children's theories about what particular objects could be used for appeared to be of high importance to the teachers.

The decisions that the teachers made to support the children's learning were often based on preceding assessments that were concerned with what the child was intending to

do or achieve. These assessments were frequent, ongoing and were more likely to be informally shared through discussion rather than being documented.

One of the crucial factors in these assessments was the effectiveness to which the teachers could 'read the children' and their intentions (as one teacher so aptly stated). Understanding very young children's communicative gestures and verbalisations was a topic that was frequently raised by the teachers during interviews. The teachers saw themselves as taking an active role in promoting technological language and were observed doing this in situ of the children's work and play, sometimes using books or gestures, for example a teacher 'drew' circles in the air with her finger as she described the rotation of helicopter blades to a toddler after one had just flown overhead.

The findings reported here are based on the technology education programme at the centre studied. It is not envisaged that this approach is applicable to all centres or even to all infants and toddlers. It is hoped, however that what is presented here might be of interest to others involved with infants and toddlers and technology education.

Several key themes were identified from the data and have served the basis for reporting back the findings of this research. Chapter three initially seeks to describe the technology education context. This includes the teachers' working definitions of technology education. In their individual interviews the teachers each discussed "what counts" as technology education in relation to the interpersonal, physical and temporal environments therefore these notions have been included in the context picture. The notion of the 'teacher-as-technologist' as someone who designs, makes, appraises and modifies each environment is also considered.

Next, the children's exploration of the designed world is examined. Provided are descriptions of how specific children's technology-based interests and understandings are supported through directed exploration and guided exploration of structures, mechanisms, materials, routines and the living world. The proceeding theme is concerned with children's technological capability in relation to skills, affordances and problem solving.

The 'findings section' concludes with 'communication and technology'. The notion of intentionality is an important theme in terms of how we understand what it is that infants and toddlers want to do, know or achieve in order to support them. Gestures and the language of technology is very briefly discussed, as well as how technological ideas might be communicated through symbols.

Finally, the concluding statements made in chapter four summarise some of the children's technology-based interests, understandings and capabilities. It also briefly describes the nature of the technology documentation and assessments as well as the responses that the teachers made to the children's learning. Suggestions for further research are given.

A literature review and further details about the research focus are provided in the following section.

Literature Review

According to the literature reviewed, technology education in an early childhood setting will allow opportunity for the children to:

- Design, make, appraise and modify products, systems, environments or services (Anning, 1994; Fleer, 2000; Gardner, 1990; Hope, 2000; Napper, 1991; Solomon & Hall, 1996).
- Appraising the effects of particular technology on the wider community (Mackay, 1991; Young, 1991).
- Refine ideas and develop appropriate solutions to problems (Malcom, 1991; Mawson, 2002; Napper, 1991; Roth, 1995; Smorti, 1999).
- Work innovatively and creatively, following their interests (Carr, 2001; Hope, 2000; Mawson, 2002; Napper, 1991; Smorti, 1999).
- Take responsibility for their own learning and develop theories to make sense of the world (Malcom, 1998; Mawson, 2002; Parkinson & Thomas, 1999; Siraj-Blatchford & MacLeod-Brudnell, 1999)
- Explore and utilise tools, systems and resources (Carr, 2001; Fleer & Jane, 1999; Napper, 1991).

Te Whāriki (Ministry of Education, 1996), the Early Childhood Curriculum framework document, has a few explicit references appropriate to technology education in the *Communication* and *Exploration* strands that include developing increasing skill in using tools, materials and technology to explore and represent ideas. Mawson (2003, p. 505) states that the goals from all five strands in *Te Whāriki* directly relate to those in the

Primary Technology document and that as an entire document, *Te Whāriki* acknowledges and seeks to "develop the considerable range of technological activity that it occurring every day in children's play". Technology can be defined as:

> ...a creative, purposeful activity aimed at meeting the needs and opportunities through the development of products, systems or environments. Knowledge, skills and resources are combined to help solve practical problems. Technological practice takes place within, and is influenced by social contexts.
> (Ministry of Education, 1995, p.6).

It is important to note that almost all of the literature discussed technology education in relation to children aged three years and over. Obviously, the physical skills, problem solving, content knowledge and communication of infants and toddlers are less sophisticated to that of older children. For this reason, many of the examples provided in the literature of teachers working technologically with older children are inappropriate to illustrate ways of working technologically with younger children, especially with those that are pre-lingual. It is important to take stock of what is known about the capabilities of infants and toddlers that may bear relevance to technology education.

Bauer, Schwade, Saeger and Delaney (1999) concluded that children from as young as nine months can plan a sequence of actions in advance to achieve a specific goal or problem. An infant may have the ability to remember what they have learned in one situation and apply it to another. They are able to retrieve learning from relevant prior experiences and apply procedural strategies or solution principles to a current problem. In other words they are able to integrate findings from other situations in order to achieve a goal (Chen, Polley, Sanchez & Campbell, 1997).

These goals can be communicated by very young children through gestures. Infants as young as one year old appear to appreciate that symbolic gestures can be used to communicate intentions, as well as name and/or request objects. (Goodwyn, Acredolo &Brown, 2000; Namy, Acredolo & Goodwyn, 2000). Research has found that adults who use gestures with children are likely to both model the gestures and be sensitive to the gestures that children make. Gestures have found to be important in episodes of joint attention because they serve to initiate communication about things that the child has an interest in, thereby making the discussion highly meaningful. Goodwyn et al., write: "The symbolic gestures themselves constitute a "scaffold" be enabling the children to gather information about the symbolic function in general, and about the specific objects, events, and conditions that make up their world" (2000, p100).

Through communicating with others, very young children are likely to be learning about the technological objects around them. Spelke (1985) states that by three months, infants have a 'stable perceptual world' in the sense that they seem to be able to identify objects as being separate and distinct from their background. By five months the infants appear to differentiate between causal and non-causal movement in objects (Leslie, 1982). Although their manipulative skills may be restricted, infants generally have plenty of opportunity to observe others using various objects and appear to develop theories about them. One example is shown in the research of Kolstad (1991, in Mandler, 1992) that determined that the studied children (aged five months) demonstrated considerable surprise when bottomless containers appeared to hold things.

These attributes of infants may bear some importance to their increasing abilities in working technologically. Another attribute worthy of consideration is Mandler's (1992) assertion that between three to five months of age, infants appear to develop a contemplative attitude. This could be seen as important in the development of planning capabilities. Infants and toddlers do possess the cognitive capacity to engage in technology education.

Rogoff, Paradise, Arauz, Correa-Chasez and Angelillo (2003) have examined the processes by which young children learn through observing others and listening in on their conversations. While they did not speak specifically about infants and toddlers, they did state that children are active agents when it comes to seeking information and skills about activity that interests them. They refer to the notion of 'intent participation' which has much potential to enrich our thinking about technology education with infants and toddlers, especially when one 'cross-pollinates' this idea with the following diagram from *Technology in the New Zealand Curriculum* (Ministry of Education, 1995).

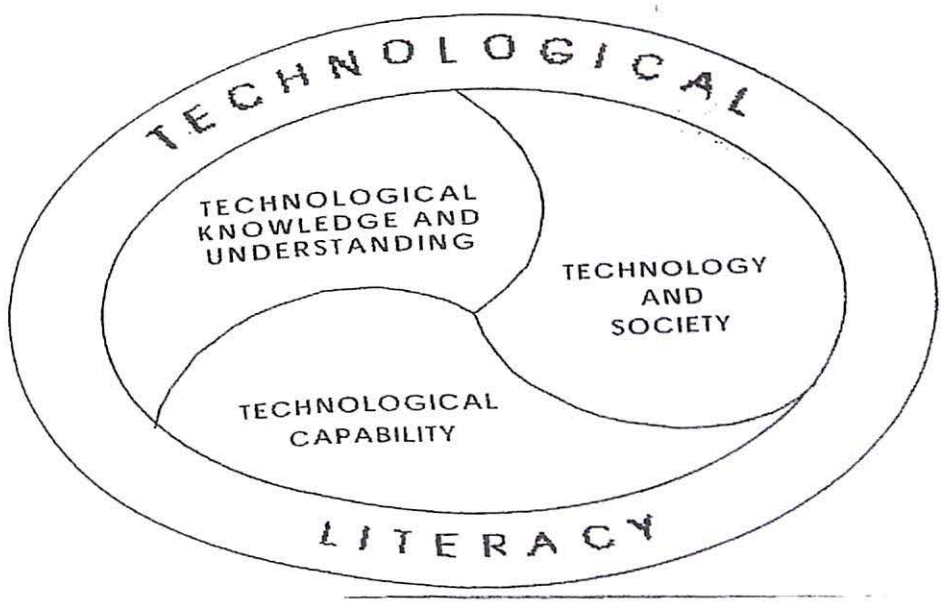


Figure 1: Technological Literacy from *Technology in the New Zealand Curriculum* (Ministry of Education, 1995)

Intent participation refers to experienced people and learners involved in a shared focus. The learner participates alongside the experienced person, observing, often offering their own ideas and contributing to the task at hand with increasing independence (Rogoff et al., 2003). This bears some resemblances to the Māori notion of '*ako*', whereby two participants teach and learn from each other. In terms of its relation to the diagram and technology education with infants and toddlers, we can presume that children may develop emerging technological-literacies as they act as observers and participators to the technological activity of more experienced 'others'. Knowledge, understandings and skills and capabilities are made visible in real contexts that have social and cultural meaning, and in which the child has an interest.

Research Focus

What adults do matters greatly in technology education (Browne, 1991; Mawson, 2002; Palmer, 2001) therefore I decided to focus on the teaching. This project will describe the approach to technology education with infants and toddlers at one childcare centre. In particular, three questions have been developed in order to focus the collection of data:

1. What do the teachers identify as the technology interests, understandings and capabilities as indicated by what they know, discuss and / or observe about the work and play of a group of infants and toddlers?

2. What documentation and / or assessments do the teachers make about the technology interests, understandings and capabilities that the have identified of the infants and toddlers?

3. What responses do the teachers make to progress or extend the technology interests, understandings and capabilities of the infants and toddlers?

The notion of 'interests', 'understandings' and 'capabilities' are interwoven into each question. The 'interests' of the children have been chosen as a focus based on Carr's work on dispositions and the importance of 'finding something of interest' to meaningful learning (Carr, 2001). The idea to use 'understandings' and 'capabilities' has been taken from two strands in the curriculum statement: *Technology in the New Zealand Curriculum* (Ministry of Education, 1995). These strands are: '*Technological knowledge and understanding*' and '*Technological capability*' (Ministry of Education, 1995, p.13). Mawson (2001) states that this curriculum document integrally links technological understanding and capability to the development of technological literacy, which, is itself at the 'heart of technology education' (p. 135).

