

Evaluation of the Early Childhood Education Information and Communication Technology Professional Learning Programme

LITERATURE REVIEW
15 MARCH 2009

Carmen Dalli, Sue Cherrington, Lisa Oldridge and Vanessa Green

ISBN 978-0-478-34139-3



JESSIE HETHERINGTON CENTRE FOR EDUCATIONAL RESEARCH

Te Puna Rangahau ki Ako Pai



Literature review

Technology is a creative, purposeful activity aimed at meeting needs and opportunities through the development of products, systems, or environments. (Technology in New Zealand curriculum document, 1995, p. 5)

The implications of information and communication technology (ICT) for early childhood pedagogy started to raise discussion in scholarly early childhood literature during the 1980s (e.g., Donahue, Borgh & Dickson, 1987; Fein, 1986; Hill, 1985). A key debate of this decade was the desirability or otherwise of introducing computers in early childhood settings. Variable opinions on this debate continued to be expressed throughout the 1990s (e.g., Elkind, 1996; Gerzog & Haugland, 1999; Harris & Lysaght, 2003; Shade, 1996;) alongside a call for PD (professional development) initiatives focused on ICT (e.g., Dockett, Perry & Nanlohy, 1999; Shade, 1996; Visser, 2000; Wright, 1998). More recently, a consensus has emerged around the potential of ICT to enhance children's development and learning (e.g., Anderson et al., 2007; Brown, 2006; Clements, 1999; deWacht, 2004; Edwards, 2005a, 2005b;) with Edwards (2005b) noting that the debate around the use of computers in early childhood settings has been replaced by the realisation that computers play a significant role in children's everyday life, a point acknowledged also in Bolstad's (2004) literature review on the role and potential of ICT in early childhood education. Zevenbergen (2007) has gone a step further referring to young children as "digital natives" (p.19) whose worlds are heavily influenced by technologies. She argues that children now live in a "digital habitus" that has its own "particular ways of seeing and acting in the world" (p. 20) and that this has implications for early childhood practice .

This chapter provides an overview of literature relevant to the questions addressed in this evaluation. In particular it seeks to provide research-based answers to the following questions:

1. What factors increase teacher capability in ICT?
2. What organisational support do teachers need to increase, and sustain, increased ICT capability and sound ICT pedagogy?
3. How useful is an action research model in PD?
4. What creates a community of practice generally, and around ICT specifically?
5. What transforms pedagogical practice in ICT ? What works from the learners' perspective? What sustains the transformation?
6. What are the perceived outcomes for children of enhanced teacher capability in ICT?
7. What are the barriers and enablers for different services? What varies across services?

These questions were formulated from the focus of each of the four levels of the evaluation framework used in this project and adapted from Guskey's model (2000, 2002), namely:

- Level one: focus on participant learning, and in particular, increased ICT capability (Literature review question 1);
- Level two: focus on organisational support for change, in particular, the process and implementation of the PD programme; (Literature review question 2, 3 and 4);
- Level three: focus on participants' use of new knowledge and skills, in particular the transformation of their professional pedagogical practice and the sustainability of the transformed practice/ new learning; (Literature review question 5);
- Level four: focus on student learning outcomes, in particular outcomes for children including parental perspectives, and on any unexpected negative outcomes (Literature review questions 6 and 7).

This literature review is structured around the four levels of this evaluation and the questions relevant to each level:

Level One: Focus on participant learning and increased ICT capability

Literature Review Question 1: What factors increase teacher capability in ICT?

Studies that throw light on how early childhood teachers' learning and capability in ICT may be increased emphasise that the use of ICT is embedded within an educational and philosophical context (e.g., Bailey & Weippert, 1991; Dockett, Perry & Nanlohy, 1999; Patterson, 2004). It is impacted by assumptions about the effectiveness and possibilities of ICT, as well as by teachers' knowledge and skills (e.g., Anderson, Rooney & Vincent, 2007; Flear, 1993; McLeod, 1999; Moss & Pence, 1994; Visser, 2000).

This argument is sometimes framed in the terminology of discourse theory, with the state of ICT pedagogy being attributed to dominant discourses within a given context, including cultural practices. One example of an early childhood study within this framework is Anderson, Rooney and Vincent's (2007) small collaborative action research project, conducted by the first author with two student teachers in two New Zealand infant and toddler centres. The project investigated how and whether ICT could be used with very young children; it concluded that the use of ICT was "shaped by the discourses that develop in educational settings" (p. 12) and reflected the assumptions held by the teachers about what they could achieve with ICT when working with very young children. By 'discourse', the authors mean all "the saying/doing/thinking that takes place each day in our conversations and relationships" which contribute to "our understandings of how the 'world' functions and should function" (p. 12). In this study, the two student teachers started out with different attitudes towards the use of ICT in their centres: One was initially very sceptical and the other was very positive about ICT as a resource. The study reported that for both students and centres, a change occurred through the student teachers' actual *engagement* with the ICT equipment. For example, the use of a laptop for presentations led to the teachers wanting to engage more with the equipment.

