

Information and communication technologies: transforming views of literacies in early childhood settings

Libby Lee^{*a} and Maureen O'Rourke^b

^a*Murdoch University, Western Australia;* ^b*Australian National Schools Network, Australia*

This paper reports on an early childhood technology project that has been conducted in Australia since 2000. The background to the project is that IBM extended their international KidSmart Early Learning program to the Asia-Pacific region. A partnership with the Australian National Schools Network was formed to implement the program in Australia. This organisation took responsibility for identification of early childhood centres (preschool and day care) serving low socio-economic status communities across Australia (approximately 100 centres per year), the design and facilitation of professional development for teachers and research and evaluation in conjunction with the program. Whilst this was a national project, this paper deals only with the research conducted in Western Australia with the first round of centres involved in the project. The paper highlights themes emerging from teacher action research based in early childhood centres. The pedagogical considerations, challenges and dilemmas emerging from teachers' use of ICT in early childhood settings are also discussed.

Keywords: Information and communication technologies (ICT); Multiliteracies; Action research; Computers; Early childhood

Introduction and background

In 2000, IBM Asia-Pacific donated a Young Explorer computer unit to 100 early childhood centres around Australia. In addition to this donation, IBM partially funded initial research to investigate issues arising from the introduction of this technology to these centres. Centres were located in all eight Australian states and territories, with three high intensive sites (New South Wales, Victoria and Western Australia) designated. Research circles (clusters of early childhood centres and Australian National Schools Network (ANSN) colleagues) were formed in the high intensive sites to explore how best to integrate the use of Information and Communication Technologies (ICT) in each setting, particularly in relation to

*Corresponding author. School of Education, Murdoch University, South Street, Murdoch, Western Australia 6150. Email: l.lee@murdoch.edu.au

fostering children's learning. In Western Australia, the State Education Department subsidised this research with its own funds to further support teacher research circles associated with the use of the Young Explorer.

The participating centres were selected on the basis of the following criteria:

- high incidence of socio-economic disadvantage;
- high proportion of children and families with language backgrounds other than English;
- strong links with Indigenous communities; and
- limited computer access and availability within the local community.

The aims of the project were to:

- increase the ability of economically disadvantaged children to succeed in primary school, by providing hands-on experience with technology;
- assist the residents of low-income neighbourhoods to develop familiarity and comfort levels with using computer technology;
- develop and promote new methods of engaging children in learning through technology access; and
- support early childhood educators, through training and professional development, to effectively integrate new technologies into their teaching and learning programs.

Western Australia

The 11 Department of Education early childhood centres were initially selected on the basis of an expression of interest to the ANSN. IBM donated one Young Explorer Fun and Learning Computer Centre (a desktop computer system combining durable furniture designed by Little Tykes, hardware from IBM, and software from Edmark). Many of the centres successful in obtaining a computer had a high proportion of Aboriginal students. The majority of the centres were kindergartens or pre-school centres located in government schools, providing a pre-compulsory program for four- and five-year-old children. The ANSN has been involved in providing professional development for teachers and ongoing support for the rollout of computers and the implementation of case-study research. Teachers engaged in the project as participant action researchers (Kemmis & McTaggart, 2000), hence the work focused on the practical classroom situation and the interpretation of that situation by the teachers themselves. As an intensive research site, the Western Australian project invited a university associate to assist with the development of an action research project with each early childhood centre.

An initial two-day professional development session was conducted in Perth and teachers were given opportunities to explore the software, engage in discussion about the role of technology in young children's learning and become familiar with the notion of classroom-based action research. There was a strong emphasis on networking with colleagues to learn from and with each other in a process of research and professional collaboration. At the conclusion of this training, teachers were

asked to develop a research question as part of an action research cycle. Initially, teachers were asked to think about the computer and the software as tools for literacy learning. The focus on literacy was mandated by the Department of Education and Training as part of the funding agreement.