Chapter Two

Methods

The research followed a qualitative case study model (Bouma, 1996; Creswell, 1994) with the researcher taking part as a participant-observer (Bouma, 1996).

Sample

The centre was purposively chosen (Bouma, 1996) because the teachers had an existing understanding of technology education. They also took an interactionist approach in their work with children, as defined by Mawson (2002) in the sense that they perceived their role as teachers to be one where they actively engaged with children on shared experiences. The centre was also chosen as they shared an existing relationship with the researcher. I had worked at the centre as a teacher several years ago and have a child who currently attends the centre. The centre teachers and I had also worked jointly to make a booklet about technology education in 2003.

The research population

The setting was one particular New Zealand, community based, non-profit childcare centre for children aged four months to five years with the children coming from a diverse range of cultural backgrounds. The children were physically separated into two groups:

1. Group one:

   Ages of children: four months- two years.

   Group size: no greater than seven children.

2. Group two:

   Ages of children: two- five years

   Group size: no greater than sixteen children.

Staff: Each group had three fully trained teachers, two with each group of children at all times, with the third covering breaks and non-contact duties. There was also a semi-trained part time teacher, an in-training teacher, and a part time teacher aid employed by the centre. These people participated in non-contact duties or released the other teachers to spend time with whānau or attend to centre management duties. The teachers had a range of teaching experience from 15 years to 5 years. All of the teachers had been permanently employed by the centre for at least three years, and in one case, longer than 12 years. Collaborative teaching within the staff formed an integral part of their philosophy (Centre philosophy statement, 2003).

The two groups came together for substantial parts of the day, where the concept of [1]tuakana-teina was visibly active. For the rest of the day, the two groups were separated.

Data was sought from interviews with teachers, observations of them working with children, and portfolio books. The potential to gather an unmanageable amount of data was recognised so I decided to narrow collection by focusing on only some of the interactions and portfolios. To do this, I asked the teachers to nominate four children of whose interactions and technology experiences I would concentrate my attention on.

[1] Tuakana-teina is the Māori concept of older children assisting the younger children.

These children were: (pseudonyms given):

Casper, aged 22 months, male, of Samoan descent.
Cia: aged 14 months, female, of Māori and Pakeha descent.
Ned, aged 10 months, male, of Pakeha descent.
Talia, aged 8 months, female, of Pakeha and Samoan descent.
However, because they played with and alongside other children, many of the other children enrolled at the centre were included in the project also. The project was not concerned with collecting data that was specifically concerned with age, gender or ethnicity due to issues of manageability and time constraints.

Data collection strategies

Data was collected through three main methods: observations, interviews, and through studying relevant documentation.

Observations:

Firstly, I was present at the centre to take observations of the teachers and the focus children over four weekly sessions (2-3 hours each) through video, still camera shots and written notes. Each child was observed continuously for up to an hour each session. Exceptions were when the child required routine care such as sleep or toileting and it was considered an invasion of the child's privacy to continue filming. Segments were then isolated by the researcher, having been chosen against the following criteria:

(a) The provision of technological artefacts, experiences and routines by the teachers for the children.

(b) Evidence of children's engagement in exploring technological phenomena, presenting behaviour indicating technological knowledge, understandings and/or capabilities.

(c) Teachers attending to, and/or responding to the children's interests in things technological.

Teacher-researcher interviews:

The segments of the video footage and observations based on the above criteria were shown to the teachers who were involved in each learning episode, or where there was no teacher directly involved, the footage was shown to each teacher in the infant-toddler group. Overall, two of the three trained infant-toddler teachers, the part-time semi-trained teacher, and one of the teachers belonging to the group of older children were interviewed. Interviews took place at the centre in a secluded room with the researcher and the teacher in question. A relief-teacher had been arranged once a week for four weeks to release teachers from duties in order for them to participate in interviews. Two hours was negotiated for each interview session. The two hours was then divided between the teachers so that each had individual interviews.

The segments were discussed in relation to the technology learning/ teaching that could be identified. The teachers often volunteered information individually surrounding each episode that was not visible to the researcher, such as the teachers' beliefs in regards to infants and toddlers, and/or learning and technology. Links were also made to the other interests of the child or anecdotes from home. The three focal points for these interviews were:

(a) What the teacher noticed about an emerging technology interest, understanding or capability by the particular focus child.

(b) What she did / intend to do by way of teaching response.

(c) "What counts" as technology education from their perspective.

A basic interview schedule was also developed to focus questioning and discussions (see appendix 1).

Notes were taken from the discussions and recorded in a notebook. The segments of footage were typed up as observations with pictorial evidence and the data yielded from the interviews and information informed the analyses of them.

Documentation:

The focus children's portfolio books were also examined by the researcher using the same focal points listed in the previous section. The teachers were also asked to note down anything that they felt was relevant to the project. This proved to be a fruitful source of data that increased remarkably as the data collection phase progressed. One teacher even telephoned me several times after hours. Each of these calls proved to be a turning point in the project as the focus children were noticed engaging in increasingly sophisticated and complex technological work. Information given by the parents of the children (either to the researcher through informal verbal discussions or to the teachers via informal/formal discussions and from home planning sheets) was written down and included. Where information was given to the researcher verbally, notes were taken in a field diary at the first possible moment.

Finally, the data was written up as a series of observations with analyses and photographs attached. Copies of these were given to the families and to the teachers.

Further input was invited, and three families gave responses confirming what the teachers and I had noticed. Two of these families contributed anecdotes that enriched that data by placing particular technological interests, understandings or capabilities in the home-context. Key threads were then teased from the analyses (see Chapter three).

The initial intention was to develop four case studies about technology education. However, it quickly became apparent how often the children's interests and understandings influenced and informed the work of others in the group. As is expected in a socio-cultural approach, many of the understandings of the children were perceived by the teachers to reside in the group, causing the specific elements to each case study to be highly complex. For ease of reporting, the teachers' key ideas have been taken from the data and have been described in general terms. Specific examples have been provided to support and illustrate each idea.

Ethical considerations

One of the primary ethical considerations in approaching this centre for research was the fact that I had an existing relationship with it in both a personal and professional capacity. The centre and I had worked together on a previous project regarding technology education a year prior to this project, and I had been a member of the teaching team a few years before that. My son currently attends the centre also. Because of these existing relationships it was important to discuss expectations about my roles with the teachers and with the centre management. Before agreeing to be part of this project, the teachers and management received copies of the project proposal which they discussed in meetings. I also attended a staff meeting to explain the project to the teachers and give

them a forum where they could have any queries answered. From a researching perspective, it was important that I kept a field diary and noted any issues or times where bias may have affected the data. I decided early on that I would collect data on days when my son did not attend the centre to further minimize bias.

Once approval had been given from the Massey University Human Ethics Committee (number PN04/70) information sheets and forms seeking written permission for each type of data gathering was sent to the teachers and each family enrolled at the centre (see appendix 2 and 3). It was important to have the permission of all children as the two groups at the centre came together for substantial parts of the day, and it was likely that many of the children might be captured on tape, and/or engaged in the technology work of the group of infants and toddlers. Permission was received for most children. Where permission was not received, video footage was deleted. Families and staff were informed in writing that they could withdraw from the project at any time, however, nobody chose to.

In terms of reporting back, informant responsibility was kept in mind in accordance with Creswell's (1994) definition of ethical responsibility to participants: "the informants' rights, interests and wishes will be considered first when choices are made about the reporting of the data and the final decision regarding informant anonymity will rest with the informant" (p.166).

Where segments of learning were transcribed from video to observations, the teachers and families of the children involved received copies to keep and to make comment

about. A second round of informal verbal and/or written permission was sought to include the data in the final reporting of this project.

Other provisions for reporting back include an undertaking that each teacher and each family whose child is included in the project shall receive their own copy of the final project after it has been marked. A condensed report of the key findings shall also be written for the centre community.

Limitations of the research

The findings that are reported here, apply to the centre from which the data was taken from only. The conclusions are not intended to provide a conclusive and generic approach technology education with infants and toddlers. However, it does provide an interesting point from which other centres may like to discuss what technology education with infants and toddlers might mean to them.

As the project progressed and the data was collected, it became increasingly hard to stay with the children who were initially selected to be the focus for case studies. Part of this was because of the extent to which their technology work was connected to other children. However, this was also because the teachers and myself saw some of the teachers' ideas about technology education with infants and toddlers that had been raised in discussion exclusively exemplified through the interests, understandings and capabilities of other individual children. Perhaps it would have been more appropriate to collect data without specific children in mind. The criteria for analyzing the video

footage, and the focal points for interviewing teachers most probably would have sufficed to serve as criteria in deciding what and whom to observe.

Another limitation is apparent in terms of the researcher wanting to include "the favourite stories" that appeared to become dear to the both the teachers and myself. A reluctance to leave some of these stories out has meant that the reporting of this project is somewhat larger than intended, however, it is hoped that the participants are left with a document that acknowledges their contributions and work.

Chapter Three:

Findings

Defining 'technology education'

Initially, I had some rather convoluted discussions individually with four of the teachers: Naeve and Arywyn (two of the infant-toddler teachers), Eli (part-time teacher) and Jennifer (teacher for the older children). These occurred during interviews as well as casual discussions at other times and highlighted how difficult defining technology education is, especially in relation to what it means for infants and toddlers. However, by the end of the project a definition for technology education was developed by Naeve, and agreed upon by the other teachers. It appeared on a wall display and stated that:

"Technology can be seen as any way we modify our environment, physical and temporal, for a purpose".

This reflected the teachers' belief that technology education involves how infants and toddlers come to explore and understand the dynamic between their environment and their ability to make affect upon it. It was agreed that technology education for infants and toddlers is based upon certain assumptions, including:

- The belief that infants and toddlers are powerful learners.
- That exploration is a key component to technology education.
- That infants and toddlers do learn from the technology that surrounds them.
- That infants and toddlers do engage in technological activity.
- That the responses of adults matter greatly.

It became apparent, that the teachers' approach was not centred on the notion of technology education *for* infants and toddlers, but rather *with* them (such as in 'co-

construction). This was because in most instances the child was the protagonist to many of the actions and reactions of the teacher. This has particular relevance when considering Mosier and Rogoff's (as cited in Lally, 1995) belief that infants learn about their own potency, or lack thereof, from success or failure in using their caregivers as instruments to achieve their own goals.

