Preschool children's learning with technology at home

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Abstract
We produced case studies of fourteen families based on nine rounds of data collection during the period from June 2008 to October 2009. We focused on fourteen children who were three years old when our visits started and used an ecocultural approach to examine their experiences of learning and playing with technologies at home. The study describes i) which technologies children encounter at home, ii) how family practices influence children's encounters with technology, and iii) what children are learning through their interactions with technology. We present a framework of four areas of learning that could be supported by technology: acquiring operational skills, extending knowledge and understanding of the world, developing dispositions to learn, and understanding the role of technology in everyday life.

Keywords
Preschool, family, home, toys, technology, learning

1. Introduction

The role of the family in supporting young children's learning seems obvious when we consider that three- and four-year-old children in the United Kingdom spend most of their time at home and parents exercise considerable control over their children's activities and the resources to which they have access. Research that provides information about the role of the family in supporting young children's encounters with technology at home has been limited, with the emphasis so far on surveys that measure technology use in hours per day. The study reported here focuses on a limited number of families to provide a more nuanced understanding of children's access to and use of technology than is possible for large-scale surveys conducted by telephone. We look in particular at the ways in which a range of technologies can support children's learning at home and how this is influenced by family practices and attitudes.

Originally associated with assessing the impact of television, surveys that measure use have since been extended to encompass the effects of a range of digital technologies. They can have considerable influence, especially as their headline findings may be enlisted by media effects studies to make connections between exposure to technology and what are seen as undesirable outcomes, such as obesity or a decline in book reading. The American Academy of Pediatrics (2011), for instance, 'discourages' exposure to television and other forms of screen viewing for children under the age of two and would restrict other children and adolescents to two hours per day of exposure to entertainment media (2010). Funk, Brouwer, Curtiss and McBroom (2009) investigated the reach of such guidelines by surveying 94 parents of children under five, calculating that preschoolers were exposed to an average of 12 hours of screen media in a typical week. Parents stated a belief in the potential negative effects of screen exposure but had a low level of familiarity with the relevant guidelines. This led the authors to conclude that researchers may be more concerned than parents about the potential influence of screen media on children, in line with our finding (Plowman, McPake & Stephen 2010) that parents were not worried about negative effects as they believed that they had the right balance of technological activities for their family.

Oakes (2009) provides a critique of media effects studies, pointing out that they tend to focus on age and gender but rarely look at outcomes for different social groups and do not take full account of the context of use. Further, the task of measuring exposure has recently become increasingly complex as

the shift from analogue to digital media has resulted in simultaneous use of multiple platforms at home. It is difficult to make judgements about patterns of use if a family member can watch a television programme in real time or as 'catch up' on a television, computer or handheld device, or watches television while sending a text message. These developments have led Vandewater and Lee (2009: 2) to conclude that the measures used so far have been 'singularly unsatisfying' in terms of highlighting the extent and content of media messages. Rideout, Foehr and Roberts (2010) accounted for multi-tasking in their survey of 2000 eight- to 18-year-olds but the associated press release has headlines typical of the alarm that can be engendered by media effects research: 'Big increase in mobile media helps drive increased consumption' and 'Most youth say they have no rules about how much time they can spend with TV, video games, or computers' (Kaiser Family Foundation 2010).

Most of the recent research on children in the early years has taken place in the United States and covers a broad age range: Takeuchi (2011) combined case studies with a national survey of 800 parents of children aged from three to ten and Gutnick, Robb, Takeuchi and Kotler (2011) synthesised a number of studies of children ages nought to 11. Rideout's (2011) survey of 1,834 parents of children between the ages of nought and eight is explicitly aimed at those concerned with promoting healthy child development by providing data on a range of screen technologies, such as computers, games consoles, tablets, smartphones and television. It finds that among two- to four-year-olds, 12 per cent use a computer every day, with another 24 per cent doing so at least once a week, and television still dominates, with 73 per cent of two- to four-year-olds watching television at least once every day. Across nought- to 8-year-olds activities vary significantly by race and socioeconomic status but not by gender, the only substantial difference being in use of video games. Reports such as this provide a useful baseline for noting trends and informing debate but, for a more complete picture of use, benefit from being supplemented with situated studies.

These more detailed studies of play and learning with technologies at home tend to focus on children aged five and over. Marsh (2010) draws on data from 17 children in the UK aged five to seven to investigate their play with online virtual worlds at home and Chiong (2009) describes intergenerational gameplay for children aged six to nine. Much less is known about younger children's encounters with technology at home, in part because of the challenges in involving preschoolers as active research participants and gaining access to family homes for repeated visits.