Initial research questions included teachers reflecting on their current practices in literacy and observing and recording how having a computer and a range of software might influence the teaching and learning program in their setting. Examples of initial research questions developed by teachers are as follows:

- How can I include technologies in my literacy program to improve student outcomes in a culturally inclusive way?
- What effect does the computer have on the technological literacy of the children and their parents?
- How can I use technology as a tool to develop literacy...?
- How can we use the computer to assist our oral language program?

In order to answer these key questions, teachers nominated a range of data collection strategies including work samples, checklists, running records and parent questionnaires.

Additional funds were directed towards this project from the Department of Education of Western Australia, making it possible for teachers and teacher assistants to come together for two additional, two-day research circle workshops in Perth, as well as having two on-site visits from university-based research associates.

A visiting university research associate supported teachers in developing their classroom-based action research and discussed the issues and challenges of integrating the computer in their early childhood education setting. There were also opportunities for teachers to share ideas and strategies with one another at research circle workshops. The collegial atmosphere and networking with other professionals is an aspect of the project that many participants regarded as a major strength and the highlight of their participation.

Themes emerging from the action research case studies

A focus on literacy outcomes across the centres in Western Australia and the high enrolment of Aboriginal students in the centres was the impetus for many case-study reports focusing on Standard Australian English oral language skills. An international trend toward focusing on literacy outcomes of ICT use in classrooms is noted by Plowman and Stephen (2003). Through written reflection at a summative workshop, many teachers identified the peer tutoring and increased social interaction as unexpected outcomes of computer use by young children. Other teachers identified particular software that enhanced oral language skills. The five themes which emerged from this study are now discussed in turn.

1. The computer's capacity to enhance learning

Social interaction. Many teachers have noted the impact that the computer has had on social interaction. They were initially concerned, as many have been (Alliance for Childhood, 2000) that computer use would hinder students' social interaction and

language development. However, teachers in this study have consistently noted that the computer has proven to be a very powerful stimulator for social interaction. The following extract from a teacher's report emphasised this emerging belief:

the computer corner is a very active, social area of the classroom, which generates a lot of purposeful, meaningful opportunities for oral language to occur.

Oral language. The development of oral language is a major emphasis of English teaching and learning in the Western Australian Curriculum Framework. This framework is mandated for use by all schools in the State. Childcare centres, on the other hand, operate by a set of national accreditation standards, but some have elected to utilise the Curriculum Framework in order to more closely align their programs with school-based early childhood programs.

Teachers initially did not anticipate that the presence of a computer in the classroom would facilitate oral language development. In fact they were concerned that computer use would be a solitary and introverted activity. However, the design of the Young Explorer is such that two children are encouraged to sit together at the computer on a bench seat. Other children can easily gather around and observe. Consequently, turn-taking and other collaborative behaviour developed in conjunction with extensive and sometimes unexpected talk by children.

Using naturalistic tools such as anecdotal records and incidental observations, teachers observed a positive impact on both the quality and quantity of children's oral language use. Some children, particularly those with additional needs, were observed to speak and interact more readily at the computer than they would in other play situations. The style of language that children used while engaged with the KidSmart programs included directional language, hints related to problem solving (e.g. 'try this...') and planning and organisational language as to how the turns would proceed.

Many teachers involved in this study claimed that children's oral language was enhanced through the collaborative tasks they engaged in when using the computer. One early childhood teacher noted the usefulness of some software in facilitating oral language development by using the message recording facility on the Kid Desk. She noted that this also contributed to children's overall confidence in using the computer:

When I first showed them how a message is recorded, the children were fascinated. They were totally overwhelmed at the opportunity to speak into a microphone. At the point when the children could replay their message, their reactions were just of sheer fascination. It was a pleasure to see how the children grasped the steps involved to record a message or retrieve one. Their learning journey within two weeks from not knowing anything to feeling confident in using the computer was amazing.

Another early childhood teacher reported that the computer facilitated collaboration and oral language use:

Everyone crowded around. They didn't mind who was using it, they were happy to watch and listen, adding their bit of advice and discussing strategies among themselves. I often asked 'how did you do that?' and have encouraged them to share their discoveries with each other. I can see this as a great motivator for their oral language development.