As Greenfield (2002, p50) writes: "our cognition is socially situated" therefore it seemed important that this project was situated in the socio-cultural paradigm. The influence of the teachers upon the children's work, and indeed, the influence of the children upon the work of their peer group were evident. The environment was also perceived to influence, and be influenced by the technology skills, understandings and capabilities of not only the infants and toddlers, but of the teachers (see figure 2).

The 'Teacher-as-Technologist'

One of the things that was determined very early on in the project was the importance of the teachers' own abilities as technologists who could design and plan, implement their ideas, and appraise and modify them. It was felt by the teachers who were interviewed that teachers' own skills provided certain models for the children in terms of technological capability and utilizing technological processes. It was also felt that these skills shaped the children's own technology experiences through the materials, equipment, systems and routines and support that were given by the teachers in response to the children's interests and work.

The approach here involved moving beyond focusing solely on cognitive processes and examined relationships between the adult, the child and the total environment (see figure 2). In this context, the teachers highlighted three learning environments as being central to children's technology experiences and to their learning: physical, temporal and interpersonal. The next section 'unpacks' some of the teachers' ideas about the relationships between the environments and technology education.

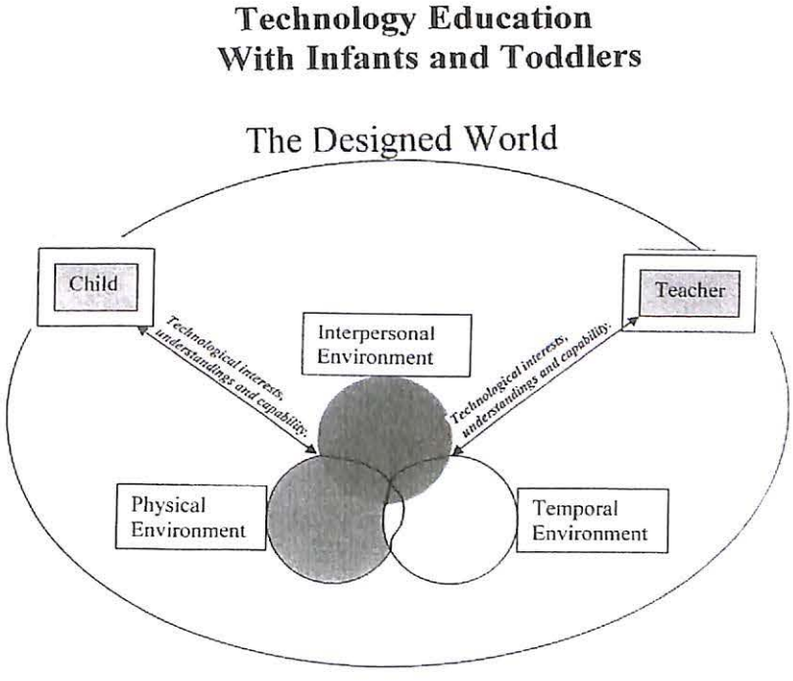


Figure 2:
Relationships between the technology interests, understandings and capabilities of the child, the adult and the environment.

The physical environment

This included the physical internal and external layout of the centre as well as equipment and materials. Considerations for the physical environment included what the teachers provided and how it enabled children to explore equipment and materials, use them, problem solve with them and make things using them. In the following example

the equipment that the teachers designed and made (technological processes) was used by the children in developing games that involved repeated routines of action.

> In response to some of the children's interest in musical instruments and making sound, the teachers designed and made bells on strings and suspended several of them from the roof of the deck. The children used them for individual exploration as well as in games involving groups. Ally and Eileen (children) were observed looking at each other and smiling while pulling the elastic and causing the bells to shake. During one observation, they let go of the elastic causing the bells to spring up. This caused much laughter.
>
> Later, as the interest shifted, the teachers strung balloons from the roof, sparking renewed interest in the group games. One group game was for the older toddlers to run along the deck, banging the balloons with their heads watching each other and laughing.
>
> Games of this nature can also be considered "technology" given that the design is negotiated between individuals, in this case, mainly through gestures and actions, and is modified and renegotiated as the play progresses.

The teachers were also concerned with the messages that certain equipment and materials gave to children, especially in regards to their competence. Naeve (teacher) noted that anything that was manufactured was a technological artifact. Given this, we know that certain technological artefacts are values-laden and carry implicit messages regarding purpose, intended users and benefactors (Fleer, 1999; Young, 1991). The teachers gave one particular example when they discussed how the provision of certain things can empower children in their work such as a painting easle that they had bought specifically for children who were interested in painting but who were not yet standing (see appendix 4).

The temporal environment

The temporal environment included the routines and rituals that make up the day. They were designed for specific purposes concerning structuring time and were

constantly appraised and modified as needs change. Therefore, routines were counted as technology under the broad category of 'systems'. The teachers at this centre most certainly incorporated the issue of routines into their discourse of technology. Naeve said that for children: "knowing what a good system was, was dependent on experiencing one".

The importance in having routines that are responsive to individual children's needs is associated with children being able to predict what will happen to them next and having skills in basic prediction or forecasting are essential to planning (Fleer & Jane, 1999).

The temporal environment was divided into three levels:

Micro-routines: *predictable repeated sequences of actions to mark key events* such as Ned's morning tea ritual seen in the following example

When it was time for Ned to have his morning tea, Naeve bought Ned his highchair. She told him it was time for something to eat and then lifted him up. When she went to place Ned in the highchair, he protested. Naeve said: "Oh. I forgot to set your food out". She set up his highchair with food and then attempted to put him back in. This time he squealed and wriggled his feet, smiling.

Figure 3: Ned's morning tea ritual

Meso-routines: *one child's individual routine over the day based on his or her biological, emotional and intellectual rhythms*. The importance of the teachers approaching meso-routines responsively is highlighted by one of the letters that goes home to parents which states:

"At the centre, the programme for infants and toddlers is guided by each child's individual routine for eating, sleeping, and nappy changing/toileting. Your child's primary caregiver is responsible for ensuring that this occurs in a calm and caring manner. In this way children experience consistency and continuity between home and centre which is necessary to develop confidence and trust to explore and to establish a secure foundation of remembered and anticipated people, places, things and experiences." (Single page centre handout).

Macro-routine: *how these individual rituals and routines are organised and come together to make up the centre's overall routine.*

It was noted by the teachers how children can effect change upon their temporal environments *if* teachers are able to recognise and support the children. Bexs identified an episode where the toddlers developed their own ritual concerning afternoon tea where they all repeatedly chose to have yoghurt. Over several sessions the children all removed their bib as soon as the yoghurt was placed in front of them (appendix 5). This may not have happened if the teachers were not sensitive to the technological potential in what the children were doing.

Arywyn, in particular talked about the importance of the temporal environment acting in accordance to the child's rhythms. She also talked about the importance of the children feeling safe and having attachment to the staff in order to be able to take risks in their technological exploration and problem solving. Having responsive rituals and routines is integral to this.

The interpersonal environment

The physical and temporal environments were seen to impact on the social interactions that the infants and toddlers would experience in the interpersonal environment. Terrini and Pairman corroborate this by stating:

The environment 'speaks' to children- about what they can do, how and where they can do it, and how they can work together". (2001, p1).

Large structures enabled the children to develop particular types of play and games, for example, a box was seen to facilitate games of 'peekaboo' between two children in particular (see appendix 6).

Naeve, in particular seemed interested in how systems, routines and rituals could support and re-enact social conventions. This raised interesting implications of links between what Barber (1992) called a 'social-systems perspectives' and technology, particularly in the examination of systems to support power or cultural practices. Naeve noted that rituals can be designed and expressed by individuals of a group in order to meet a specific goal or aim (often as part of a wider system). After we had discussed Cia's interest in shoes and the systems/rituals governing them (i.e. taking shoes off at the door when going inside), she wrote in a note to me:

"The times and places you wear shoes and where to put them when you take them off are systems of social convention which may vary with culture and are learnt quickly by young children who seem to look for order and sense in their environment."

Rituals to re-enact social conventions were also expressed in the group culture of the infants and toddlers, such as the following one governing turn-taking.

After talking with Bexs about it I wrote in my field notebook:

> One ritual/system that has been developed over several weeks is one where some of the toddlers determine that they want a piece of equipment that another child is using...the toddler may choose a different piece of equipment and offer it to the other child as an exchange. Interestingly, the teachers note that the children seemed to have an awareness of what equipment might be appealing to the other child. Usually the notion of "swapping" toys seems highly successful. [The origin of this appears to have come, in part, from Bexs doing this one day, and then a child utilizing the same strategy when encountering a similar situation at a later date. How it has 'spread' from here is unknown]. The teachers appear to be complementing social concepts with the problem solving processes of technology education. Paraphrasing the 'problem' to be solved is a teacher-strategy that has been visible throughout the project.

Another important facet that appeared to be prevalent in the interpersonal environment was the teachers' ability to provide ongoing and articulated appraisals for different phenomena. These teacher-appraisals were often articulated to the children in the course of their work and were considered to be valuable in the transmission of certain values pertaining to technology education (such as "doing good") but also for providing a model of appraising for the children, as seen in the following examples.

> The feet-part of Talia's stretch'n'grow kept stretching as she negotiated her way up and down the side of the rowboat. After a while she tripped over them. Eli (teacher) said to Talia: "You're trousers are too long" (providing a basic appraisal). She pulled them up, articulating that this was what she was doing and why. Later Talia tripped over again. This time it was Naeve that noticed. She too articulated a basic appraisal that the bottom of the trousers was too saggy, and then verbalized a solution- putting shoes over the top. This done, Talia was able to resume her walking and the teachers were able to articulate that her shoes were preventing any further stretching.

Cia picked up an old pair of headphones and attempted to get them on her head. She eventually did so but looked unhappy. Arywyn (teacher) approached and took them off Cia's head. She showed her the headphones and pointed to one side where the ear cushion had come off. She explained to Cia that the lack of cushion had caused Cia's discomfort and talked about how the cushion will need to be glued back.

Because the physical, temporal and interpersonal environments were constantly appraised, modified, designed and redesigned as the children's and teachers' technological interests, understandings and capabilities evolved, they were part of, what can be described as the 'designed world'.

Finding interests and developing understandings: Exploration of the designed world.

Exploration was characterized by the children having interest in equipment and materials, as well as exploring systems such as rules and routines. Exploration included the child developing understandings about the properties of technology, including the exploration of what may happen when those properties are acted upon in certain ways. Exploration was identified when the children engaged in self-directed play as well as through episodes of joint attention.

