

# Technological Tools Supporting the Scaffolding of Learning

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**ABSTRACT:** *The rationale for the scaffolding of children's cognitive learning has a sound foundation in current research and literature in early childhood. Sociocultural theory supports scaffolding and co-constructive interactions as the most appropriate for encouraging children's higher mental functioning. While the "why" of scaffolding and co-construction of learning is well documented, the "how" to accomplish it in practice, in the climate in which most staff members are currently working, is less well documented. Scaffolding and co-construction of learning are as applicable to the processes of adults' professional development as they are to the processes of children's learning. This paper reports the development of one set of processes involving technological tools that encourages teachers to engage in co-constructive and scaffolding experiences in both their own action research and in working with children.*

## INTRODUCTION

This paper comes from the author's ongoing doctoral research programme. The aims of the research are to:

1. Identify how four early childhood centres currently plan for children's thinking, and;
2. Deliver programmes of professional development in each of these centres that will support teachers in developing their processes and personal skills in planning for children's thinking.

During the implementation of the action research methodology utilised in the programmes of professional development, it became clear that all participants, including adults and children, were involved in exercises of co-construction and scaffolding of learning. Making clear links between two sets of processes, one set for the adults and the other for the children, contributed to the adults' learning about how to scaffold children's learning.

Four case study centres, two kindergartens and two childcare centres, have been engaged in programmes of professional development with a focus on their planning

processes which extend children's thinking. In each centre, the children who were the current focus of the centre's specific planning, also become the focus children for this project. These children, their teachers and families, were participants and co-learners in this action research. All the children in the research programme were between three and five years old.

The programme of professional development in each centre was facilitated in three centres by the author, and in the fourth by a facilitator in the local professional development team within their contract with the Ministry of Education. Centre self-selection into the research programme, from a general invitation to all local centres, ensured that centre staff were committed to a focus on scaffolding children's thinking. In this study three to five year old children were chosen as the focus of the study in order that verbal interactions could be utilised as the window to children's thinking.

Discussion in this paper is an outcome of the completion of the programme of professional development in two of the centres, one childcare centre and one kindergarten. The focus here is on the use of the programmes of professional development and some technological tools that support staff teams in examining their practices of scaffolding of young children's learning.

## THEORETICAL BASIS OF CO-CONSTRUCTION AND SCAFFOLDING LEARNING

Children's learning in early childhood centres has for decades been supported from a Piagetian framework, which advocates the individual child's construction of knowledge with minimal intervention. Under this paradigm, it is now realised that children are being denied access to some of the most readily available and knowledgeable support - that of the adults working closely with them. To engage with children's thinking will require for many early childhood teachers a major change in philosophy and in practice. As Meade (1995, p. 68) identified for the six centres that were the focus of her research on schema, adults do "not engage with the children's thinking". This situation is no doubt fairly general in many centres, and is the result of the majority of current teachers' guiding philosophies being deeply embedded in developmental psychology.

The sociocultural framework for teaching and research advocated by Vygotsky (1986), requires adults to take a much more active role in engaging with children's thinking and learning. Vygotsky argued that the most effective learning occurs when the adult draws the child out to the jointly constructed potential level of performance, within what he termed the zone of proximal development. Bruner (1962) later coined the term scaffolding of learning, to represent the manner in which the learner can be supported in achieving this higher level of performance. Thus, learning is a creative

activity, in which learners who are involved in meaningful interactions, are able to “synthesise knowledge from disparate opportunities, and construct further learning opportunities” (McNaughton, 1995, p.5).

Valsiner (1988, p. 119) discusses the emergence and unfolding of cognitive challenges during social exchanges: “A social relationship between participants is a dynamic medium through which the form of cognitive challenges is co-constructed”. The term co-construction is used as an interpersonal construct in which people engage one another as “an effort after shared meaning” (Bartlett, 1964, cited in Valsiner, 1988, p.119). The role of the adult in supporting children’s developing higher mental functioning, or as a more expert peer supporting other adults’ learning, is a crucial one. The major task is to establish and maintain inter-subjectivity, that is, to remain in touch with the learners’ understanding in order to be able to support their successful internalisation of the situation. Bruner (1962) called this maintaining the learner within the zone of proximal development (ZPD).