The double bench seat provided with the unit allowed opportunities for children work in pairs. One teacher used the opportunity to assess two students whose oral language skills were of concern. Using Literacy Net checkpoints (Department of Education, 1999) she focused on describing, answering questions and following instructions. Consequently, she developed an assessment instrument to evaluate these components for other students.

Peer tutoring. Valuable opportunities arose for peer tutoring and several teachers reported this in their action research reports. This indicates a focus on the significance of child–child interaction and the empowering of students as competent ‘experts’ in the use of technologies. Jackie (an early childhood teacher) reported:

Two sisters of two pre-primary children came to pick them up after school when they noticed the computer and expressed an interest to know more about it. At that point the 5-year-old children taught the 12-year-old children how to record and send messages. There was great excitement and all they did in the beginning was make different sounds. Later on as they explored and replayed their voices, they began sending messages to one another with actual words, e.g. ‘hello Clayton this is your sister Jenny’.

Early childhood teacher Janice recorded her observation of peer tutoring and oral language development:

When I took time out to really notice and listen to what was happening there (at the computer), the pure power of peer tutoring was very evident. Common phrases I overheard were: ‘this is how you do it’ ‘I’ll show you how to do it’ ‘can I help do that?’ ‘look at this!’ And an instance in which Harry makes a new discovery exclaiming ‘I can do it! I can do it! Come and look everyone!’ Groups of children flock around the computer to see what Harry’s latest discovery might be. They watch and the questions start flowing. ‘How did you do that? What happens if...? Can I have a turn?’

2. *Teachers’ changing notions of literacy*

Notions of literacy in the twenty-first century are changing dramatically. A shift towards a dynamic and multifaceted notion of literacy is embraced in the term ‘multiliteracies’ (The New London Group, 2000) and is the subject of significant national and international research. The notion of ‘multiliteracies’ embraces the idea that:

‘Mere literacy’ remains centred on language only ... a stable system based on rules such as mastering sound-letter relationships ... multiliteracies, by contrast, focuses on modes of representation much broader than language alone. In some cultural contexts—in an Aboriginal community or in a multimedia environment for instance—the visual mode of representation may be much more powerful and closely related to language than ‘mere literacy’ would ever be able to allow. (Cope & Kalantzis, 2000, p. 5)

Cope and Kalantzis also argue that ‘cultural differences and rapidly shifting communications media mean that the very nature of the subject of literacy pedagogy is changing rapidly’ (2000, p. 5). With this in mind, teachers were asked during the final research circle session to respond in writing to a series of questions in relation to their use of the Young Explorer over the previous nine months. In particular, they

were asked to reflect on their perceptions of literacy. The following section will summarise teacher responses to these questions.

'How has your notion of literacy changed or expanded?'

Teachers responding to this question highlighted how the presence of the computer in the centre allowed them to connect their existing notions of literacy with ICT-based experiences. This meant a fundamental shift in their thinking about what it means to be literate. Examples highlighting these shifts are evident in the following quotes from the teachers' case-study reports:

Literacy is...more than books and writing, it is being able to see and understand signs, symbols and icons.

This has provided me with a tool in which all aspects of literacy are available and accessible to children at their developmental level ... children are learning the skills of viewing, writing, reading, communicating, decoding, making connections and critical literacy ... with purposeful use of oral language.

Before I would think of literacy as oral language ... after, enhancing literacy through a medium but still being able to look back to real life situations.

Children need to become critical users of the technology available to them and these skills can be developed from an early age.

Prior to having a computer in the room, I wouldn't have considered using it as a tool of literacy development.

It is clear then, that for some teachers, having a computer in the classroom has meant more than simply mapping new technologies on existing pedagogies. The mere presence of a high-quality computer in an early childhood classroom has afforded teachers an opportunity to examine their values and beliefs in relation to technologies and to critique its role in early education meaningfully.

'The computer is the best way I've seen so far to...'