Reporting on research and intervention with 14 New Zealand primary school teachers over a three-year period, Moreland, Jones and Chambers (2001) similarly noted that it was important for teachers to engage with the technology, and its knowledge base, if they were to promote technological literacy and to teach it effectively. Moreland et al. aimed to enhance primary school teachers' ability to provide formative feedback on students' technological practices; they elaborated in detail on the nature of the necessary knowledge base explaining that it relates to conceptual understanding of relevant technological concepts and procedures; procedural knowledge that enables one to know how to do something, what to do and when to do it; societal knowledge or knowledge about how technology relates to groups of people; and technical skills that relate to practical techniques (see also Jones, 1997, cited in Moreland et al. on p. 16). The authors concluded that in order to enhance and sustain learning in technology, there needs to be a focus on teacher knowledge of specific and detailed technological learning outcomes, alongside appropriate pedagogical approaches.

Researching in the Australian state of Victoria, Edwards (2005b) used pre-piloted interviews to examine the views of twelve early childhood teachers on what influences computer use in early years settings. Edwards reported that the teachers identified nine factors as important with the four most important factors being:

1. the need for educators to have operational knowledge of the computer;
2. the need to select software appropriate to the children's learning and developmental needs;
3. the need for children and educators to have access to current and reliable technology; and
4. the need to actively consider where (and why) the computer would be located in the classroom.

The other five factors that teachers discussed were:

5. the need to teach children how to use the computer and its associated peripherals (e.g., scanners and /or digital cameras);
6. supporting children to work collaboratively when using the computer;
7. considering the educational or intended purpose in using the computer in the context of the broader curriculum;
8. assisting children to share and /or take turns in using the computer; and
9. ensuring that children have the necessary fine motor skills to operate the computer effectively.

Edwards (2005b) concluded that her findings, with their particular focus on teachers' own perceptions of their use of ICT in early childhood settings, were in line with those of other international ones (e.g., Filipenko & Rolfsen, 1999; Judge, Puckett & Cabuk, 2004; Sandberg, 2002 cited in Edwards, p. 12) where the effective use of ICT in early years settings was found to depend on a range of factors and the way those factors interacted in any one setting.

Patterson (2004) too emphasized that teachers' capability with ICT is impacted by multiple factors. This New Zealand study involved observations of sixty-four children and six teachers over a five-day period in one early childhood centre, interviews with the teachers and a record of software and hardware used in the centre, including teachers' perceptions of the impact of ICT on learning. Of interest was the finding that despite working through a model designed to enhance the teachers' use of ICT and the development of the children's information literacy skills, the six teachers in this centre were unable to articulate what children were learning in ICT. Patterson commented:

the most revealing aspect of this research is the need for teachers in early childhood education to understand the teaching and learning environment they are operating within... They need a better understanding about the world young children are exposed to daily and they must recognise that children are already able to engage with these distinctly different modes with apparent ease. (p.29)

Patterson (2004) further commented that teachers' practice needed to be informed by contemporary learning theories and to make links between these and the use of ICT as there are many "complex connections between literacy, technology and learning" (p. 30). This argument is consistent with that put forward by Cullen (1999) since the late 1990s (eg: see also Hedges & Cullen, 2005a; 2005b) that teachers require explicit content knowledge if they are to extend children's learning in early years settings in any area of the curriculum.

Summary points re level one question

In summary, the studies reviewed in this section point to the important impact of contextual features on teachers' capability in ICT. In particular, they made the point that teachers' assumptions re ICT, their understanding of the children's learning context and their attitudes to children's competence are all implicated in teachers' ICT capability. Specific factors related to increased teacher capability in ICT were also identified as follows:

- the teachers' knowledge base about ICT, including specific and detailed technological knowledge and knowledge of appropriate pedagogical approaches,
- teachers' access to current and reliable technology, and
- teachers' engagement with ICT equipment.

Level two:
Focus on organisational support for change, in particular, the process and implementation of the PD programme

Three of the literature review questions are relevant to this level of the evaluation framework. These are:

Question 2: What organisational support do teachers need to increase and sustain increased ICT capability and sound ICT pedagogy?

Question 3: How useful is an action research model in PD?

Question 4: What creates a community of practice generally, and around ICT specifically?

These questions will be dealt with individually and insights on all three questions will be combined in a summary at the end of this section.

Literature Review question 2: What organisational support do teachers need to increase and sustain increased ICT capability and sound ICT pedagogy?

A number of studies highlight that PD is essential to both the type and extent of ICT usage in early years settings. At the same time, as identified by Anderson et al. (2007), the time that is needed for PD around the use of ICT, and the implementation of sound ICT pedagogy, is a practical issue that must be taken into account.

Drawing on her practical experience in New Zealand early childhood centres, Visser (2000) argued that “an ICT culture supportive of children’s learning” (p. 11) does not necessarily flow on from the mere provision of ICT resources. Instead, she suggested that systematic strategies are needed in the area of curriculum planning, implementation and evaluation; at the level of the teachers’ facilitation of the curriculum; in the management of the learning environment; and at the level of policy. Elaborating on the desirable components of a policy on the use of ICT, Visser advocated a policy to cover:

- ongoing PD to increase adults’ awareness of their role in implementing a rich ICT environment;
- an holistic approach to ICT, so that learning outcomes are truly integrated across the curriculum with the computer treated as another multimedia tool;
- a wide variety of teaching strategies;
- attention to the learning environment; and
- resources that are open-ended. (p.16)

One example of how the different components identified by Visser (2000) can work together to provide organisational support for change was that reported by deWacht (2004). The study, based in Australia, involved teachers and school leaders from primary and secondary schools who started collaborating in clusters of schools with the aim of improving literacy, numeracy and ICT outcomes for students. According to deWacht, the key to the success of the project was the involvement of school leaders and representative teachers from each school in a project leadership team. deWacht also argued that sustained *in situ* PD within the cluster groups, both through online and face-to-face meetings, created important support structures that produced a detailed and targeted PD programme that provided participants with all the knowledge and skills needed to produce desired pedagogical and curriculum changes.