The application of the ZPD to research has a considerable influence on the whole process of research. Vygotsky (1986) believed that learning is in a fundamental manner influenced by the tools utilised in the learning process and the ability of the teacher to remain in tune with the learner’s current understandings and progress. “Tools” in Vygotsky’s writing includes the use of language, especially as it represents the learner’s culture, and ways of doing things. Vygotsky believed that the processes of learning are at least as important as are the content outcomes of that learning. In any learning situation, both the processes of learning and the knowledge contents require attention. Smagorinsky (1995), writing about Vygotsky, proposed that research results are valid only when the learner understands and is able to utilise the processes which the researcher is introducing; further, in making any claims concerning the outcomes of research, the researcher needs to take into account the learners’ ongoing use of these tools. In this conception, valid research is inherently instructional in that the “congruence of learner and learning materials affords development” (Smagorinsky, 1995, p. 204).

In the current research there thus exists a very close parallel between the processes and contents of the research and the processes and contents that the staff teams have indicated they want to learn to utilise in children’s learning. Both sets of processes involve the joint generation of new meanings, and developing connections between experiences. Rogoff, Mistry, Goncu, and Mosier (1993) proposed that scaffolding of learning, or “guided participation” involves the following three activities:

- Providing a bridge between familiar skills or information and those needed to solve a new problem;
- Arranging and structuring problem-solving; and
- Gradually transferring the responsibility for managing problem solving to the child.

These three principles are equally applicable to the process of facilitated action research, where the learners are not children, but staff teams in early childhood centres.

Winter (1989, p. 71) further suggests that one of the main principles of action research is that it presents a “plural text, where the single voice of an author contriving the sequences of a logical argument is partly (at least) replaced by an interplay between the many voices of those who have participated (in different ways) in the work”. Action research is an approach to improving education by changing it and learning from the consequences of the change; it is participatory, as people work toward the improvement of their own practices; it develops through the self-reflective spiral, a spiral of planning, acting (implementing plans), observing (systematically), reflecting, and then continuing in this cycle; it is collaborative, involving those responsible for the programme in improving it; it establishes self-critical communities of people participating and collaborating in all phases of the research cycle, and committed to enlightening themselves; it is a systematic learning process, in which people act deliberately, though remaining open to surprises and responsive to opportunities (Kemmis & McTaggart, 1988). In effect, the facilitator of a centre professional development programme who utilises action research, is modelling with the adults in the centre, the sorts of interactions which are most effective in scaffolding children's learning.

## THE RESEARCH PROCESS

Because of the individuality of each centre, there was no one process of professional development that all four centres worked through. However, the two centres which have completed the major cycles of the action research seem to have progressed through similar phases.

Phase one included about six two-hour meetings with the staff members, over a period of about six months. Staff interviews were audio-taped; transcriptions of all video and audio recordings were provided to each staff member, for their own analyses - these contributed to the team's observations and planning for group activities based on the individual children's interests, as appropriate. Any written documentation was also examined, including: centre philosophy; charter statements relating to children's cognitive learning, and to the observation, planning and evaluation cycle; centre organisation of routines, size and groupings of staff and children; rostered duties, staff qualifications and recent professional development.

Familiarisation of staff members, children and their families with the presence and activities of the researcher/facilitator was an important part of this phase. This applied especially to accepting the use of the video camera and the radio-microphone.