In responding to this statement, teachers were asked to think of ways the computer had enhanced their existing program. In particular, they were challenged to decide if the computer was actually the *best way* to undertake particular tasks. Social outcomes were identified as being fostered in a unique way, especially for reluctant or unmotivated students:

To foster sharing ... children readily accept and follow sharing and turn taking rules.

To engage reluctant learners.

To introduce a concept, gain attention and motivation.

Encouraging independence and responsibility was noted by one teacher as a significant learning outcome for students using the computer:

It's the best way I have seen so far to allow kids to take responsibility for their own learning.

Some teachers saw the computer as a particularly useful means of facilitating communication skills; they wrote:

To develop communication skills as the children interact with each other, peer tutoring.

To give children positive feedback in developing their own language skills.

'How the computer supports my literacy program'

In the context of their emerging sense of the term 'multiliteracies', teachers' action research projects were focused on 'literacy' outcomes. At the end of the project they reflected on ways in which the computer supported their literacy program. In most cases teachers used the computer as an additional tool in their existing program to enhance their strategies related to alphabetical literacy. This is what Plowman and Stephen (2003) describe as merely 'ICT as a tool to improve traditional literacy' (p.155) rather than developing the types of multiliteracies we have defined and discussed earlier in this paper. Despite many teachers identifying changed notions of literacy, their sense of the implications for practice remained rooted in traditional literacy acquisition. For example, one teacher commented that the computer supported the program by providing 'with letter identification'.

In a few instances teachers highlighted the significance of using the computer as a means of catering for visual learners and encouraging critical literacy, a dimension of literacy which we have previously identified as vital for all learners. This indicates that some teachers were in fact adopting a multifaceted notion of literacy in line with the 'new literacies' advocated by Gee (2000, p.43) and The New London Group (2000).

In addition, some teachers made very specific links between their use of the computer and the mandated Curriculum Framework (Curriculum Council, 1998) and Literacy Net (Department of Education, 1999). Examples of these responses are:

The computer supports my literacy program...

Viewing: Identifying icons for a purpose-reading and recognising environmental print.

The software relates to pointers on the Literacy Net, e.g., critical literacy skills.

Speaking: An awareness of audience when peer tutoring.

The above quotes highlight that their definition of literacy influenced the ways in which teachers used the technology as a support for the literacy program.

In addition to the expanding notion of literacy, teachers' knowledge and beliefs about *how* young children learn are evident in their interpretation of the ways in which the computer supports their existing program. The following quotes highlight the teachers' beliefs about extending children's interests, the significance of interaction in learning and the importance of purposeful 'real-world' experiences in young children's literacy acquisition.

I have a tool to 'teach' reading, writing, concepts of print etc. in a variety of open and closed learning experiences, a fun way for children to *teach each other* literacy skills.

Writing for a purpose (e.g. sending a letter to a friend in KidPix).

The oral language development and co-operative learning opportunities are great.

Encourages interaction and provides opportunities to make reading materials based on children's interests.

3. *Software*

The Edmark software provided with the computer was donated by IBM and consisted of the following titles: Kid Desk, Bailey's Book House, Millie's Math House, Sammy's Science House, Trudy's Time and Place House. In addition, teachers were supplied with the Kidpix Deluxe program.

Teachers generally commented that the software was useful and in their words 'developmentally appropriate'. However, a common concern was the cultural appropriateness of software created in the USA, which includes North American voices/accents and images. The fact that the software was developed in the USA and had some limitations in terms of cultural appropriateness was utilised as an opportunity to teach *critical literacy*. Children were encouraged to question some of the 'facts' the programs presented. For example, the game 'Trudy's Time and Place-Earth Scout' shows a photograph of the famous Australian monolith in Alice Springs, a rock named 'Uluru' by the Indigenous people of Australia. During colonisation the rock was named 'Ayers Rock' but has been reclaimed by the Indigenous people of Australia and is now widely known by its original name.