Cluster group arrangements in PD initiatives have also been favourably reported when used in areas beyond ICT. For example, school principal Margaret Grevett, who in 2003 chaired a school cluster in the Bundaberg district of Queensland wrote with great enthusiasm about the impact of bringing principals of schools together in a cluster group

and noted the effect of this on the principals' leadership of curriculum change. The article by Grevett (undated), published in a practitioner magazine, noted also the effects on the school staff when the principals in turn provided PD to all their teachers either personally or through outside facilitators. Grevett argued that a learning community was established that "ultimately resulted in staff taking on leadership positions within their respective schools" (p. 26). Grevett summarized the major outcomes from the cluster model of PD as:

- the sharing of professional expertise;
- productive professional discussion that ensures ongoing development and refinement of the approach;
- networking of staff across the cluster leading to building of a strong learning community using productive pedagogies;
- the development of a particular type of pedagogy; and
- more ownership of the curriculum.

Within New Zealand, general PD literature provides further useful insights into the organisational factors that promote and sustain successful change. Hampton (2002), for example, concluded from her literature search and her analysis of interview and focus group data with twelve teachers, that the ability of PD processes to produce change depended on individual factors such as the teachers' assumption of personal responsibility for their participation in the PD opportunities; their ability to be reflective about their practice; and their engagement in self-assessment. At the same time, Hampton recommended that PD be structured in a way that allowed for ongoing contact with facilitators and time for reflection and feedback, factors which require organisational support.

The importance of both personal commitment to PD and organisational support was also highlighted by Lovett (1995) who, reflecting on PD as a career-long quest, concluded that "the success of PD rests with the individual" (p. 24) but equally emphasised the importance of collegiality and reflective practice in making PD an effective "life line for quality work environments" (p.21), a view echoed also in Gilmore's (2000) report on the PD associated with the National Education Monitoring Project (NEMP). Lovett used a definition of collegiality derived from the work of Barth (1991, cited in Lovett, p. 21) who sees collegiality as consisting of four behaviours that need to be planned for within the organisation of an educational setting. Barth's four behaviours are:

- (i) school adults frequently talking about practice in a continuous and precise way;
- (ii) school adults observing each other's practice and reflecting and talking about this;
- (iii) school adults working together in planning, designing, researching and evaluating the curriculum; and
- (iv) school adults teaching each other what they know about teaching and learning so that they reveal, articulate and share their knowledge of their craft.

This emphasis on collegiality is reported also by Andy Begg (1991) who interviewed New Zealand high school teachers about PD needs and their views on how best those needs could be met. The teachers identified that time and resources were essential alongside support from their colleagues both during the PD courses and on their return to school.

Working within a Kaupapa Māori framework, Rau (2000) used narrative ethnography data from six Maori women early childhood educators who attended *Ngahihi* PD programmes to illuminate another dimension of organisational support. Rau argued that Maori women educators need to be able to enhance their development within a *Kaupapa Māori* perspective; she concluded that the educators in her study believed that PD needs to be "for Maori, by Maori and with Maori" (p. 4).

In an article entitled *Kaupapa Māori messages for the mainstream*, Bishop and Glynn (2000) argued that central to *Kaupapa Māori* theory is a focus on an analysis of power and that *Kaupapa Māori* practices are based on power-sharing relationships, and on experiences that are holistic and interactional. Listing principles of *Kaupapa Māori* practice identified by Smith (1992, 1997 cited in Bishop & Glynn, 2000, p. 4) in Māori medium primary schools, Bishop and Glynn argued that *Kaupapa Māori* practices can be extended into mainstream educational settings. Elsewhere Glynn (1999) further argued that all educators need to develop a culturally relevant pedagogy; in other words, educators do not have to be Maori to work on this. This suggests that while the educators in Rau's study believed that PD needs to be "for Maori, by Maori and with Maori", an acceptable alternative organisational support measure might be a culturally relevant model of PD based on power-sharing relationships and interactions.

Literature Review question 3: How useful is an action research model in PD?

Literature Review question 4: What creates a community of practice generally and around ICT?

Overall, studies that have used an action research model of PD, report a number of significant changes in practice as a result of the action research process. In most cases, the creation of a community of practice was one of the reported changes (e.g., Anderson et al., 2007; Depree & Hayward, 2001; 2004; Kember et al., 1997; McLeod, 1999) and thus literature in this section is used to answer both question 3 and question 4 above.

One of the earliest New Zealand-based articles to promote the use of an action research model for PD in early childhood settings was by McLeod (1999). Also in the late 1990s, the Ministry of Education's (1999) *Quality Journey* resource was published, advocating a version of the action research cycle popularised by Kemmis and McTaggart (1988, p.7) as the process through which early childhood staff could engage in reviewing specific areas of practice. At about the same time, PD contracts using action research approaches became popular (e.g., Gaffney, 2003).