Two to three children and their families in the current round of planning, became the major focus of field data collection. Video recordings of these children during sessions were made: (a) prior to the children being the subject of planning (three sessions were videoed); (b) during the period in which these were the planning focus children, (approximately three sessions videoed); and (c) at least six weeks subsequent to their planning cycle focus (probably one session on video). As soon as possible after each set of video recording the tapes were shared with the staff members as part of the action research process. The questions at this stage were: How are we scaffolding children's learning? What does this mean for the children, and for us? What are our beliefs about scaffolding, both as a team and as individuals? Where did our beliefs and practices originate? (Smyth, 1991).

In practice phase two was likely to have already begun during phase one. Clearly it would have served no purpose to wait until the end of the initial data collection to begin considering ways of making improvements in the processes. Phase two involved learning about scaffolding, co-constructed learning, and the role of documentation of dialogues in the development of projects. It also involved deciding on appropriate actions to improve current practices, towards better scaffolding of learning.

Once the team had identified its strengths in scaffolding of children's learning, largely through the provision of equipment and materials, they felt reinforced for what they were already doing, and were ready to work on listening to what the children were thinking. Analysis of verbal scaffolding of children's ideas; transcripts of audio tapes of staff interacting verbally with children (a radio microphone facilitates the collection of the raw data); consideration of definitions and models of scaffolding, and of levels of reflection, and cognitive functioning each contributed to the teachers' reflection on their practices. The questions at this stage were: What are our alternatives for improving practice in scaffolding? How can we support each other in this process of improvement? How can we find out what the children are really thinking, and extend their learning?

During phase three, areas of improvement were likely to be made in:

- Planning processes, especially in the documentation of dialogues;
- The development of projects with children, based on analysis of dialogues;
- Greater involvement of parents in the programme, and with their children's learning at home;
- Staff members researching topics of children's interest, to extend their own knowledge bases;
- The use of photos printed from the video in initiating dialogue with children;
- Consulting children about the plans for extension activities, and really hearing their voices at all stages of the planning.

Staff and the facilitator together analysed the pre- and post- questionnaires, and early and later transcripts, to consider evidence of progress. Questions for the staff and researcher to consider at this stage were: What has changed for the children, for the staff, and for the parents? Where to next?

Phase four included negotiating a revisit in approximately twelve months time. This allowed some monitoring of the sustainability of the changes over time. Also, remaining available on-call for staff in centres of completed programmes encouraged the continued reporting of successes and discussion of issues. Consistent with the principles of both action research and of scaffolded learning, the roles of the researcher and the staff members changed over the period of professional development.

The roles of the facilitator and staff members at each phase of the project are summarised in the following table:

	FACILITATOR ROLES	STAFF MEMBER ROLES
PHASE 1	Directing the process; explaining study requirements; suggesting video and audio recordings.	Responding; perhaps some defense/reluctance/ initial nervousness, with confidence that the process is theirs, developing.
PHASE 2	Facilitating; suggesting.	More confident in contributing; the work is clearly understood as their own; some excitement.
PHASE 3	Supporting (when allowed!).	Directing, very much in control of their own processes; commitment to continual reflection.
PHASE 4	Minimal support from distance.	Independently implementing changed practices; communicating with other centre staff.

## THE VALUE OF LISTENING TO CHILDREN'S THINKING

In order to engage with children's thinking teachers need to attend to what the children are saying. The support of technology in this process is addressed in this next section of the paper.

The process of listening to their own dialogues with children was a powerful tool for change for the teachers. The teachers realised that they needed to provide more spaces for the children to talk. They also needed to listen to what the children were saying, to encourage the children to listen to each other, and often, themselves, be silent. One of the teaching teams has expressed its learning as:

- Becoming more skilled at listening to the children through really hearing what they are saying;
- Identifying children's ideas and interests. Ongoing projects frequently develop as children and teacher together return on subsequent occasions to activities on related topics. The optimal level of intervention will lie just above the child's current level of functioning, with the task being neither too simple nor too difficult for the child;
- Involving the child in social situations with small groups of children, as they together explore the topics, each from their own perspectives and supported by the adults;
- Becoming comfortable with silences and allowing children to do their own thinking without interruption, or doing their thinking for them; and
- Following the children's leads rather than following their own agenda.