Self-directed Exploration

At times, the teachers felt that it was important to provide play materials that the children could be free to explore on their own terms, as in the Heuristic model (Gerber, 1987). The play materials included some technological artefacts that were familiar to the

children and some that were slightly more unfamiliar. Learning occurs when there is an optimum incongruity between what is known and what is new (Gonzales-Mena & Eyer, 1989). This means that children must discover something that is similar enough to already-discovered things so that it is not 'scary', but that is different enough to be interesting. The following is an excerpt from Cia's portfolio.

Cia was given opportunity to explore the treasure basket of Heuristic play materials. At first she [experimented] with the objects by handling, mouthing, tipping and banging them. Later, Cia selected the hair gel jar. She examined it closely then she experimented with the jar and the lid, turning the lid on the jar. She continued the experimentation for quite a long time. While Jennifer (teacher) (her mother) visited during her break she said that at home Cia loves playing with bottles and jars with lids.

Figure 4: Cia and Heuristic play

Free exploration and guided exploration

Many of the interactions between the teachers and the children were characterized by changes in free exploration to guided exploration and back again in one episode. The following example demonstrates how Arywyn modeled the use of the equipment in response to Casper's interest in knowing what it did and also in response to his frustration in not being able to replicate her use of it. Once a model had been provided to Casper's apparent satisfaction, the teacher "stepped back' in order for the child to undergo his own exploration of how to use the mechanism. The resulting exploration involved Casper being able to resourcefully use a key as a tool to turn the cog, thus providing an alternate model for the teacher.

Casper, indicated an interest in what the cogs did, so Arywyn made the decision to set some up for him, and to model how they worked, by turning them with her hand. Casper disconnected the cogs, and then expressed frustration when he experienced difficulty in reconnecting them. Arywyn acknowledged his challenge, and then showed him the convex and concave parts to the cog could interconnect with another cog. After seeing that Casper was still experiencing difficulty Arywyn shared her thoughts that he should change the position of his hand to achieve a better grip in order to connect the cogs. This done, Casper was able to place the cogs together. He then selected a key to insert in the top of one of the shapes. Twisting the key meant that the cog-mechanism also turned.

The 'teacher talk' in interviews and discussions emphasised the importance of staying back until the child's intention had been clearly established, and until the child had accepted the offer of adult involvement. They felt that initiating interactions with children before this had been done would cause the teacher to take the experience "away from the child" therefore make it less meaningful. Establishing the child's intentions, was seen as being crucial in developing intersubjectivity.

The teachers at this centre mainly ascribed to the notion of joint attention and scaffolding that has become common in early childhood education, whereby the adult and the child are involved in a shared focus. Through observing and interacting with the child, the adult determines his or her current understandings and capabilities and works with the child by asking questions, providing equipment, or giving demonstrations.

Technology and Exploration of the Living World

As well as the manufactured technology, the teachers felt that it was critically important that children were able to explore the living and natural world as well. Such experiences might have a stronger links to environmental education, or, as Bexs stated, to developing [2]kaitiakitanga. However, a relationship with the natural environment can facilitate "respect and a developing sense of responsibility" for it (Ministry of Education, 1996, p 90) which could be considered an essential tenet to encouraging environmentally responsible technologists and technology-users. Technology can be appraised against criteria concerned for the environment, but this is likely only if the "appraisors" care for the living world to begin with.

Here, "*Ned is sitting on the grass holding pine needles and a dried leaf from a tree.*" (excerpt from portfolio book)

"*Children learn about the universe through the sum total of all their experiences. The earth, sun, wind, air, rain, rainbows, water, clouds, tress, rocks, bark-other plants allow children to feel, see and connect with the physical aspects of the world. Other creatures such as spiders, worms, dogs and tigers enable children to learn about the complexities of life on earth*".
-Bexs's wall display.

Figure 5: Ned and the living world.

[2] Māori concept of guardianship over the living earth.

Exploration of structures and mechanisms

The New Zealand school curriculum for technology (Ministry of education, 1995) includes structures and mechanisms as technology areas. The teachers identified many interests of the children that related to structures or mechanisms, and exploring their bodies in relation to them, as shown by the following examples.

Row boat structure:

Talia reaches her arm a small way into the boat. As she does so, the boat rocks. Talia rights herself and places both hands on the boat so that they are a reasonable distance apart and causes the boat to rock from side to side. She makes an utterance- excitement at her discovery? She steps from foot to foot, nearly on the spot, and looks in the direction of the other children. (Observation from video footage).

Steps: Structure

"*Recently, Ned is using furniture to pull himself up into a standing position. Now he begins to walk around the furniture by stepping sideways. It allows Ned to be independent in exploring toys or equipment, which are provided on the shelves. In this photo after he pulls himself up into a standing position, Ned attempts to climb the steps. When he reaches the top he is able to turn his body into a sitting position.*" (Excerpt from profile book).

Figure 6: Structure- Ned climbing the steps.

Mechanism: Bolt

"*Opening and closing the gate is a popular activity for several of the children but undoing the bolt is a challenge. Hattie knows it needs to be undone to move the gate so she attempts to open it.*" (Excerpt from profile book).

Figure 7: Mechanism: Hattie and the bolt.

Technological understandings and capability

The technological understandings of the children were seen to feed into their technological capability. Children go through two key stages in technology education. The first is exploration of materials, equipment and skills and the second is the application of skills and knowledge in problem solving situations (Fleer & Sukroo, 1999; Napper, 1991). In interviews, most of the teachers referred back to past episodes involving each child's, interests and understandings that related to the episode on hand. It became evident that the teachers recognised that the child's past work (although not necessarily technology-based in nature) formed the base that supported and informed the child's current technological capability.

One example was how the teachers described Cia's interest in climbing from her earliest toddlerhood (both verbally, and through photographic and written anecdotes). Admittedly this was not initially technology in origin, but what emerged over time in the teachers' descriptions was that Cia's focus moved increasingly away from practicing the actual skill of climbing, to climbing for a purpose (e.g. to see out of a window, to reach something up high). She demonstrated considerable ability to determine different things as tools to climb on order to solve problems of height. Her mother reported that at home, Cia had indicated that she wanted something off the bench but that she could not reach it. Cia then found a chair to take to the kitchen and climb on, thus enabling her to reach the bench top.

The emergence of chairs as "climbing tools"

Above: Cia explores climbing the chair and the climbing frame, as well as encountering the problems that arise through such experiences.
Below: Cia uses chairs as tools to see out the window in the fence, and an internal window of the centre.

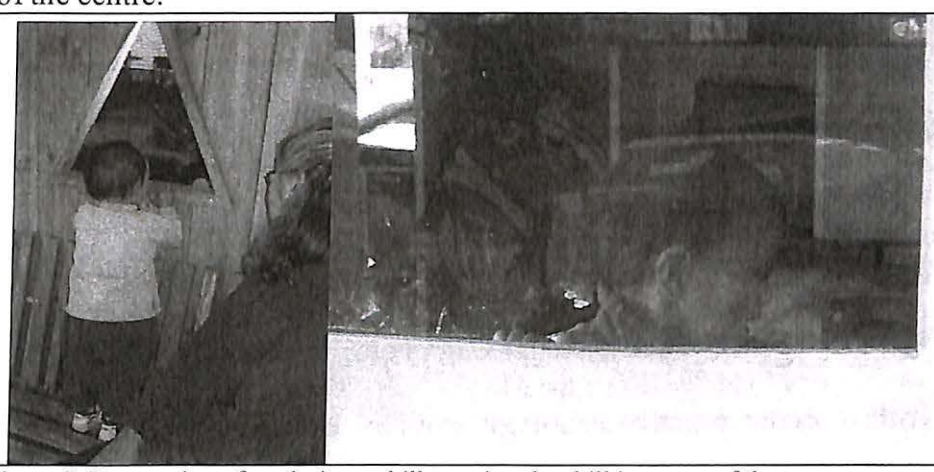


Figure 8: Progression of exploring a skill to using the skill in purposeful ways.

This aspect of technological capability was described by Jennifer (teacher) as the children's "creative technology". By this she means technological capability that was recognised in the way that children demonstrated their intention to do something, the way that they applied their understandings and capabilities to initiate and solve problems and/or develop affordances for equipment and materials. It was important to note that these skills were embedded in situ of the task and did not appear in a [3]linear fashion.

[3] Linear approach to technology: Technology processes appear in the exact order of (1). Designing something, (2). Making it, (3). Appraising it. Infants and toddlers are most likely to work in an integrated way. An integrated approach is likely to see these things happen simultaneously and in any order, often being repeated several times as new problems and ideas arise.

The following observation is an example of "creative technology' in action.

Casper and the duplo path	
Casper is sitting on the carpet in the infants/toddlers' room with pieces of duplo all around him. Nearby sit two cars on the floor. He appears to be very engaged in what he is doing.	
Casper holds a duplo construction in one hand and takes off individual pieces with the other hand. He places each piece on the ground in front of him. At one point two pieces come off that are stuck together. He puts down the main construction and picks up the two pieces that are stuck together. He pulls them apart, and then resumes taking apart the other part of the construction.	*The teachers have noted that deconstruction is as important in developing the basic core skills of technology building as construction. Casper skillfully takes the construction apart and is very thorough. He ensures that each piece is separate from the others.*
Once done, he arranges two of the same-sized pieces (both red) so that they are placed slightly apart and at an angle from each other (like an open gate).	*Casper makes a gate-like structure.*
He then takes a four-hole blue piece and a four-hole green piece and arranges them so that they are end to end. He then puts his fingers around the last piece of duplo without taking it off the ground and pushes it along the ground so that it in turn is pushing the piece in front of it. He then pushes a car through the gate-like structure and alongside the two other pieces of duplo.	*He makes a structure similar to a train with carriages. He connects the two pieces without joining them and is able to push both along the ground.*
Casper 'drives' the second car along the carpet and around the pile of duplo on the floor. He 'parks' it in a square shaped gap so that the car is perfectly lined up with the duplo. He lets go of the car and sits back and looks at it for a while.	*Casper introduces the cars into the game.*
He then takes the first car and drives it around the pile of duplo. He stops, lets go, and arranges a few of the pieces so that they are touching the main pile of duplo. He then drives his car about ten cm again. Stopping once more, he moves a few more pieces of duplo. It has become clear that Casper has constructed a type of path or road that the cars are driving on in the space between the pieces of duplo.	*Throughout the next segment, it becomes clear that Casper has created a construction, not actually out of the pieces of duplo but out of the **space** between them. This is most certainly a "making" endeavour that is appraised and modified by Casper as he goes along.*

Skills

Although, wisely, skills were not the sole focus for the teachers, at times in the interviews they appraised the equipment for the kinds of potential technology-skills that could be promoted and used for "making" something. Such skills included: disconnecting and connecting, taking something apart, putting it back together, posting, being able to insert one shape into another, working three dimensionally, balancing one object on top of another, fine and gross motor skills, and learning about materials used for joining such as sellotape, string, glue and nails. It also included skills for organising and creating basic systems or routines.