McLeod (1999) pointed out that one advantage of the action research approach is that it concentrates on the types of collegial and collaborative practices that have been claimed as typical in early childhood work settings. McLeod added that action research provides a process for careful and setting-specific planning and that it maximises opportunities for teachers to develop their reflective practice, something which she argued "enhances organisational and individual performance" (p. 43). McLeod also argued that action research can have important spin-offs through creating a "framework of team leadership" (p. 43) at centre or team level.

In a pilot study in which Depree and Hayward (2001) used the action research cycle of 'plan, study, do act' recommended in the *Quality Journey* resource (Ministry of Education, 1999) to review specific areas of practice in ten early childhood centres, the authors reported that there had been verbal, visual and behavioural changes of practice in each of the three centres they reported on. The reported changes affected all aspects of the centre's life and the overall culture of each centre. Furthermore, a follow-up study carried out in 2002 using questionnaires and group interviews with staff of the nine centres who had completed one action research cycle, found that the action plans had been maintained in all nine centres (Depree & Hayward, 2004). The staff in the nine centres attributed this result to (i) the inclusion of parents, children and teachers throughout the review and change process; and (ii) to the development of systems to support the successful maintenance of change. Below are some specific outcomes of the action research process reported by centre staff:

In relation to parents, changes reported were:

- an increased sense of partnership with parents at centres including increased involvement by parents in the centres;

- increased understanding by parents of bicultural practices;
- strengthening of behaviour management strategies between home and centre;
- broadening of parent education opportunities;
- improved feedback between parents and teachers on children's learning.

In relation to children, improved learning outcomes were reported as follows:

- bicultural and bilingual learning;
- self-correcting behaviour;
- emerging literacy skills,;
- involvement in documenting learning.

In relation to changes for teachers, there was:

- improved teamwork;
- reflection on practice with the support of colleagues;
- support in applying behaviour management strategies;
- fostering biculturalism and Maori language;
- reflective thinking about literacy.

Deprea and Hayward (2004) also reported that the interview data highlighted the importance of organisational support and curriculum management systems for implementing assessment, planning, and evaluation. Also important were systems for time management, and for budgeting to meet planned goals, including the purchase of equipment, and for hiring high quality staff. This study further identified factors that enabled or hindered the maintenance of the changes; these will be reported as part of the level 3 discussion in this review.

Evidence of the usefulness of an action research model in PD can be found also in the study reported earlier in this chapter by Anderson, Rooney and Vincent (2007). This small New Zealand study focused directly on the use of ICT in an early childhood setting and reported that the ICT practice of the two student teachers was transformed through the use of a collaborative action research model that incorporated processes based on the concept of *Ako*. Anderson et al. define *Ako* as “a traditional Maori conception of teaching and learning in which teacher and learner share both roles”(p.12); this concept is also listed as one of the six *Kaupapa Māori* principles in the work of Bishop and Glynn (2000; Glynn, 1999) referred to in the level one section of this review. Gaffney (2008) also refers to the reciprocal nature of teaching and learning as an integral part of action research when discussing participatory action research as an experience of group problem solving in which participants learn from each other. Gaffney’s overview article draws on reports of New Zealand action research studies as well as his own experience as an action researcher; it is the introductory article in a special edition of a journal with a focus on action research.

Also relevant to the questions in this section is the work of Kember et al. (1997) who, in reporting the results of a PD project that used an action research model with 50 different teacher-researcher teams in Hong Kong, noted that the action research model acted as the catalyst for the creation of a community of practice. The teacher-researcher teams worked with six associate co-ordinators from across the seven universities in Hong Kong. The role of the associate co-ordinators was to be a ‘critical friend’ and Kember et al. described the diverse aspects of this role in terms of the twelve metaphors of: financier; project design consultant; rapport builder; coffee maker; mirror; teaching consultant; evaluation advisor; research advisor; resource provider; writing consultant; match maker; and deadline enforcer.

Of interest to this literature review is the outcome reported by Kember et al. (1997) from the “match making” aspect of the “critical friend” role. The term “match maker” was used

to talk about the way the “critical friend” was able to bring together different teacher-researcher teams with similar interests. Apart from enabling the teams to benefit from the sharing of expensive resources, the authors reported that “a community of academics interested in teaching research and development” (p. 477) developed which the project team sought to maintain beyond the duration of the project through electronic mailing lists and bulletin boards. One of the writers recounted his match-making experience as an associate co-ordinator thus:

Match-making could be really useful. One of the team told us that they were trying to build a multimedia laboratory, we told them there was one in the same building now being used by another team. One team said they wanted to do 3-D simulation but lacked experience. We told them there was a team in another university using the same technology to build state-of-the art learning tools. (p.478)

This experience is one example of the way that a community of practice can be facilitated through action research. Bennett et al.'s (1997) work provides other examples from the context of seven part-time MEd students who met regularly with their MEd tutor outside the formal teaching sessions to support each other through their study. The paper provides evidence of the facilitative nature of self-managing learning groups and the contribution that the role of critical friendship can make to continuing PD.

Summary points re level two questions

Studies reviewed in this section have highlighted that beyond the personal commitment of staff to make their PD experiences result in change, there are some important organisational factors that impact the process and implementation of PD (PD) courses.