When the photograph of Uluru appears in the program, a North American voice says 'Ayers Rock'. This is particularly offensive for Indigenous people and the location of this computer and software in Indigenous communities would be regarded by many as 'inappropriate'. However, in one centre, children were asked by the teacher to confirm the correct name of the rock and they came to understand that the computer isn't always 'right'. This is a rich example of developing critical literacy in an information age, where very young children are invited to question the realities presented to them through technologies and to provide evidence to the contrary. It also raises questions regarding censorship and power in relation to the selection of resources for use with young children. Positioning children as 'experts' in the selection of the software they use might pose a challenging scenario for educators in an era where 'quality' is determined by educators in the interests of inclusion, cultural and political sensitivity.

4. *Parental and community involvement*

Responses from the community were typically excited and centres took the opportunity to appear in local community newspapers and the Department of Education's publication *School Matters*. Responses from parents were a major highlight of the project. Many teachers reported that parent involvement and interest in the program increased as a result of having the Young Explorer in the classroom. One teacher reported:

Once the computer was delivered, we had our first ever parent helper. There was a whole school interest in the computer and in including parents as teachers.

On the other hand, some centres reported no change in parental involvement. Suggestions for improving parent involvement in the program more generally were discussed among the teachers. In many settings, a high proportion of Aboriginal students in the class had an impact on the level and type of parental involvement due to a range of cultural and social factors. One issue that arose was the lack of adequate support for teachers working in these settings in the form of appropriate professional development. Access to high-end technologies in any community is related directly to socio-economic status (Becker, 2000) and Aboriginal communities are at particular risk of being disadvantaged further by a lack of participation and engagement with information and communication technologies. The *'Bridging the Gap Between the Haves and Have Nots'* (National Education and Employment Forum, 2001) report makes recommendations that both *early childhood education* and *intensive support for Indigenous education* are crucial to addressing the increasing inequities between the 'haves' and the 'have nots' in the emerging knowledge economy.

5. Ideas from teachers for using the computer

As with any new resource, the development of innovative ideas takes time and is by nature a process of trial and error. Many teachers found that their initial focus on teaching computer skills such as keyboard, mouse, printer, etc. were useful as a beginning strategy. However, teachers quickly found that a more substantial focus was required if the computer was going to be integrated meaningfully into the centre's program.

Teachers experimented with a range of activities and, in keeping with Piagetian perspectives of early development and learning, attempted to connect concrete experiences with those experiences children accessed on the computer. An example of this is the work done in one early childhood centre with the software 'Millie's Math House: Build-A-Bug'. The children created a 'critter' on the software and then recreated it in 3D using playdough, matchsticks and other collage materials. Making a connection between the image and the object was a powerful tool for engaging reluctant learners and the teacher was encouraged by the student response to the experience.

Another example of this type of experience was developed by a teacher in a rural pre-school centre who used the program 'Sammy's Science House: Workshop' to design, make and appraise a toy or machine. The children were invited to design a machine using the software and to describe what its function was. The teacher suggested that some children might like to build the machine out of materials of their choice. The teacher commented:

building the machines provided an excellent challenge giving children the opportunity to extend their thinking using a variety of tools and techniques.

The possibilities for integrating Technology and Enterprise and English learning areas (Curriculum Council, 1998) in the program are evident and children were able to make connections between the image they had created and the creation of a three-dimensional representation of their design. This was a natural extension of their

explorations of the software and assisted children in making important connections between concrete and abstract experiences as well as engaging in the design and redesign processes so crucial to developing multiliteracies in multimodal ways (Cope & Kalantzis, 2000).

The possibilities for teachers to use the software in these ways allow for a range of opportunities to integrate ICT in the program. By asking new questions and raising new possibilities, teachers may further develop the links students make between their own ideas, what they do on the computer and real-life activities and purposes.

Integrating technologies into the program

Many early childhood centres now own, or have access to, digital cameras, and these became an important feature of some teachers' exploration of their research question during this project. An example of this is a kindergarten where children were exploring the text *'The Three Little Pigs'*—traditional activities associated with this story were developed with the children. However, the teacher decided to incorporate the computer into this experience and when the children recreated the story in dramatic play: she recorded their play episode using the digital camera. By downloading these photographs and sequencing them in the KidPix Slideshow program, the children were able to view their play on the computer later on the same day. This was a source of fascination for the children and their excitement at seeing their own faces and familiar environments on the screen increased the teacher's confidence and a sense of the computer as an exciting extension of her play-based program.