	Ned knocks down a block structure- all of the teachers of the infants and toddlers emphasised how important "taking things apart" was for children's early understandings about construction.
	*"Casper still continues his interest in connecting in this block-and-cars play. At first he collected several cars, then he lined them up on the floor. Then he took the long blocks and placed them around the cars. Then he rearranged them by lining up the cars next to the blocks. Then he added sloping blocks one at a time. He was carefully arranging them. Casper has been doing this play for several days and also he has been watching an older child who encloses items with blocks."* (Excerpt from profile book).

Figure 9: Skills- deconstruction and construction

Other skills that were highlighted leaned towards developing understandings of how to *use* particular technology. There were many examples of this, however, one that held particular appeal to me was the children's exploration of the zippers, and the apparent awareness they had of the zipper's ability to afford them with a way outside.

Top: The three children explore the flap of the awning and the mechanism of the zipper, imitating each other's strategies for opening it.

Due to the weather the children have been told that they must wear coats to go outside. Casper observes Arywyn's hands as she does up the bottom part of his zip. He attempts to do this himself. As Arywyn (teacher) does the zip up on another child's coat, Casper appears to observe closely. Later, he stands on the steps and experiments with pulling his zip up and down.

Figure 10: Using technology- zips

Naeve wrote the following regarding Talia's technological skills (and understanding) in relation to using a ball run.

"Talia got the idea right away, posting a ball in the top and watching it come out the front. She repeated this over twenty times, always leaving the ball until it popped out the bottom, even though it is visible as it runs down the slope. When other children show an interest in the toy, Talia whizzes over and appears to give them a 'demo'. From her interest we introduced her to the big ball race. We showed her once, and then she looked at it, looked at the balls in her hands, looked back at the ball race and then crawled over to it. She put her ball in the hole at the top and watched it roll down. She picked the ball up, posted it again. She let it run all the way down many times. She repeated this for about ten minutes.
It seemed that Talia observed and repeated the method/system for operating the small ball race. She then applied the same method/system/pattern to the big ball race. I thought that this was significant because she is eleven months old and is definitely able to identify a pattern or system in how something like this works and then is able to apply it to something that looks similar (i.e. both for posting balls)."

Affordance

'Affordance' is a term used to encompass the perceived uses for something as well as how it can actually be used (Carr, 2000). The notion of affordance was one that was quickly embraced by two of the teachers in particular. These two teachers felt that children should develop their own uses for much of the equipment and materials. Arywyn, in particular felt strongly that manufacturers' guidelines on equipment should be ignored and that commonsense (in regards to safety, especially) and knowledge of how the child might use the equipment should prevail. The creative ways that the children use objects, materials and equipment were deemed to be as equally as valid as the manufacturers' intended use. Naeve noted: "Where possible, allowing [children] to use items as they choose builds on problem solving, resourcefulness".

The following observations show the children using a variety of objects in ways that demonstrate that their affordances of them are most probably different to what the manufacturers' intended uses were.

Talia holds onto the basket of duplo and rakes her hand through it. She reaches in and picks up a 'duplo' pram, putting it to her mouth and pushing the wheel around with her tongue. When her bottle "arrives" she holds onto the basket and uses it as a tool in order to remain upright and sidestep her way closer to Arywyn and the bottle.

Eli sets a beadrunner down in front of Ned. He pulls on the wires for a while, then looks around. He reaches into a nearby basket of toys and selects a rattle (still holding onto the wire of the beadrunner). Ned then begins striking the beadrunner with the rattle. Arywyn (teacher) noted later that Ned often will use toys to make sound, for example, when he is given two blocks, he is likelier to bang them together than use them in any other way.

The teachers could also think of times, however, when they wanted to influence a child's affordance of certain materials or equipment. This also came through on the video. These times where characterized either by:

•concerns over safety,

•social convention,

•the child's own interest in using something for its intended purpose, or

•the teachers wanting to present a new use for something.

For example, on one particular day the teachers set up a bubble blowing activity using straws. One child immediately used the straw for sucking- a typical affordance. The teachers helped her be rid of the unpleaseant taste of the bubble mix then an older child demonstrated how to use the straw for *blowing* (see appendix 7)

Naeve developed the following model to depict the different affordances of materials and equipment that adults and children may have, and how each can influence the other.

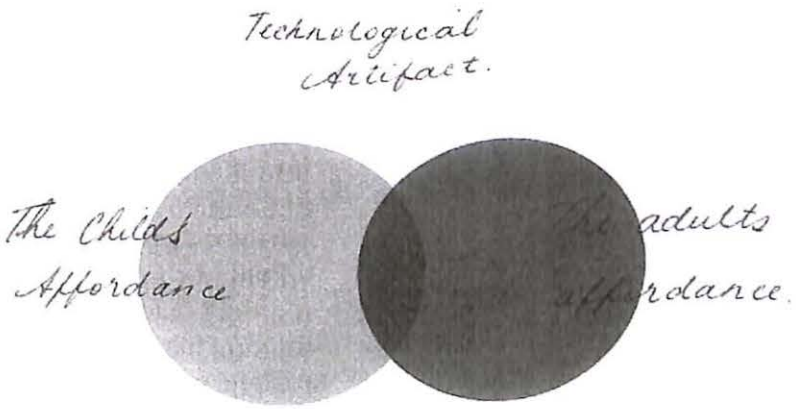


Figure 11: Affordances of technological artefacts.

Problem solving

Throughout this paper so far, there have been many examples of child-initiated problems, however at certain times the teachers were seen to deliberately place certain problems in front of the child. One such example was when both Eli and Naeve saw that Talia had been reaching into the row boat (exploring space and balance in relation to the structure?). After a while she abandoned this. At different times both teachers picked up a book that she had previously showed interest in and placed it on the rowboat seat, just out of her reach. Talia had to use her problem solving skills and her physical skills to retrieve the book. Many problem solving episodes were also characterised by evaluative behaviour, and this is evident in the following illustration also.

She used the row boat as tool for balance and sidestepped closer. At a certain point she stretched out her arm into the boat towards the book, but could not quite reach. She then took another few steps closer, again reaching out, she still couldn't quite reach. She then held onto the boat with a visibly tight grip with one hand and leant her torso over the edge of the boat towards the book. This time when she stretched out her hand she was able to retrieve the book.

Figure 12: Teacher initiated problems- Talia and the book.

Another example could be seen at morning tea time when the teachers only partially undid or took off wrappers around food, or banana skins. The rest was left up to the child to problem solve and negotiate. Bexs introduced a box wrapped up in layers of wrapping paper for the children to work out how to undo and of this, Naeve later wrote:

"Exploration of connections can often be observed through disconnection of

enclosure/enveloping- boxes, baskets, gifts, presents. The child appears more interested in undoing the paper and box than in the actual toy"

Where teachers provided problems for the children, there was a strong emphasis on having the problems in the realm of the "real world"- in other words, ensuring that the problems were meaningful.

Communication and technology

Communicating Intentionality

An integral component to technology education in Primary schools is children's ability to plan /design and communicate their ideas (Ministry of Education, 1995). Regardless of how little we know about young children's skills in planning we do know that intentionality develops in the first two years of life. Gonzales-Mena & Eyer write that:

"Intentionality gradually emerges as a child selects objects, plays with them, repeats actions on them, and creates a plan...Take a moment to think about the complexity of creating and using mental images, and the ability to construct a plan for thinking" (Gonzales-Mena & Eyer ,1989, p122).

The teachers at this centre emphasised, with absolute conviction, the extent to which infants and toddlers could develop and communicate an intention to do something. The intentions that the children communicated "spoke" much about their affordances of materials and equipment, as well as their self-selected problems and challenges.

The teachers' ability to observe children's actions and determine their intention in regards to their work was integral to their co-construction with children. In the following

observation, Cia communicates her intention to be lifted, as well as demonstrates her awareness of Naeve as an instrument to fulfill her intention.

> Cia indicated that she wanted to look out of the awning. The clear window was slightly too high for her. She looked around to the teacher, Naeve, and then lifted her arms up, flicking her fingers towards her palms as she did so. Naeve picked her up immediately and held her to the window. Cia had successfully recognised Naeve as an instrument to enable her to fulfill her intention to look out of the window.

Language is an important part of exploring interests, technological knowledge, skills and understanding (Ministry of Education, 1995). The teachers felt that one of the core teaching strategies in technology education for infants and toddlers was to model the language of technology as often as possible in contexts that were entirely meaningful for the child. Discussions with children included the names for particular technological inventions, naming certain parts, as well as naming the function and the properties of these things. Links were also drawn between children's actions and the effects on technological objects, as seen in this example taken by Naeve.

> *"Last week a child had a duplo piece which flashes and beeps when pressed. A child did it. Bexs said: 'Did you make that happen? Can you make it happen again?' The child did and Bexs said: 'You did make it happen.'"[sic].*

Gestures and the language of technology

Interestingly, the prevalence of gestures in discussion amongst children, and between children and teachers was extremely high, for example, gesturing the movements that certain things made. This was partly attributable to each party possibly not possessing the exact terminology to name the actions of mechanisms, or the specific parts of technological artefacts.

However, it served to reinforce and illustrate ideas. For the children, using gestures was a key component in the way that they communicated their intentions to each other and to teachers, as well as for initiating episodes of joint attention. Non-verbal actions and "unspoken shared meaning" are one of the most important communication modes (Greenfield, 2002, p60). The following examples are just two of many recorded instances where children and teachers used and decoded gestures effectively.

Ned had discovered the springs on the antennae of the tradition iconic "buzzy bee". He looked around him, the saw Eli (teacher). He lifted the bee up into the air, looking at her all the while. She said: "Have you got the bee?" Ned intentionally attracted Eli's attention to something he appeared to have a high level of interest in.

Jennifer (teacher) calls out to Casper: "Look Casper! A helicopter". Casper runs over. Jennifer highlights the rotary blades by gesturing circles with her arm. The helicopter tips on its side, and Jennifer describes this, tipping her hand to the side also. She says; "I can see a light flashing", gesturing with her hands. She says: "It's up high" (pointing upwards towards the helicopter) and asks: "where's it going?" putting her hands out to the side, with palms facing upwards. Casper looks at her but does not respond. He then makes a one word utterance that I do not hear but "draws" a complex shape in the air with his hand. Jennifer says: "That's right. Maybe it will go all around and come back again."