In particular, studies have indicated the following practical factors as necessary components of organisational support for change:

- enough time set aside for the necessary PD;
- planned time for reflection and feedback activities;
- a policy to cover the necessary structural arrangements to enable the PD;
- PD that is delivered on site;
- use of cluster groups whether face-to-face or online;
- ongoing contact with PD facilitators;
- the involvement of management in active support for the PD and specifically for ICT PD; and
- a model of PD based on *Kaupapa Maori* principles of power-sharing and reciprocal learning.

In relation to the usefulness of action research as a model for PD, the studies reviewed indicated that action research has been shown to result in positive changes that are able to be maintained. Other specific positive outcomes of an action research approach included:

- the development of a culture of collegiality;
- maximising of reflective practice;
- creation of a framework of team leadership; and
- improved teamwork.

Additionally, an action research approach to PD has also been shown to be an effective way of creating a community of practice around an area of focus that can also impact more broadly on the culture of the overall setting. The use of a “critical friend” as part of the action research process has been reported as useful to the creation of a sense of community.

Level three:
Focus on participants' use of new knowledge and skills, in particular the transformation of their professional pedagogical practice and the sustainability of the transformed practice/ new learning

Literature review question 5: What transforms pedagogical practice in ICT? What works from the learners' perspective? What sustains the transformation?

Literature discussed in earlier sections has already thrown light on the question at the centre of this third level of the evaluation framework focussing on participants' use of new knowledge and skills, in particular the transformation of their professional pedagogical practice and the sustainability of the transformed practice or new learning.

For example, in discussing literature on factors which increase teacher capability in ICT (focus of level one of the evaluation framework), reference was made to studies that have highlighted the critical role of context, or dominant discourses, including teachers' assumptions about ICT, in the enhancement of teachers' ICT capacity. Additionally, literature relevant to the second level of the evaluation framework, with its focus on organisational support for change, identified a list of practical factors that support change, including desirable features of PD models using action research.

In this section the focus is narrowed onto a small subset of studies that have investigated teachers' own perspectives of what makes a difference to their practice, with the aim of elaborating specifically on the participants' perceptions of their use of their new knowledge and skills.

Useful to this focus are the findings reported by Peter deWacht (2004) from two major PD projects in primary and secondary schools where teachers worked in cluster groups. According to deWacht, who facilitated one of the clusters, teachers perceived *in situ* PD as highly effective in producing desired pedagogical and curriculum changes. In deWacht's project, the PD included both online and face-to-face cluster group meetings; bringing in experts to upskill participants on ICT; and bringing teachers together online with partner groups for specific projects. deWacht argued that the teachers put great value on the fact that all the activities they engaged in during their PD were purposeful and aimed at implementation in a later stage. deWacht reported the following two statements by school principals as capturing the impact that the participants perceived the project as having:

There has been an incredible improvement in ICT skills right across the schools, especially in the area of videoconferencing and the use of ICT to assist learning.

It has allowed people to experiment and try out things in a supportive environment. (The benefit) flows on to students, because ...what we are hoping (is) that students will stretch their boundaries. (p.11, brackets in the original).

The importance, identified above, of having an opportunity to experiment and engage with ICT equipment hands-on also emerged as a critical transformative factor for the teachers in Anderson et al's (2007) project, and likewise those in Moreland et al's (2001) project. For example, Anderson et al. reported that two of them (Rooney and Vincent, who were both student teachers working with Anderson as their supervisor), found that taking photos of the children when they had settled into their childcare centre, and re-playing a slideshow of the photos, enabled them to help the children to 'revisit' their early experiences at the centre. The authors argued that this created opportunities for the children to develop cognitively, emotionally, linguistically and socially" (p.14). At the same time, seeing the impact that the use of the digital technology had had on the way children settled in was a powerful transforming factor for the student-teachers themselves - it "converted" the initial resistance of one of them to using the technology, and confirmed the other's belief in its potential. This effect applied also to the authors' use of the laptop: After

using the laptop for presentations, the student teachers felt they wanted to engage more with the equipment (see level one section earlier in this chapter). In this way, presenting and discussing their findings was a transformative process for the student teachers and made them reflect on their assumptions about the use of ICT with young children. Furthermore, the authors argued that the transformation may not have occurred if the student teachers had simply discussed the relevance and possible importance of ICT with their supervisor. In other words, it was the intense exploration of the potential of ICT that had worked. Jordan's (2006) article describing how teachers in one Centre of Innovation project used ICT in their planning and documentation of learning of under-two-year olds, similarly makes the case that intense use of ICT equipment transformed teachers' practice. According to Jordan, the teachers in her centre "learned to use their new ICT equipment in the immersion of their current work in the centre" (p.25). She argued:

Such immediate and ongoing application of new skills leads to ready understanding of their value in both teachers' and children's repertoires of knowledge – an example of what Rogoff (1988) has termed a 'transformation of participation' (p.25)

Interestingly, this reported effect for the student teachers mirrors Clark's (2005) finding for children who, when enabled to take their own photos to record their experiences, felt empowered in their use of ICT.