This scarcity is surprising given that government and policy makers have a growing interest in the preschool years. Aware that the trajectories of children's futures are mapped out when children are very young, the home is seen as a key site of learning (Plowman, Stevenson, McPake et al. 2011). However, while parents and preschool staff are well aware of ways in which literacy, numeracy or topics such as healthy eating might be supported at home, the learning that can ensue from interactions with technology has not yet been fully recognised and little attention has been paid to the ways in which children's emerging competences with technology are supported and can flourish. The study reported here, *Young children learning with toys and technology at home* (2008-2011), was designed to address some of these omissions. It does not claim to measure use but to describe it. rather than conducting large-scale surveys, it focuses on case studies as a means of understanding more about the context in which children's encounters with technology may lead to learning. The study refers to three- and four-year-olds as children generally start school at about the age of five in the UK. The early years are characterised by shifts in what children like to do, where they go, and with whom they spend time, making it difficult to report on patterns of use across an age range of several years, especially when it includes a transition to formal schooling.

Its aim was to use household case studies to produce a richly detailed account of young children's encounters with leisure and work technologies at home, including technological toys. The key research questions it set out to answer were:

- Which technologies do children encounter at home?
- How do family practices influence children's encounters with technology?
- What are children learning through their interactions with technology?

We consider these questions in sections 3, 4 and 5.

2. Design of the study

Our study draws on an ecocultural approach (Tudge, 2008; Weisner, 2002) that highlights the interactions between people, places and things. This enabled us to think not only about the role of the people involved, such as family members, and the things, such as the toys and the technologies in which we were interested, but also to give more analytical attention to the spaces in which these interactions occurred. These people, places and things are interwoven with the values and practices that permeate family life and everyday activities. We tracked changing patterns of use and attitudes over eighteen months and explored the particularities of everyday lives as described by Tudge (2008: 5):

> It is by engaging in practices - activities and interactions in which we engage alone and with others - that we both recreate the culture of which we are a part and help to change that culture. To see this process, it is thus important to examine how people, particularly young children, engage in their typically occurring activities and interactions with others.

Consistent with an ecocultural approach, the emphasis here is on the children, their families, and the values and practices that influence how the toys and technologies are integrated into family life. This is important because beliefs about the value of education, whether technology is seen as beneficial or detrimental for young children, and whether children should find things out for themselves or receive explicit instruction all shape, recreate and transform the cultures in which the toys and technologies are situated. Tudge (2008: 103) points out that parents' experiences during their own school days and employment influence the ways in which they raise their children. We found that parents' previous experiences with technology and their views about its educational potential were particularly significant (McPake & Plowman 2010): these experiences shape values and attitudes and so influence practices.

For Tudge (2008: 89), an ecocultural approach requires no artificial separation of the participants from the contexts in which they are situated (ie laboratory experiments) or separation of the researchers and the researched. We were not able to fulfil this second condition completely as conducting ethnographic research in the families' homes would have been intrusive, but we were able to make use of a number of techniques to ensure that we obtained a range of perspectives on their actions, interactions, values and practices.

The concept of ecological validity is relevant here as it is associated with the extent to which activities and processes observed in a study can be generalised to other settings. Although we can be confident that our research settings were naturalistic and that our observations were congruent with real life activities it would be naive to think that our presence in family homes did not have an impact on behaviour. There is also an issue of how to represent the richness and uniqueness of case study data. The solution adopted here is to provide two vignettes to indicate the data relating to family practices and show how these practices interact with other factors. These are based on field notes combined with sources such as interviews and a technology audit.

2.1 The families

We recruited fourteen families who had a child aged three at the start of the study by leafleting preschools in central Scotland that had been selected to attract harder to reach families. We assessed seven families as having low socioeconomic status (SES) on the basis of the National Statistics Socio-economic Classification (Office for National Statistics, 2005), giving us a distribution roughly in line with the Scottish Household Survey. Twelve of the target children had siblings, two were only children and one family had a baby during the course of our visits. Table 1 shows the distribution of families in terms of gender of the target child (seven boys and seven girls), socioeconomic status (seven 'high' and seven 'low', although we acknowledge that describing SES is more complex than this), a broad classification of technology ownership, and an indication of the parents' attitudes to their child's engagement with technology.