One consequence of listening to the children's thinking was that the teachers realised they required further knowledge about the topics of the children's interest. Teachers therefore needed to engage in their own research, often alongside the children, though they also become inspired to continue further, with their own learning on the subjects inspired by the children. This is an example in practice of Vygotsky's (1986) beliefs that the processes of learning (listening to children's thinking), and the contents of learning (material researched to support the topics of children's interests) need to be addressed for both adults and children (Roberts, Lepper, and Dekker, 1998).

As Chloe, a teacher in the kindergarten, said: "I think the whole process (of professional development, especially of recording dialogues) just makes you more conscious of the way that they talk and the questions that you ask".

The technological tools used to support the teachers in the above processes were a tape-recorder, video camera and computer.

### **Recording dialogue with the tape-recorder and video**

The only way to analyse children's dialogue with any degree of accuracy in a naturalistic setting such as an early childhood centre, is to record dialogue by some electronic means. When the teachers in this research programme decided that they needed to attend closely to what the children were saying the most supportive tool

was the tape recorder. Through recording and analysing adult-child dialogues the teachers quickly realised whether they were:

- Following the children's leads or their own agenda;
- Encouraging the children's thinking, or interrupting them and doing their thinking for them;
- Making the thinking more complex through distancing the dialogue from the here and now, or remaining always in the present; or,
- Encouraging the children to imagine, project into other experiences, predict/anticipate, think logically, or stay with simple classification and naming of objects.

As with any observation there was no hard and fast rule as to what to record. The subject, timing, and duration of recordings depended on the aspects of their practices that the teachers decide they want to investigate. Transcribing tapes was time-consuming, so it was important to record useful information. Options included one staff member wearing the microphone for a whole session. The Head teacher who did this engaged in some significant learning (and some 60 pages of transcript!). When teachers began to record dialogues for specific purposes they learned to have their recording equipment set up ready to press a couple of switches. At this stage teachers recorded only exchanges between adults and children, or between children. Some of these recordings were later transcribed either as part of the planning process for children's activities/projects or for analysis by the teachers regarding their skills of dialogue.

Because of the noise level in early childhood centres and the mobility of children the use of a radio microphone greatly improved the flexibility of recording, either with the tape recorder or the video camera. The radio microphone is usually worn on the lapel or in a top pocket (child or adult). It transmits the sound to a receiver that is attached to either the tape-recorder or the video camera. The microphone is a small transmitter that attaches by a clip and trails a short length of wire as the aerial. The tape-recorder with receiver attached can be placed in the office to receive sound from anywhere in the centre. The video camera can be recording from anywhere in the centre, though to also record pictures, using the photoscopic lens, it needed to be within the line of sight.

The following excerpts from recorded dialogues in the two case study centres are examples that would have been very difficult to record during the busy activity of the centre programmes without a radio microphone.

**Dialogue 1:**

Child 1: Look, I've found a shell.

Adult: Hmm...

Child 1: It's like a snail's shell. (pause, holding shell in hand; turns



it; feels its shape, inside and outside of the shell).

Child 2: No it's not a snail shell. (pause) Its a beach shell.

Child 1: Look this one's a scallop shell. You can eat a scallop for tea.

Now look at this one it's a pipi. My Dad dives for shells

(pause). Its like a snail shell.

Child 2: No it's not a snail shell.

Many children in the centre were at the time of this recording engaged in a project related to the sea, and the teachers analysing this dialogue became aware of the richness of the children's ideas being expressed here. The teachers were able to help the children make clear links between this discussion and the snail "race" experienced the previous week, and to help them identify why seashells need to be so much harder than land shells. Extension of the children's ideas about shells could clearly centre on the similarities and differences between snail and sea shells; the large variety of sea shells (even amongst the bivalves) in terms of shape, patterns, colour, taste, location; and on topics related to the dad as a diver. The teachers involved in this dialogue realised that they were supporting the dialogue in the direction of their own interest and knowledge (the hardness/softness of the shells), at the expense of much richer potential in the children's own verbalisations.