Teachers involved in this project who used technologies (including the computer) for real purposes and in integrated ways have expressed more satisfaction with the computer as a *tool for learning* rather than merely a reward for early finishers or an additional learning centre. There is ample support in the literature for an integrated approach to the use of ICT in early childhood settings. For example, Davis and Shade (1999) argue that 'technological fluency can be fostered only by having the technology integrated into the classroom environment in such a way that it is used appropriately as a natural tool for meaningful learning' (p. 225).

At the final research circle meeting, teachers were challenged to consider ways in which they could develop the notion of the computer as a tool for integration and many of them expressed a desire to return to their classrooms and experiment with more real-life applications of the computer in their day-to-day programs. For example, one teacher decided that her own use of the computer for 'real' tasks was not being transferred into her teaching practice. She was using the computer after hours to produce labels and signs for the classroom and to write newsletters and captions for children's artwork and stories. As a result of discussion in the research circle, she decided that these activities should be undertaken by the children and their ownership of the classroom environment could be extended to them deciding and designing signs and labels for the room, transcribing their stories and writing captions for their artwork. By developing such strategies, this teacher provided a learning environment that directly enhanced the children's ICT literacy by applying their skills in real contexts for meaningful purposes.

Outcomes for students

The previously identified themes emerging from the case studies are the most frequently reported outcomes of the project in terms of student learning. However, a careful examination of the teachers' reports highlights a number of other important outcomes for students. These include the valuing of children's competence in using the computer. This point was made particularly in the following quote from Sharon's case-study report:

The teacher was unsure how to use KidDesk and was amazingly relieved when Lena (student) wandered over and said 'I can do that' and immediately became the 'teacher'. That began a very happy story—Lena felt so important and continued to work one on one with those new to our class, but there were lots of new experts in a very short time.

This outcome linked closely to the engagement of reluctant learners in successful experiences in several centres. The fostering of independence and decision-making were also important features of the experience for many children.

Teachers also found that the software facilitated the consolidation of children's prior knowledge, critical literacy and specific number and language concepts.

Outcomes for teachers

The Department of Education, Science and Training (DEST) report '*Raising the Standards*' (2002) notes that teacher competency in use of ICT is related to dimensions of ICT use (see Table 1). The report describes levels of competency that assist in describing ICT use by teachers involved in this project with the Young Explorer. At the conclusion of the project the teachers involved, who began at minimum or developmental levels of competence, have since become ICT 'innovators'. By the DEST definition a teacher who is an *innovator* in the area of ICT sees 'ICT as an integral component of broader curricular reforms that change not only *how* students learn but also *what* they learn' (p. 33).

The process of becoming an *innovator* was preceded in the case of the teachers in this project beginning with either a minimal or developmental level use of ICT. Each teacher began the project with a view of ICT only as a tool, and for many this understanding persists in some respects. However there is a sense that teachers involved in this project have identified, through reflection and a process of action research, ways in which ICT empowers students to be users of technology in the future. For example, Alice noted that children had become critical users of technology, and were able to make realistic judgements about the usefulness of the computer for given tasks:

these skills are going to be vital for their future as more and more information becomes available through Information and Communication Technologies in the classroom.

Alice recognised the social and technological change and curricular reforms that will affect student learning in the future.

The research funds from the Department of Education facilitated teacher research circle meetings and teleconferences, allowing teachers to share common experiences

Table 1. Dimensions of ICT use in teaching and learning

Dimensions of ICT Use	Stages of ICT Competence	Key Groups
ICT as a tool for use across the curriculum or in separate subjects where the emphasis is on the development of skills, knowledge, processes and attitudes related to ICTs.	Minimum	Underpins all teaching practice.
ICT as a tool for learning to enhance students' abilities to deal with the existing curriculum and existing learning processes.	Developmental	For pre-service/beginning teachers.
ICT as an integral component of broader curricular reforms that change not only how students learn but also what they learn.	Innovator	For practicing teachers who are beginning users of ICT and for accomplished users of ICT.
ICT as an integral component of the reforms that alter the organisation and structure of schooling itself.	Leader	For highly accomplished users of ICT and for school leaders and teacher educators.