The experience of teachers who took part in the PD associated with their participation in the National Education Monitoring Project (NEMP) further provides support for hands-on experiences with new pedagogical practices (Gilmore, 2000), even when these are not ICT-related practices. Using data gathered via weekly diaries, questionnaires, visits, and interviews from 200 participants in the NEMP PD (PD) in the period between 1995 to 1997, Gilmore reported that teachers identified numerous factors that led 96% of them to give a rating of 4 or 5 (5 being the highest on 1-5 scale) to the PD. Reasons for this high rating included the provision made in the PD for time for reflection; the ability to immediately apply learnings; the enjoyment of the experience; the greater self-confidence they gained through the PD; the hands-on experiences; and comprehensive training which allowed them to sustain the new practices.

Summary points re level three question

This small group of studies indicates that, from teachers' perspective, to make a difference PD needs to be,

- on site;
- sustained over time;
- relevant to the desired curriculum change; and
- provided by people who are expert in the relevant area.

Additionally, from teachers' perspective, PD in ICT is transformative when:

- PD ICT activities are purposeful; and
- participants are enabled to engage with ICT in a hands-on way.

For one study included in this section (Jordan, 2006), immersion in ICT, and the associated transformation of practice, was not through a PD project per sé but rather within the supportive environment of a Centre of Innovation action research project. As the author herself noted, the Col action research projects often serve as PD for the teacher-researcher teams.

Level four:

Focus on student learning outcomes, in particular outcomes for children including parental perspectives, and on any unexpected negative outcomes

Literature review questions 6 and 7 are linked to level four of the evaluation framework; this section addresses each question separately with relevant points collated in a concluding summary under each question.

Literature review question 6: What are the perceived outcomes for children of enhanced teacher capability in ICT?

In a short research note on introducing computers to under-five-year-olds, Fletcher-Flinn (1997) argued that not all children take to computers “naturally” (p. 14) and that it is worth taking time to introduce computers to preschoolers. Almost a decade later, this observation was supported by Patterson’s (2004) study in one Auckland centre (see level one discussion). Patterson reported that when teachers sat with the students and became involved in their learning for some time, children accessed more informative and open-ended programmes than when they were on their own; she also reported that the teachers were able to support the children in problem-solving and in building on their existing knowledge.

Recently Jordan (2006) argued that learning in New Zealand early childhood centres is being transformed through a combination of a credit-based model of planning and assessment based on principles from sociocultural theories, and through teachers’ increasing use of ICT with children, and particularly in planning and documenting learning. Reporting on an interview with the manager of the older section of the Col centre, Jordan noted that the manager saw teachers’ use of digital images as enabling children’s thinking and learning to become more visible. The centre manager also noted that enhanced use of ICT meant that children had easy access to wireless internet and this enabled them to find answers to their own questions and to pursue their own interests. Examples provided by the manager illustrated children reflecting on how to improve their acting after viewing video footage of their play. Jordan concluded that ICT enabled children to engage in re-visiting, and thereby extending, previous thinking, including through accessing their learning portfolios of digital images. Jordan further argued that the Col project she was involved in was only one of six which had similarly used digital images for collaborative analysis of children’s learning. She suggested that early childhood centres in New Zealand have much to offer as leaders in the pedagogical use of ICT.

Anderson et al.’s (2007) results in one under-twos centre in New Zealand similarly point to beneficial outcomes for children, particularly in the way that ICT can be used to break down the communication barriers in early childhood settings. This study demonstrated that ICT became the ‘voice’ to bridge communication gaps between teachers and children, as well as a way of communicating with parents; Anderson et al. noted:

by placing the laptop on a low table and seats around the table for the children to come and go as they pleased...Parents were amazed that we used this type of technology with the children at this young age, letting the children use the laptop to show their parents [the slideshows]. (p.14)

The authors concluded that ICT enhanced communication, socialization and learning experiences for the children at the same time as it facilitated their emerging ICT literacy. Similar results were reported by Clements and Sarama (2002) in the domain of mathematical learning.

These findings resonate with the conclusions drawn also by Yelland (2006) who, having reviewed a wide range of empirical literature on the use of ICT in the curriculum areas of literacy, numeracy and communication, critical thinking and creativity, concluded that the

teacher had a critical role to play in the effective use of ICT to enhance learning and expression with young children.

In summary, these studies suggest that:

- teacher involvement with children using ICT enhances children's problem-solving and their existing knowledge;
- enhanced use of ICT by teachers enables children to engage in re-visiting and extending their learning especially through the use of digital images; and
- ICT breaks down communication barriers between teachers, children and parents.

Literature review question 7. What works for different services? What varies across services? Barriers and enablers for different services?

As noted in the discussion of the literature review questions linked to level one and level two of the evaluation framework, there is acknowledgement in numerous papers that contextual factors have a considerable impact on ICT capability in early childhood services and pedagogical change generally. For example, Clements (1999) noted that populations can be very diverse and that the design of the ICT curriculum needs to be appropriate for the social setting, an argument strongly supported by Edwards (2005b) in Australia, Sandberg (2002) in Sweden, and Begg (1991), Moreland et al (2001), Patterson (2004), and Raymond, Butt and Townsend (2001) in New Zealand. Rau (2000) further noted that in Kaupapa Maori contexts, PD needs to be "for Maori, by Maori and with Maori" (p.4).

Overall, however, studies accessed for this review are limited in the light they are able to shed on any differences between service types in relation to barriers and enablers of ICT capability and of pedagogical change more generally. Rather, the studies reviewed reveal commonalities in what works and what doesn't. A summary of enablers and barriers identified across the studies follows.