**Dialogue 2:**

Adult: Okay. Do you need anything else to make it go?

Child: Here, I got a box for the motor. And the wires are just going to poke through. And it's going to hold it when it's draining.

Adult: Tell me about a drainer. What's that for? What does the drainer do?

Child: It's gonna drain. To drain all the water out.

Adult: Yeah, and what's the function of this piece here?

Child: The box is gonna go, gonna be the electric box and this bit is gonna be the thing that goes beep and beep and it's gonna suck into the motor and then it's gonna squirt out back into the hose.

Adult: Mmm, okay.

(break)

Adult: Why does that happen? Why does the fire come out when you push the button?

Child: Cos the water comes out and sprays it all out.

Adult: Oh, okay. So where does the water come from?

Child 1: From up where the ...

Child 2: From up at the sky.

Child 1: Yeah. Up at the sky.

Adult: From in the sky?

Child 1: Yeah.

Adult: So how do you get the water from the sky to put out the fire

out of your pump?

Child 1: Well I get up there. I get up a real high ladder and I push the (hose?) in and the water comes down too.

This teacher was adept in following the child's lead, in talking and in action. However, without the use of the radio-taped dialogue it would have been very difficult for her to remember the key features of the children's thinking. The exchanges recorded above provided several leads for further possible investigations: about the water cycle; the origin of weather; fire extinguishers; pumps; siphons; and about where their ideas came from, as beginning possibilities. During the busyness of coping with a group of children all excitedly expressing their ideas, teachers find it difficult to always follow the relevant lead, or to address all the children's ideas. At times it is more appropriate to complete the immediate project, than to digress on a tangent to follow a new idea, no matter how good that new idea might be. The advantage of having such significant dialogues recorded is that they can be easily returned to at a later time. The teachers in this study sometimes place a copy of the same transcript in the portfolio of each of the several children who were involved in it, to contribute to the learning story of each child.

We need to be conscious of making the time to record dialogues.

It's typical, well for me, to make sure I've got a moment to actually sit with children. Which you actually have to plan for or make time for (Sue).

Once committed to recording dialogues teachers seem to find the time during even the busiest sessions to do so.

Yeah, nothing's changed (in the business of the session) it just that last time I felt that it was sort of like a really busy day and I actually consciously, I said to (Teacher) I'll put the tape deck on and then I'll try and find a quiet moment where I'll sit and talk to children and it took me a wee while to get to that. And then I saw a couple of children sitting on that big, black tyre so I went out there and just sat down with them (Sue).

One of the things that was the difficulty was if we were the outside teacher and we sensed that we were going to have a neat conversation here. Stop. Wait a minute. And I'll come back in a minute (Chloe). (Note that this was necessary where the teacher had to go inside to turn the tape deck on to begin the recording).

Through analysing their transcripts these teachers found themselves reflecting on how they could continually extend the children as their interests shifted.

Like, Malcolm, he started a lot of conversation about how pumps worked and then that moved on and the next day I brought a pump from home. But he talked about the car battery and that sort of thing to make a pump with and I could have brought a car battery or something like that, couldn't I? I need to keep extending him where he's at (Loris).

### **The use of the computer in support of scaffolding children's learning**

In addition to their versatility in word processing, for recording and reproducing transcripts of dialogues, computer programmes have been utilised in the current programme of professional development in three ways: (a) in conjunction with the video camera, to print photo prints from the video recording of children's activities; (b) as a source of knowledge related to children's areas of interest, and (c) as support in recording the planning process.