Technology ownership is based on an audit of the families' technology, as observed on a tour of the house and confirmed by interview. The classification of 'high' and 'low' operates only within this sample of families and does not relate to any external measure of ownership. A comparison of the technology ownership of the two single parents in the study illustrates this. Ms. Sharp (low SES, low technology) had one computer, reliance on a USB device for broadband as she did not have a fixed line at home, one mobile phone, four televisions and a PlayStation. Ms Searl (high SES, high technology) owned one desktop and two laptop computers, one mobile phone, three televisions, four DVD players,

one video player, a handheld organiser, a PlayStation and a surround sound system. The audit was updated over the period of the study as families acquired new products.

Table 1 about here

The classifications of the parents' attitudes to their child's engagement with technology were assigned by three researchers based on data from a number of sources: recollections of the parents' childhoods and the values they associated with those memories, field notes and observations from visits, and views on play and learning from interviews. We selected 'guarded' and 'well-disposed' rather than 'positive' and 'negative' to reflect some of the ambivalence felt by parents but emphasise that these attitudes are on a continuum rather than polar opposites.

We produced in-depth case studies of these fourteen families over the course of a minimum of nine rounds of data collection based on visits to these households from June 2008 to October 2009. Multiple visits to households enabled us to build relationships of trust, elicit children's perspectives, and develop an understanding of family cultures and practices. As a result, all of these families maintained their full involvement in the study throughout its duration.

2.2 Methods

A cluster of methods enabled us to document and examine the complex interactions with peers, family members, the technology, other toys and cultural practices. Informed by the ecocultural approach, this involved documenting children in their natural settings, close description of their play and attempts to represent both children's and parents' perspectives. Each round of data collection had a specific focus, such as audits of toys and technologies, conversations with children about their favourite toys, parental perceptions of their child's play and learning, mobile phone diaries to illustrate 'typical' days, and interviews about the changes brought about by the transition to primary school.

The limited number of case studies lent itself to a multi-dimensional analytical approach which drew on this wide range of sources to produce detailed descriptions of the household ecologies, the perspectives of children and other family members, children's play activities and specific technologies. NVivo was used to manage and analyse the textual data and supported the early stages of developing the case studies. This was an iterative process of data interrogation in which research questions and researcher observations were checked against the initial coding and revised as necessary. From this, we were able to build a profile for each household, including the range of technologies to which each child had access and the child's developing competences, preferences, and patterns of use. This data was contextualised in terms of parental attitudes and expectations.

Family practices are closely linked to an analysis of family values and attitudes. The latter are not as easily observable, and so we used a variety of techniques with the parents, including interviews, responses to prepared statements on laminated cards, autobiographical accounts of their own childhoods and a photo elicitation exercise designed to enable us to understand more about the various discourses and experiences that parents draw on when making choices and judgements about parenting.

Morgan (1996) used the term family practices to shift emphasis away from notions of a prototypical family to an understanding of the ways in which people 'do' family through the activities they share. Although families were selected to provide a broadly representative range of socioeconomic status for this geographical area, we do not focus on the detail of how this played out in family practices, other than to comment that it did not seem to be the most important factor for the issues that we discuss here. Nevertheless, we share Morgan's position that structures such as class and gender also influence these practices, recognising that parents' decisions and practices are grounded in material and social realities (Gillies, 2006) and that there may be cases where socioeconomic status influences parents' attitudes to children's use of technology (Ames, Go, Kaye & Spasojevic, 2011).

3 Which technologies do children encounter at home?

We used the term technologies to refer to digital devices (such as computers and mobile phones) and to products or outputs (DVDs, websites, games, interactive stories) that are viewed, read, played or created on these devices. By the time they started school, nearly all of the children in our case studies had encountered a range of technologies, such as mobile phones, television, games consoles, DVD and MP3 players, as well as desktop and notebook computers. We also included toys such as play mobile

phones and laptops as they provide a means for children to engage in role-play about how these devices are used in everyday life.

We generally describe children as 'encountering' technologies in the home because this suggests fleeting or unplanned practices rather than a predictable pattern of use. Like Lewin and Luckin (2010), we found that ownership does not guarantee parental engagement in supporting their child's use and that presence does not lead to access. Some high cost items, including computers and mobile phones, had limited availability for preschoolers because parents were concerned that they might get damaged, if not by the target child then by their younger siblings. The complexity of the interface also affected accessibility, particularly if reading text was a requirement for use. Almost all of the children had learned to switch on the television and could select channels, and most could use DVD players, which entailed choosing and inserting discs and recognising different icons for controls. Some could use onscreen menus to select programmes stored on hard disc, to check television schedules or to play interactive games. Parents usually encouraged this growing autonomy as it freed them from the need to change channels or insert DVDs on demand. However, this was not universal: Katie Simpson's parents had bought her a combined television and video cassette player as she was not allowed to use the DVD player.