Enablers of change:

1. Engagement with ICT equipment (Anderson et al., 2007) and hands-on experiences generally rather than just lectures (Begg, 1991; Edwards, 2005b; Jordan, 2006; Moreland et al., 2001). These studies emphasised the powerful effect of gaining knowledge and skills in theory and in practice;
2. Teachers who are informed about contemporary learning theory and explicit content knowledge about ICT (Patterson, 2004; Hedges & Cullen, 2005a; 2005b);
3. Teacher who have access to resources, including support and knowledge about what to do when problems arise with computers or other technology (Sandberg, 2002; Visser, 2000);
4. Access to PD for teachers (Depree & Hayward, 2004);
5. Adequate time to spend on PD on the use of ICT (Anderson et al, 2007; Begg, 1999;);
6. Centre leadership and management systems that support the planning, implementation and evaluation of the change (Depree & Hayward, 2004; Visser, 2000);
7. Children having free access to computers so that they can build confidence with it (Sandberg, 2002);
8. Having a 'critical mass' of a centre's staff attend PD to ensure changes are carried out with support from all staff in a centre. Sharing interests and experiences supports change and development, as do relationships with peers. (Begg, 1991; deWacht, 2004; Lovett, 2000; Patterson & Fleet, 2001; Raymond, Butt & Townsend (1992) ;

9. PD based on the specific needs of the educational setting, the people within the setting and also curricular needs (Begg, 1991);
10. Understanding how PD has happened before for teachers. This requires opportunities for teachers to be able to examine and make explicit the roots of their personal commitments, histories, and teaching styles (Raymond, Butt and Townsend, 1992);
11. Friendly and inviting atmosphere in PD courses geared to adults; facilitator skill in matching content and level to participants' needs (Begg, 1991);
12. Opportunity for ongoing professional relationship with PD facilitators and opportunities to practise, reflect, discuss, and get feedback on the change from colleagues (deWacht, 2004;;
13. Intrinsic motivation to attend PD rather than a requirement (Begg, 1991) and personal commitment to change and self-evaluation (Gilmore, 2002; Hampton, 2002; Lovett, 1995);
14. Culturally relevant models of PD based on power-sharing relationships and interactions in Kaupapa Maori settings (Bishop & Glynn, 2000).

Barriers to change:

1. High teacher turnover (Depree & Hayward, 2004):
2. Lack of time to undertake PD and to implement and maintain changes (Begg, 1991; Depree & Hayward ,2004; Sandberg, 2002)
3. Limited teacher access to appropriate resources (e.g., money to pay for professional development, leave opportunities, availability of relievers, travel and accommodation to distant courses, lack of texts etc) (Begg, 1991; Depree & Hayward ,2004) such as computers (Sandberg, 2002)
4. Limitations of space and buildings (Depree & Hayward,2004);
5. Limited access to technology (Depree & Hayward ,2004;
6. Lack of teacher confidence (Depree & Hayward, 2004);
7. Differing philosophies within a teaching team (Depree & Hayward,2004)., including entrenched negative views of some older/more traditional teachers (Begg, 1991; Hampton, 2000);
8. Lack of support from management and colleagues (Begg, 1991; Hampton, 2000);
9. Being rural, living in isolated communities, and feeling isolated in one's practice (Begg, 1991);
10. Lack of Ministry direction (Begg, 1991).

Conclusion

The primary focus of this review has been on identifying what works to increase and sustain teacher capability in ICT, and specifically within the context of a PD programme. Seven questions were used to interrogate relevant literature on this topic and summary statements to answer these questions have been provided in each section of this review.

This review makes clear that much is known about the components of effective PD programmes generally, and to a lesser extent, about PD programmes with an ICT focus. A key message was that increased teacher ICT capability was not solely dependent on the specific features of the PD programme but was also impacted by contextual features in the teaching and learning setting, including dominant attitudes to ICT usage.

The effectiveness of action research models for PD programmes was supported by the literature which also indicated that action research facilitates the creation of a community of practice and a culture of collegiality among participants.

Transformation of ICT practice works best when there is hands-on engagement and ongoing structural support to sustain the new practice in the context where it will be applied.

Teachers' increased use of ICT was found to enable teachers to engage more with children in ICT activities which in turn enabled children to enhance their knowledge and to use ICT to re-visit and extend their learning.

Literature that distinguishes between what works and what doesn't by service type is limited. However, two Kaupapa Maori-based studies highlighted the importance of models of PD that were culturally relevant and based on power-sharing principles.