What was unclear from the data collected in this project is how gestures could affect the child's understanding of how an object works. An example might include the adult making a gesture for "eggbeater" that involves mimicking the actions required to use one.

Communicating technological ideas through symbols

Books, pictures and posters were another key tool used by the teachers in discussions about different technology depicted.

Arywyn determined that Casper has been very interested in one page of a book about vehicles and was involved in several joint attention episodes with Casper using this page. Although I was unable to tape these episodes the potential for discussing technology is easily seen:

- ✓ The names of the vehicles
- ✓ The purpose for each vehicle.
- ✓ Where the engine is situated, what it might sound like.
- ✓ The strength of the wheel loader to lift the rock.
- ✓ Motion of hydraulic arms and lifts.

Figure 13: Symbols- Deschamps, N. (1999). *My first truck book*. UK: DK Books

Diary notes:

When sharing a book with Talia and Ned, Arywyn was careful to verbally label the pictures that the children showed interest in.

Ned's portfolio states:

"Ned turned the pages and looked at the pictures while Arywyn explained what they were. When Ned looked at a picture of a sun, Arywyn said: 'It's the sun'. Ned bent his head to look more closely at the picture. When Ned looked at the picture of the house, Arywyn said: "It's a house".

Initially I was unsure as to why episodes like this "count" as technology education; however the teachers, Naeve in particular feel that children's ability to grasp the names of objects and develop a growing vocabulary "feeds into" their technology discussions when older.

From this, I read that there is a premise that articulate technologists require a wide vocabulary; therefore it is important to introduce words and language in episodes of joint attention where the context carries interest and meaning for the child.

Later, Naeve wrote in a note to me:

> *"It relates to technology in that they [children, may] begin to develop concepts that items and ideas and 'how to do' things can be represented in text or pictures. I thought that this was significant as I'd observed in the "over two" group a recent interest in recipes and instruction sheets for lego...with one child calling this sheet her recipe [sic], and another wanting a teacher to write down instructions about how to make a cake."*

The link between communicating technological ideas through drawn symbols was one that another teacher, Erin, had also identified. She was singing a popular song: *"The wheels on the bus"* with two toddlers while they were drawing pictures when she decided to encourage them to draw in circular motions to depict the movement of the wheels. Next cam the drawing of the motion of the wiper blades of the bus in the song (see appendix 8).

Chapter Four:

Conclusions

Teacher-identified technology interests, understandings and capabilities

Within the teacher-talk children's interests were inextricably associated with exploration. In turn, the children's exploration was seen to lead to developing awarenesses of the properties of materials and equipment, and the development of a range of skills, including physical and communication skills. The belief prevailed among all of the teachers who were interviewed that the children's exploration often was not necessarily explicitly technological, but that the resulting learning could support technological capability.

The teachers at the centre had a strong awareness of the principles underpinning notions of capability. However, rather than focusing on designing, making and appraising as the key "signposts" of capability, their attention mainly revolved around affordances, intentionality and problem-solving. It must be stressed however, that the teachers recognised and engaged with children's making and appraising endeavours when such activity was present in the children's work. The teachers felt that it was appropriate to place some teacher-initiated problems in front of the children, as well as model certain affordances for equipment and materials. Mainly, however, the children's initiative in developing their own problems and solutions, and affordances seemed to be emphasised as the truly creative side of the children's technological capability.

The documentation and assessments that the teachers made

The teachers used their assessments (documented and otherwise) in a formative manner. Their assessments of the things that children appeared to be trying to achieve were used to direct the teacher-decisions. Assessments were viewed across time, for example teachers often linked the children's development of skills and understandings in an earlier phase to their current emerging technological capability. The assessments that were shared by the teachers verbally (with each other, with whānau, and with the researcher) were rich in what they identified as children's technological interests, understandings and capabilities. The children's portfolios themselves, contained less data, however they stimulated much discussion by the teachers as they recalled aspects that they had noticed about the children's work, made links to other learning episodes and reflected upon their teaching decisions.

Teacher Responses

The teachers' roles as technologists were pivotal in designing, provisioning, and appraising the physical, interpersonal and temporal environments to best effect children's work. The teachers' abilities as technologists were integral in being able to recognise and respond to children's activity where there was a potential for technology learning to occur.

The teachers aimed to respond to the infants' and toddlers' interests, understandings, and capabilities in a co-constructive sense whenever possible when the children developed and/or affected rituals and routines, and when they found their own affordances of things. Obviously to do this effectively the teacher must have an existing awareness of the child's current interests, understandings, capabilities, and in fact their agenda. Without understanding the latter, any interaction that the teacher may be involved in with the child may lack meaning and

may misdirect the child's learning. This issue was continuously reinforced in the interviews by the teachers.

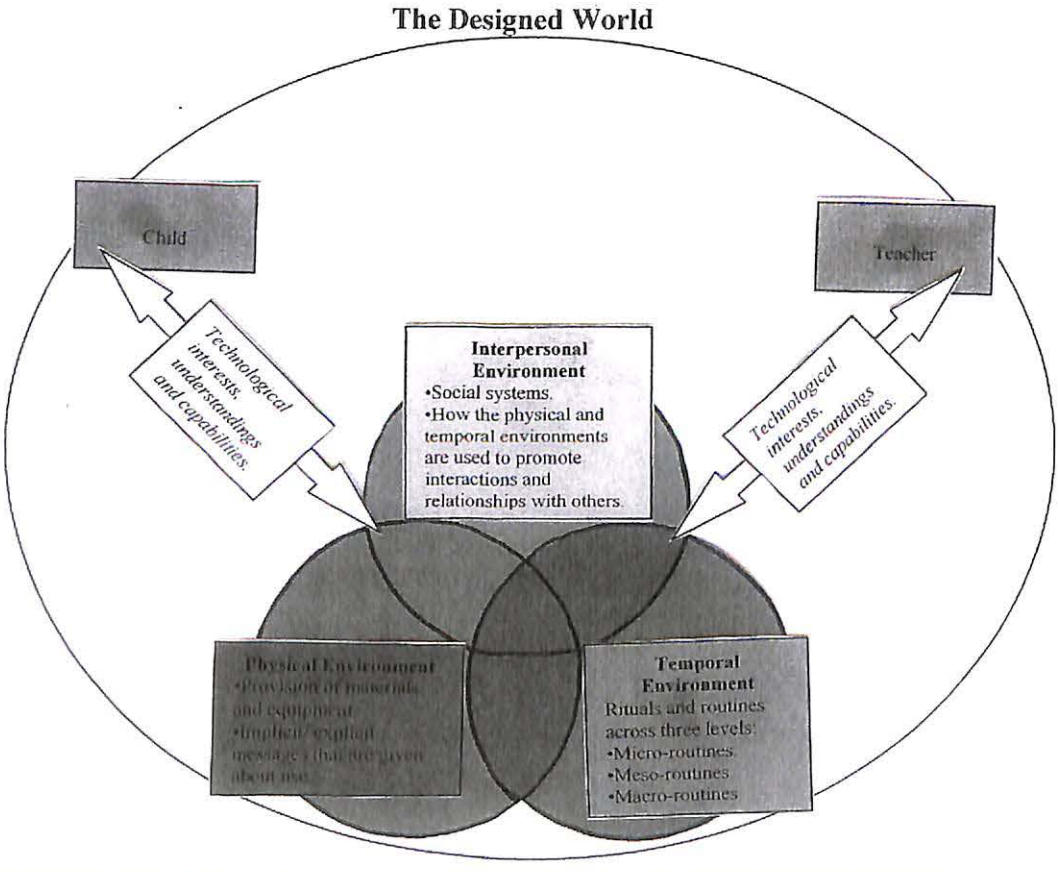
To date, the emphasis in some of the literature concerning infants and toddlers has largely involved allowing children to explore unhindered. Visser (1999) writes that children learn through construction and experiential activity rather than instruction. While I am essentially in agreement, it must be stressed that sensitive interventions, especially those that are co-constructive, have the potential to progress children's learning in ways that self-directed exploration alone cannot . Respecting children's work involves assisting them to fulfill their intentions. Sometimes teacher involvement is necessary, including giving moments of appropriate modeling (Siraj-Blatchford & MacLeod-Brudenell,1999). Joint attention and a commitment to establishing what the child is trying to achieve is essential. If we think of ourselves as one of the child's instruments or tools then we may be more likely to consciously choose a teaching strategy that enables them to realise their agenda.

There were many examples of how the teachers at this centre addressed these issues. I believe that having an existing awareness of what 'technology education' meant to them, as well as an existing content knowledge of technology partially resulted in their ability to recognise and respond accordingly to the children's technological interests, understandings and capabilities. One of the critical factors to effective technology education must be teachers who have an understanding of technology and the processes involved (Fleer & Jane, 1999; Mawson, 2002).

The following diagram (figure 14) illustrates a synthesis of these ideas and builds on the relationships depicted in figure 2 between the child, teacher and the environment (p22). In this diagram, the teaching and learning responses are depicted by the arrows between the children and adults and the different environments. A two way arrow is used because the environments are both modified in response to the varying technological interests, understandings and capabilities of both children and adults, but in turn they also may enable and influence them.

The World Makers
Technology Education with Infants and Toddlers

The quality of the environments are dependent upon the technological knowledge, skills, and capabilities of the teachers. This includes their ability to design, implement and appraise the effectiveness of the three environments in promoting, strengthening and extending children's technological interests, capabilities and understandings.



Technological Interests, Understandings and Capability		
Interest in:	**Understandings about:**	**Technological capability expressed through:**
•Exploring the designed world. •Materials, structures and mechanisms. •Specific skills. •How others might use and/or create particular technology. •Particular technological ideas, understandings and processes.	•Structures, mechanisms and materials. •Relationships between technology and the living world. •Specific skills. •How ideas, understandings and intentions might be communicated.	•Affordances. •Intentionality. •Problem Solving. •Applications of skills and understandings. •Evaluative behaviour. •Language and gestures. •Creative processes.

Figure 14: Technology with infants and toddlers: Synthesis of key ideas.

Suggestions for further research

It would be of interest to collect further case studies of both the technology work of children and the technology based decisions that the teachers make in response. Technology education is a relative "new comer" in terms of curriculum areas in early childhood education. Even less is known about what this might "look like" when working specifically with infants and toddlers. This is one brief study and is not intended to provide the 'definitive approach' to technology education with infants and toddlers. Further studies would help us begin to develop an increasingly richer picture, especially in regards to co-construction between adults and children when engaged in technology-based joint attention episodes.