Source: DEST, 2002, p. 33.

and challenges and build a collective understanding of effective inclusion of computer technology in early childhood settings. Without this support, the computers donated by IBM and the initial training had the potential to simply put computers into classrooms and do little more than encourage 'minimum' level of ICT competence (as defined by DEST, 2002). Teacher comments on the professional development and action research process associated with the project include:

The support provided through involvement with other teachers across the state has been invaluable. We have shared great ideas, problems and successes. The input from the university-based researchers gave the projects a professional tone, providing us with the latest research findings and provoking us to think more deeply about critical issues. (Alice)

We appreciated the opportunity to collaborate and exchange ideas with other professionals, the project has allowed us to collaboratively problem solve some aspects of best practice in early childhood learning and development. (Jodie)

Taking part in this project has been a motivating teaching and learning experience ... each research circle inspires me to introduce new learning experiences to the children ... while undertaking the IBM project my knowledge and confidence have grown immensely, computer technologies will continue to be part of my everyday program. (Susannah)

Involvement in Professional Development provided an opportunity to share ideas, voice concerns and solve problems with colleagues working with similar age and cultural group ... my attitude towards using computers with this age group has changed since involvement in this project. (Jackie)

The research circle provided the opportunity to network and work collaboratively with my peers to ensure improved outcomes for my students. Thanks to the wonderful opportunity I have been given during this project, I feel I now have a greater understanding of integrating computers into an early childhood setting. (Miriam)

Conclusions and recommendations

The value of ongoing professional development and action research with teachers (rather than about them) in improving learning outcomes for students has been made evident through this project and is supported by other international and national research (Roschelle *et al.*, 2000). Teachers require adequate support and professional development to integrate technologies effectively in their programs. Early childhood teachers are a particularly significant influence on children's emerging literacies. Teacher confidence and competence in using technologies in meaningful and competent ways is an important step in developing student ICT literacy. The Australian Federal Government report '*Raising the Standards*' (DEST, 2002) calls for 'sustained and appropriate professional development to enable all teachers to develop and demonstrate their competence (in using ICT)' (p. 4).

In addition, we have identified that early childhood education is a crucial time in a child's life that can contribute to breaking the cycle of poverty and lack of access to information technology among disadvantaged communities in Australia. Hence, funding future projects to enhance the development of ICT skills in disadvantaged communities is a key priority for education authorities in this country. Disadvantaged communities have been the focus of the IBM KidSmart Early Learning project to date and these communities will continue to be priority areas in future roll-outs of the KidSmart project in Australian early childhood settings. It is imperative that these resources are supported by adequate professional development of teachers since 'the mere presence of computers in the classroom does not ensure their effective use' (Roschelle *et al.*, 2000, p. 76).

In order to ensure the effective integration of ICT into early childhood settings, the following issues are suggested for further investigation in future research:

- clarification of effective pedagogy in relation to teaching and learning with ICT in early childhood settings;
- how technological literacy or the foundations of multiliteracies can best be facilitated in early childhood settings;
- the impact of multimedia software on children with a language background other than English;
- use of multimedia software in developing programs for children with disabilities;
- clear articulation of the opportunities that ICT presents for new learning in new ways (as opposed to old learning in new ways);

- development of teachers' and parents' understandings in relation to ICT use with young children;
- longitudinal study of early access to ICT on children's later schooling; and
- the impact of developing use of ICT in preschool settings through peer tutoring.

Subsequent funding through the Australian Research Council has been awarded to a team of researchers from around Australia and there is scope to pursue some of these recommendations. The authors anticipate dissemination of the follow-up research in ensuing publications and conference papers.

Acknowledgement

The authors wish to acknowledge the Australian National Schools Network and the Department of Education, Western Australia in the development of the research reported in this paper.

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