### **Video photo prints**

One process that has been found to facilitate dialogue between teachers, children, and parents is the use of video photo shots of recent interactions. Photos are intrinsically attractive to everyone, and dialogue between adults and children about the children's activities is readily developed. Teachers are successfully using such dialogue to challenge children to consider in more depth how and why they engaged in the previous activities, and how and why they could further develop those or similar activities in the current and future sessions. In this way the photos support teachers and children in jointly constructing ongoing projects. Carr (1998) reports that photographs of children and their work have been used in many centres to support children's recall and dialogue about topics of interest to them; they are often included in individual children's portfolios, which become a record of the child's time at the centre.

The use of recent technology which allows the production of photo shots from video recordings has many advantages over either the viewing of the video or the development of ordinary photos. As Helm, Beneke and Steinheimer (1998, p117) discuss, "often teachers are disappointed in the quality of the photographs they take when documenting". Using the video as the source of the photo shot means that it is possible, with relative ease, to print a still shot of the chosen frames. These stills can then be enhanced, in size and/or colour, to gain the image of the required expression or view, which will be most likely to engage the children's interest. While the action is taking place it is impossible to know how it will develop and therefore which will be

the significant shots, worthy of recording as a photograph. This choice can be made at any time from the video recording.

In keeping with the co-construction ethos children could readily be involved in the choice of the shots of their own action - impossibility when still photographs are being made of them in action. Viewing a video becomes quite disruptive of a session as all the children are drawn to watching the television. At times this is an appropriate activity, but viewing the still shots has been found to be more productive of small group discussion and meaningful dialogue. Still shots, as with photographs, are able to be stored in each child's profile, for ready reference at any time. A video recording is more difficult to set up for ready reference to a particular event.

### THE COMPUTER AS A SOURCE OF KNOWLEDGE RELATED TO CHILDREN'S AREAS OF INTEREST

The project approach to planning (Berk & Winsler, 1995) is encouraging teachers to research the topics that children are interested in. In support of this process the kindergarten in the current research programme has a copy of an encyclopedia loaded into its computer. The children are now requesting the downloading of specific material. In this kindergarten parents are also available to support the children's learning on the computer. Evidence of relevant material that has been downloaded and printed is seen both in the children's portfolios and on the project display boards. These teachers do not yet have access to the computer web sites, but some of the parents who do have also contributed to the children's projects through accessing material from the web.

## THE COMPUTER AS A SUPPORT IN RECORDING THE PLANNING PROCESS

Many early childhood centres in New Zealand now own computers in support of their administration functions. In the centres in this study there was at least one staff member who was computer literate and keen to extend skills in support of children's learning. Teachers are able to use their computer for recording their planning cycles for individual children. The teachers report considerable savings in time when they can use templates already loaded into the computer. With Te Whaariki loaded it is easy for teachers to transfer relevant material to each child's planning records.

Spender (1995) has identified some differences in the use of computers by men and women, and is concerned to encourage women to become computer literate. The combination of audio, computer and video technology seems to have much potential in supporting children's learning in early childhood. Perhaps the inspiration to utilise another tool in support of children's learning will lead more staff in early childhood to learn to use their centre's computer, the radio microphone, and the video camera. Certainly several teachers in the study reported here, have been inspired to do so. These teachers are acting as important role models, especially for girls, in their willingness to engage in new learning in the field of technology.

## CONCLUSION

Technology in the form of the radio microphone, the video recorder and the computer, is proving to be effective in supporting the scaffolding of children's learning through the recording of dialogues in two early childhood centres. Through their programmes of facilitated action research these teachers have experienced the scaffolding of their learning in many ways. Some of this learning, such as learning how to listen to children's ideas, was planned by the teachers and the facilitator at the commencement of the study; other aspects, related to learning to use some technological tools, were surprising outcomes. Making explicit the parallels between the research exercise as scaffolded learning, and the teachers' work in extending children's learning, has been powerful learning for all those involved in the research. The author as facilitator of the research process has been privileged to be a participant in this experience in co-constructed learning.

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