It was not one of the intentions of this project to examine possible differences between girls and boys in their technological interests, understandings and capabilities, however, exploring this issue with infants and toddlers may make a fascinating study. Browne and Ross (1991) determined that there were differences between genders in technology education with children aged three and over. The children involved in the study had clear gendered expectations about what were acceptable themes for making things. Boys tended to make mechanisms that were appraised, modified and developed further, whereas girls appeared to mostly make simple structures that were used in pretend play (Browne and Ross, 1991).

It would also be interesting to study how technology interests, understandings and capabilities might change from infanthood to toddlerhood. While infants and toddlers were involved in this project, data pertaining to differences between the two groups and technology

education were not deliberately sought. This issue did not arise in an explicit manner from the teachers either.

Complementing social concepts alongside technological concepts (such as finding an appropriate solution to fulfill the desired intent) appeared to have some merit in the context of conflict resolution (e.g. in turn taking situations) for toddlers at this centre. One of the potential issues raised might be the possible relationship between technology rituals and social systems, such as those illustrated here, and script theory, whereby children learn to follow a set pattern of behaviour (Nelson, 1981).

Concluding Statement:

Technology education with infants and toddlers at this centre was inseperable from the total environment. It influenced and in turn, was influenced by the technological interests, skills and capabilities of the children and the teachers alike. It seems appropriate to conclude with a statement written by Naeve that appeared on a technology wall display at the centre:

> From birth infants encounter technology presented to them by adults (e.g. feeding equipment, clothing, routines) and from a very young age they begin to create technology for their own purposes (systems of investigation, the use of adults as instruments to assist them, the use of furniture for support).
>
> Through their experiences and their play infants develop skills (e.g. fine motor skills, problem solving skills, communication skills), which support their technology and which gradually allow them to employ the technology presented to them in their everyday lives.

Appendices

1. Interview schedule for teachers
2. Information sheets
3. Permission forms
4. An example of technology that empowers
5. Children developing their own ritual.
6. The physical environment impacts the interpersonal.
7. Changing affordances.
8. Wheels on the bus- depicting motion in drawing

Appendix 1

Technology Education for Infants and Toddlers: Four Illustrations

Interview Schedule
Teachers

1. Can you tell me a bit more about what is happening here? [In regards to segment of video footage].

2. How do you think this relates to technology education?

3. What technology-learning may have taken place?

4. What do you think the role of the teacher has been here? (may include setting up the environment).

5. How do you think this child was extended technologically?

6. How else might you extend this child technologically?

7. Have you any other comment?

Appendix 2: Information Sheets

Massey University
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Te Kupenga o Te Matauranga

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Private Bag 11 222
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www.massey.ac.nz

Anita Mortlock
[redacted]

Management Committee
[Childcare Centre's name]
Porirua

28th March, 2004

Letter Requesting Access to Undertake Research at *[Childcare Centre]

To the Members of the Management Committee at [Childcare Centre],

As you will know, I have asked the teachers if they are willing to participate in a research project about technology education for infants and toddlers. This is to complete the requirements for a Masters Degree at Massey University. After discussing it with the centre supervisor, the Management Committee kindly gave their consent for [Childcare Centre] to be the site of data collection for this project.

However, since the initial round of consultation, I have completed my proposal and have filled in the form for the Massey University Human Ethics Committee. Dr. Barbara Jordan has been appointed as my project supervisor and has given me good feedback that I have incorporated into both pieces of documentation. I can now offer more detail about the proceedings of this project than I could give earlier in the year.

I would like to invite the Management Committee to review the proposal and MUHEC form and to take this opportunity to make a formal request to undertake this research project at [Childcare Centre] Your informed consent would be greatly appreciated.

I am specifically seeking permission for:
1. The Management to allow me access to the centre and it's enrolled families for the project.
2. The Management to allow me to video children and teachers (subject to gaining individual permission from teachers and parents/ whānau).
3. The Management to allow me to interview teachers and certain parents/whānau (subject to gaining permission from those individuals involved).
4. The Management to allow me access to children's portfolio books (subject to gaining individual permission from the parents/ whānau).

I am more than happy to make myself available to answer any queries or concerns that you may have.

I look forward to hearing your decision.

Kindest Regards

Anita Mortlock

**The name of the childcare centre has been removed from all documentation to protect its anonymity.*

Information Sheet: Older Children

Hello there! Kia Ora!

My name is Anita. I am Quinn's mum. I am going to come to [centre]. I will be writing some stories. I will write about some of the things that the teachers do with the children. I will have my video camera so that I can remember what happens.

See you soon.
Ka kite ano.

Anita

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Research Project
Technology Education for Infants and Toddlers: Four Illustrations

Information Sheet for Management & Parents/Whānau

Introduction

Kia Ora! My name is Anita Mortlock. I am also involved in teacher-training at Wellington College of Education as a lecturer. My third "hat" is that of a student at Massey University where I am completing the requirements of a degree in Early Childhood Education.

I have opted to do a research project for my final paper and am hoping that you can help me. I am very interested in technology education and how teachers might facilitate and extend the learning of infants and toddlers in this area.

About the project

Technology education is a relatively 'new' curriculum area, but its importance is being increasingly recognized. Unfortunately, there is very little research or literature available to guide teachers in their thinking about, and provision of technology education. I would like to document some of the ways that the teachers at this childcare centre provide for the technology learning of some of the infants and some of the toddlers by developing some case studies.

These will be developed through:

- An initial concept-mapping exercise (to develop shared understandings between myself and the teachers).

- Studies of profile books about the case study children.
- Discussions with the primary caregivers of the case study children.
- Discussions with the parents of the case study children.
- Video footage of the teachers and children working technologically.

I shall focus mainly on two infants and two toddlers (to keep the amount of information manageable). I would like to invite the entire centre to participate. Because this childcare centre runs a programme where all children have an opportunity to interact with each other, they may play/work with the four children who I am focusing on at some point. Another special feature of this centre is the nature of the information-sharing and collaboration that happens between the teachers. Therefore, every teacher is invited to contribute their observations and thoughts about the technology learning of the four case study children.

At present, I would like to be present in the childcare centre on the following dates to take video footage:
7th July, 14th July, 21st July, 28th July (all Wednesdays).
After each session of video taping, the footage would be analysed. There would then be two follow-up discussion times with the primary caregivers of the case study children. This would take about an hour each discussion, and would hopefully happen on the following dates between 1:30 and 2:30:
12th July, 19th July, 26th July, 2nd August (all Mondays).
One of the centre's part-time teachers has agreed to cover the teaching duties of those who are involved at these times. I respect the importance of not interrupting the teachers unnecessarily while they are teaching your children. This will be done at no cost to the centre.

Should you accept this invitation, you may appear in some of the video footage should you be at the centre during those times. If you are a parent of one of the children chosen for a case study I would ask you to participate in a weekly discussion about your child's learning that relates to the video footage. Children's experiences in the home can be rich in technological learning! This would take about half an hour and can happen either face to face or by telephone, and at a time that is convenient for you.

You are under no obligation to accept this participation. If you decide to participate, you have the right to:

- Decline to answer any particular question;
- Withdraw from the project at any point before the final report is written;
- Ask any questions about the study at any time;
- Provide information on the understanding that your name will not be used unless you give permission to the researcher;
- Be given access to a summary of the project findings when it is concluded;
- Have the right to ask that video/audio tape be turned off at any time.

You may also request to have this information sheet translated into another language or have it explained in a language that you feel more familiar with. Should you be asked to

participate in a discussion, you may also request that a translator be present. This will be gladly done at no cost to you.
At the conclusion of the project, you will be invited to read the project findings in their entirety (i.e. what I hand in to my research supervisor) or you can read a booklet that will be prepared as a synopsis of the findings. Copies of some of the video footage and notes from discussions may be kept and used by me to report the findings to others involved in education (e.g. student teachers, in an education article, e.t.c.) Neither your name, nor that of the children or teachers will be used without specific consent.

My research project will be supervised by Dr. Barbara Jordan at Massey University in Palmerston North. In the past she has taught the paper: "Technology and Social Studies in the Early Years Curriculum". She is very knowledgeable about technology education and about infants and toddlers and has an obvious appreciation for the level of thinking that babies and toddlers can engage in. As you can imagine, she is a perfect choice to supervise this project.

Project contacts
During the research project you may find that you have questions or issues that you would like to discuss. At any point, please feel free to contact me. This can be done by phoning:
[redacted] after hours
[redacted] Tuesdays, Thursdays and some Mondays
[redacted] at any point, or if I am unavailable on the other two numbers.
Alternatively, you can contact Dr. Barbara Jordan on (06) 356 9099 xtn 8854 during working hours.
The centre supervisor will also be available to answer any questions to the best of her ability.

Committee Approval Statement
This project has been reviewed and approved by the Massey University Human Ethics Committee, PN Application 04/70. If you have any concerns about the conduct of this research, please contact Professor Sylvia V. Rumball, Chair, Massey University Campus Human Ethics Committee: Palmerston North, telephone (06) 350 5249, email humanethicspn@massey.ac.nz.

And finally
If you agree to participate in this research project, please sign the consent form and place it in [name]'s newsletter pocket at centre. Again, please do not hesitate to contact either myself, Dr. Jordan, or the centre supervisor to discuss any aspect of this project.

Thank you very much for your co-operation.

Anita Mortlock

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Research Project
Technology Education for Infants and Toddlers: Four Illustrations

Information Sheet for Staff

Introduction

Kia Ora! My name is Anita Mortlock but you might know me as "Quinn's Mum". I am also involved in teacher-training at Wellington College of Education as a lecturer. My third "hat" is that of a student at Massey University where I am completing the requirements of a degree in Early Childhood Education.

I have opted to do a research project for my final paper and am hoping that you can help me. I am very interested in technology education and how teachers might facilitate and extend the learning of infants and toddlers in this area.

About the project

Technology education is a relatively 'new' curriculum area, but its importance is being increasingly recognized. Unfortunately, there is very little research or literature available to guide teachers in their thinking about, and provision of technology education. I would like to document some of the ways that the teachers at this childcare centre provide for the technology learning of some of the infants and some of the toddlers by developing some case studies.

These will be developed through:

- An initial concept-mapping exercise (to develop shared understandings between myself and the teachers).

- Studies of profile books about the case study children.
- Discussions with the primary caregivers of the case study children.
- Discussions with the parents of the case study children.
- Video footage of the teachers and children working technologically.

I shall focus mainly on two infants and two toddlers (to keep the amount of information manageable). I would like to invite the entire centre to participate. Because this childcare centre runs a programme where all children have an opportunity to interact with each other, they may play/work with the four children who I am focusing on at some point. Another special feature of this centre is the nature of the information-sharing and collaboration that happens between the teachers. Therefore, every teacher is invited to contribute their observations and thoughts about the technology learning of the four case study children.