References

- Anderson, M., with Rooney, D., & Vincent, R. (2007). Discovering the communication in ICT: An action-research project with infants and toddlers. *Early Education*, 42(2), 286.
- Bailey, J., & Weippert, H. (1991). Educational computing challenges for early childhood educators. *Australian Journal of Early Childhood*, 16(3), 28-33.
- Begg, A. (1991). Teacher's views of PD. *SAME Papers 1991*, 36-63.
- Bishop, R., & Glynn, T. (2000). *Kaupapa Māori* messages for the mainstream. set 1, 4-8.
- Bolstad, R. (2004). *The role and potential of ICT in early childhood education: A review of New Zealand and international literature*. Wellington: Ministry of Education.
- Brown, M. (2006). Toys, tools and teachers: The role of ICT in early childhood education. *Computers in New Zealand schools*, 20(2), 16-23.
- Clark, A. (2005). The silent voice of the camera? Young children and photography as a tool for listening. *Early Childhood Folio* 9, 28-33.
- Clements, D., & Sarama, J. (2002). The role of technology in early childhood learning. *Teaching Children Mathematics*, 6(6), 340-345.
- Cullen, J. (1999). Children's knowledge, teachers' knowledge: Implications for early childhood teacher education. *Australian Journal of Teacher Education*, 24(2), 15-25.
- Depree, L., & Hayward, K. (2001, December). *Creating changes to culture*. Paper presented at the New Zealand Association for Research in Education annual conference, Christchurch College of Education.
- Depree, L., & Hayward, K. (2004). Successes, barriers and enablers to maintaining quality improvement in early childhood services in New Zealand. *NZ Research in Early Childhood Education*, 7, 75-88.
- deWacht, P. (2004). Online collaborative mentoring: A PD model for the professional learning of teachers. *Educare News*, May, 8 -11.
- Dockett, S., Perry, B., & Nanlohy, P. (1999). Computers in early childhood services: A part of the educational program or less time for play? *Journal of Australian Research in Early Childhood Education*, 6(2), 165-176.
- Donahue, W.A., Borgh, K., & Dickson, W.P. (1987). Computers in early childhood education. *Journal of Research in Early Childhood Education*, 2(1), 6-16.
- Edwards, S. (2005a). The reasoning behind the scene: Why do early childhood educators use computers in their classrooms? *Australian Journal of Early Childhood*, 30(4), 25-32.
- Edwards, S. (2005b). Identifying the factors that influence computer use in the early childhood classroom. *Australian Journal of Educational Technology*, 21(2), 192-210.

- Fein, G. G. (1986). Microcomputers and young children: an interactive view. In P. Campbell & G. Fein (Eds.), *Young children and microcomputers*. Englewood Cliffs: Prentice Hall.
- Fleer, M. (1993). Can we incorporate the principles of the national statement on technology education into our early childhood programs? *Australian Journal of Early Childhood*, 18(4), 26-34.
- Fletcher-Flinn, C. (1997). Introducing computers to preschoolers. *New Zealand Research in Early Childhood Education*, 1, 7-14.
- Gaffney, M. (2003). *An evaluation of Ministry of Education funded early childhood education PD programmes*. New Zealand: Ministry of Education.
- Gaffney, M. (2008). Participatory action research: An overview. What makes it tick? *Kairaranga*, 9, Special Edition, 9-14.
- Glynn, T. (1998). Bicultural challenges for educational professionals in Aotearoa. *Waikato Journal of Education*, 4: 3-16.
- Grevett, M. (n.d.). It makes sense: A cluster approach to developing quality education. *Classroom*, 26-27.
- Hampton, V. (2000). Kindergarten teacher's PD: Views and experiences. *NZ Research in Early Childhood Education*, 3, 189-196.
- Hedges, H., & Cullen, J. (2005a). Meaningful teaching and learning: Children's and teachers' content knowledge. *ACEpapers*, (16), 11-24.
- Hedges, H., & Cullen, J. (2005b). Subject knowledge in early childhood curriculum and pedagogy: Beliefs and practices. *Contemporary Issues in Early Childhood*, 6(1), 66-79. <http://dx.doi.org/10.2304/ciec.2005.6.1.10>
- Hill, S. (1985). Beware of commercials: Young children may not need microcomputers. *Australian Journal of Early Childhood*, 10(3), 16-20.
- Jordan, B. (2006). ICT foundations in early childhood education. *Computers in New Zealand Schools*, 18(2), 22-28.
- Lovett, S. (1995). PD: A career-long quest. *NZ Journal of Educational Administration*, 10, 21-25.
- McLeod, L. (1999). Using action research to develop a PD programme in an early childhood setting. *New Zealand Research in Early Childhood Education*, 2, 41-51.
- Ministry of Education (1999). *The quality journey: He haerenga whai hua: Improving quality in early childhood services*. Wellington, Learning Media.
- Moreland, J., Jones, A., & Chambers, M. (2001). Enhancing student learning in technology through enhancing teacher formative interactions. *set* 3, 16-19.
- Moss, P., Dahlberg, G., & Pence, A. (Ed.). (1994). *Valuing quality in early childhood services: New approaches to defining quality*. New York, Teachers College Press.
- Patterson, M. (2004). How can ICT enrich the learning environment in early childhood centres?" *Computers in New Zealand Schools*, 16(1), 25-30.
- Rau, C. (2000). *Matauranga, Mana Wahine, Mangai Tautoko for Māori women early childhood educators in accessing early childhood PD in Aotearoa*. Hamilton: New Zealand Association for Research in Education, University of Waikato.
- Shade, D. (1996). Software evaluation. *Young Children*, 51(6), 17-21.
- Visser, J. (2000). Integrating the early childhood curriculum and information communication technology. How educators may effect an ICT culture supportive of children's learning. *Early Education* 22, Autumn, 11-17.
- Wright, J. L. (1998). A new look at integrating technology into the curriculum. *Early Childhood Education Journal*, 1(2), 107-109.
- Zevenbergen, R. (2007). Digital natives come to preschool: implications for early childhood practice. *Contemporary Issues in Early Childhood*, 8(1), 19-29.