At present, I would like to be present in the childcare centre on the following dates to take video footage:
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After each session of video taping, the footage would be analysed. There would then be two follow-up discussion times with the primary caregivers of the case study children. This would take about an hour each discussion, and would hopefully happen on the following dates:
12th July, 19th July, 26th July, 2nd August (all Mondays
Teacher One: 1:30-2:30 and Teacher Two: 2:30-3:30.
One of the centre's part-time teachers has agreed to cover the teaching duties of those who are involved at these times. This will be done at no cost to the centre.
Follow up discussions with the other teachers and with the parents of the case study children would take place when needed at a time that is mutually convenient.

Should you accept this invitation, you may appear in some of the video footage and some aspects of your work with children may be discussed and/or written about. You may be asked for your comment. Because I am not in the centre daily, your participation would mean that I would ask you to 'jot' down anything of interest (technologically) that the focus children do. Similarly you may want to record any reflections or ideas that you have.

You are under no obligation to accept this participation. If you decide to participate, you have the right to:

- Decline to answer any particular question;
- Withdraw from the project at any point before the final report is written;
- Ask any questions about the study at any time;
- Provide information on the understanding that your name will not be used unless you give permission to the researcher;
- Be given access to a summary of the project findings when it is concluded;
- Have the right to ask that video/audio tape be turned off at any time.

You may also request to have this information sheet translated into another language or have it explained in a language that you feel more familiar with. Should you be asked to participate in a discussion, you may also request that a translator be present. This will be gladly done at no cost to you.

At the conclusion of the project, all data will be returned to the centre. You will also be invited to read the project findings in their entirety (i.e. what I hand in to my research supervisor) or you can read a booklet that will be prepared as a synopsis of the findings. Copies of some of the video footage and notes from discussions may be kept and used by me to report the findings to others involved in education (e.g. student teachers, in an education article, e.t.c.) Neither your name, nor that of the children or their parents' will be used without specific consent.

My research project will be supervised by Dr. Barbara Jordan at Massey University in Palmerston North. In the past she has taught the paper: "Technology and Social Studies in the Early Years Curriculum". She is very knowledgeable about technology education and about infants and toddlers and has an obvious appreciation for the level of thinking that babies and toddlers can engage in. As you can imagine, she is a perfect choice to supervise this project.

Project contacts

During the research project you may find that you have questions or issues that you would like to discuss. At any point, please feel free to contact me. This can be done by phoning:
[redacted] after hours
[redacted] Tuesdays, Thursdays and some Mondays
[redacted] at any point, or if I am unavailable on the other two numbers.
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The centre supervisor will also be available to answer any questions to the best of her ability.

Committee Approval Statement

This project has been reviewed and approved by the Massey University Human Ethics Committee, PN Application 04/70. If you have any concerns about the conduct of this research, please contact Professor Sylvia V. Rumball, Chair, Massey University Campus Human Ethics Committee: Palmerston North, telephone (06) 350 5249, email humanethicspn@massey.ac.nz.

And finally

If you agree to participate in this research project, please sign the consent form and place it in Quinn's newsletter pocket at centre. Again, please do not hesitate to contact either myself, Dr. Jordan, or the centre supervisor to discuss any aspect of this project.

Thank you very much for your co-operation.

Appendix 3: Consent forms

Permission to access the families, teachers and children of [childcare centre] for research

On behalf of the Management Committee at [Childcare Centre] we:

Have received the research proposal of Anita Mortlock to undertake a research project about technology education with infants and toddlers.

We believe that we understand the proposal and the information that has been provided.

We do/do not grant you permission to undertake your research project at the centre.

We do/ do not grant you permission to access the children, families and teachers belonging to the centre for the purposes of your research.

We do / do not grant you access to seek permission from individual families/whānau to access their child's portfolio books.

We do / do not grant you access to seek permission from individual families/whānau to video their children at centre.

We do / do not grant you access to seek permission from individual families/whānau to interview them about their child's technology work.

We do / do not grant you access to seek permission from individual teachers to video them while teaching at the centre.

We do / do not grant you access to seek permission from individual teachers to interview them.

Signed:

Date:

Technology Education for infants and toddlers: Four Illustrations

PARTICIPANT CONSENT FORM: PARENTS

This consent from will be held for a period of five (5) years

I have read the Information Sheet and have had the details of the study explained to me if requested. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

Please circle the following:

I agree/do not agree to being audio taped if asked for an interview.

I wish/do not wish to have the audio tapes featuring myself returned to me (if applicable).

I agree/do not agree to being video taped. I agree/ do not agree to having sections of some of the video footage featuring me used to inform others interested in this topic.

I do / do not give permission for the researcher to access my child's portfolio book.

I agree/do not agree to my child(ren) being video taped.

I agree/ do not agree to having sections of some of the video footage featuring my child(ren) used to inform others interested in this topic.

It has been decided that the video tapes will be held by the centre after the completion of the project as they will feature other children in the centre as well as the case study children. Copies of some of the footage will be retained by the researcher for the purposes of sharing the information with others, subject to consent.

I agree to participate in this study under the conditions set out in the Information Sheet.

I agree to allow my child(ren)'s participation in this study under the conditions set out in the Information Sheet.

Signature:		**Date:**	
Full name of person signing (please print)			
Full name of child(ren) (please print)			
Relationship to child(ren)			

Please return to centre and place in [name]'s newsletter pocket. Thank you for your co-operation.

Technology Education for infants and toddlers: Four Illustrations

PARTICIPANT CONSENT FORM: STAFF
(Includes all permanent staff, relief teachers and students)

This consent form will be held for a period of five (5) years

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I agree/do not agree to being audio taped (if an interview is required).

I wish/do not wish to have my audio tapes returned to me.

I agree/ do not agree to the researcher having access to my work in children's portfolio books.

I agree/do not agree to being video taped while teaching.

I agree/ do not agree to having sections of some of the video footage featuring me used to inform others interested in this topic.

It has been decided that the video tapes will be held by the centre after the completion of the project as they will feature other children in the centre as well as the case study children. Copies of some of the footage will be retained by the researcher for the purposes of sharing the information with others, subject to consent.

I agree to participate in this study under the conditions set out in the Information Sheet.

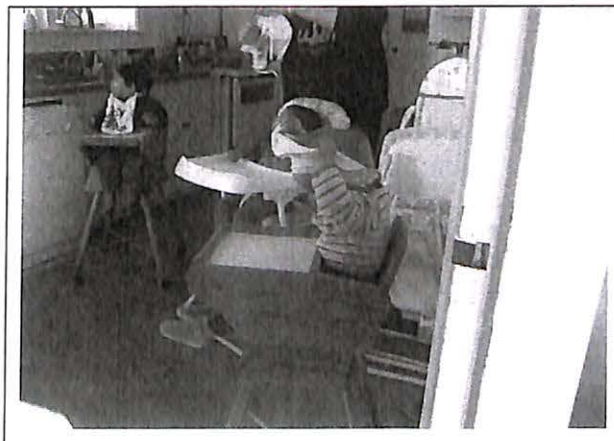
Signature: ..... **Date:** .....

Full Name – printed .....

Appendix 4

Eileen has shown an intense and sustained interest in painting over time. This photograph shows the importance of well-designed equipment to children's work. The design of this easel means that children who are not yet standing can still participate in painting comfortably. Technology that is viewed as disempowering by the teachers includes walkers and computers for infants and toddlers. These were seen to "hothouse" particular skills and hurry development through implying that what children could do unassisted by themselves is not 'enough'.

Appendix 5



When visiting the centre one day I observed Hattie experimenting with taking her bib off. Once off she waved it at Eli (teacher), who put it back on again. This happened several times.

During another visit some weeks later, I noticed that all of the toddlers were given yoghurt for afternoon tea, and that as soon as their bowl had been placed in front of them they all took their bibs off. Discussion with Kapiti (teacher), Arywyn (teacher) and Naeve (teacher) showed me that the interest and skills in using the bibs had 'spread' and had been incorporated into a mealtime routine that also included the eating of yoghurt.

Appendix 6

In this picture Eileen and Hattie play "peek-a-boo" with each other using the white cubby and the cardboard box that the teachers have provided. Gunvor (2000) determined that when teachers provide large structures in the infant/toddler environment, the children have increased opportunity to create their own group games (sometimes known as "glee sessions"). These times are typified by the children developing reciprocal games (a basic ritual/system) and through exploring the dynamic between their body and the given structure.

Appendix 7

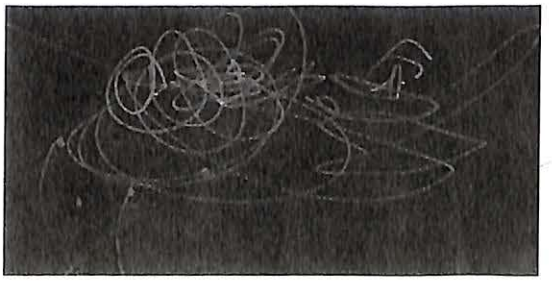
The teachers have provided straws and bubble mix, as well as bubble-loops to blow bubbles. Ally takes a straw and inserts into the container of bubble mix. She puts her mouth to the straw and…sucks. She screws her face up and spits the bubble mix out. Neal says: "No. You blow". The teachers take Ally for a drink. She returns to the area and watches Neal for a while. Ally then takes a straw and blows, making lots of frothy bubbles.

Appendix 8

Towards the end of the project, Erin, one of the teachers was involved in an unplanned moment where she and two of the children explored the process of communicating (through drawing) the motion associated with the *Wheels on the Bus* song. It is important to note that this experience most probably would not have been successful, had it been planned. Erin used her knowledge of the children and of technology to recognise and utilise a moment that had much technology potential. The following is from my field notes:

Erin) believes that one of the basic skills to drawing (including design drawing) is the ability to draw circles, lines and dots. With the children's current interest in vehicles, Erin) found a "natural moment" to incorporate drawing and singing "The Wheels on the Bus". At a stage where the children are not yet able to draw representational things, Erin has introduced the idea to them that they can make marks that signify the movement of certain parts of the bus- depicting the movement of mechanisms- wheels (circular drawing), wipers (lines) and the horn (dots). Anning (1994) suggests that this can be a difficult task for children engaging in design drawing, but Erin's work here makes me wonder about the many positive implications of introducing experiences such as this, and later design efficacy.

The toddler that drew this picture later re-enacted this experience at home, including the singing of the song. The resulting picture is on the left.



Pictures of motion: At centre (left) and home picture (right).

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