Most of the data referring to technology ownership was collected in round 5 (spring 2009) and was updated on subsequent visits. All fourteen families owned computers, although two families in the lower socioeconomic band acquired theirs in the course of the study. The family with the highest number of computers, the Hendersons, with four in a three-person household, was in the low SES group. All of the families had broadband access by the time we finished our visits in October 2009 but we completed our fieldwork ahead of the introduction of tablet computers in the UK in late spring 2010. Ten families had three or more televisions. Along with video or still cameras, MP3 players, mobile phones and DVD players, multiple video or handheld games consoles were also common across households, although the three families who did not own a Nintendo Wii were in the low SES band.

In common with findings from Gutnick et al (2011), the main form of exposure to technology was television, followed by games consoles. Standalone and mobile phone cameras were important for communicating with other family members and two of our families (Irwin and Searl) used Skype for these purposes. In addition to games consoles (which were owned by many of the parents), children enjoyed games on computers, websites such as *CBeebies, Milkshake* and *Nick Jr*., and mobile phones. Computers and mobile phones were not as frequently used on a solo basis: children usually needed support to send a text message, play a game, or view photographs but would amuse themselves once the activity had been set up. Both large-screen and handheld consoles could also represent a challenge for small children, as gameplay can require fine motor control and quick thinking. Children often found these games attractive but frustrating, although they could overcome these hurdles with the assistance of older siblings.

The toy audit revealed a very wide range of traditional toys: props for pretend play, puzzles and jigsaws, soft toys and dolls, cars, farms, construction kits, musical instruments and much more. We also found books, art and craft materials and educational games designed to support number work and reading. Our definition of technological toys covered a wide spectrum of products. The baseline requirements were a power supply (although parents were divided over whether battery operated toys were included in this category) and some level of interactivity. At a minimum, this encompassed toys that simply responded with a sound or a flashing light to a child pressing a button or flicking a switch. Other toys, such as robotic dogs, utilised developments in computing and speech technology so that they appeared to talk and to have some capacity for learning.

In ten out of the 14 families one quarter or less of the playthings we surveyed had some technological features, although they accounted for one third of the toys in the Johnson family. However, where there were siblings in the household we were not able to establish that all of these toys belonged to the target child or the extent to which they were played with. Household income did not appear to be a predictor of the quantity of technological toys and, while some purchases had been influenced by the child's gender, mainly in terms of the colour of the product, there was no clear gender bias in the types or the quantity that the target children had.

4 How do family practices influence children's encounters with technology?

We have selected Arden Bain and Jasmine Searl to illustrate this discussion as a detailed examination of all 14 families' practices is beyond the scope of this paper. As can be seen from Tables 1 and 2, although the Searls have been categorised as high SES and the Bains as low SES, both families have high levels of technology. Nevertheless, the parents have different attitudes to their children's encounters with technology, broadly characterised by us as 'guarded' for Searl and 'well disposed' for Bain. Reducing multiple sources of data to a single descriptor in this way risks simplifying the complexities involved in establishing values and attitudes but these were developed to summarise some of the ways in which families can differ (see 2.1).

Arden Bain
Arden liked to watch television and loved looking at books and magazines; he played libraries in his pop-up tent in the living room, as well as going on a family outing to the library once a week. His favourite toy was a doctor's set but, in the early days, he liked Thomas the Tank Engine and football. He enjoyed the Mario Kart game on the Wii and could explain the rules, although his skill level meant that he was not very successful. His mother, Gail, took the view that he needed to learn how to figure things out for himself and was keen on toys that had the benefit of keeping him amused on his own. As an enthusiast for technological toys ('Arden has a wee laptop and it's brilliant - he absolutely loves it') she believed that they would accelerate his learning and help with preparation for school: he had learned all the letters of the alphabet and 'it is helping him count as it has different activities on it'. She was so impressed that she had bought similar play laptops as presents for family members. Gail had a laptop computer that she used for studying and her husband had one for work, but access was restricted because she was worried about the younger children getting hold of them; however, we observed Arden sitting at the kitchen table with his laptop, imitating his mother while she studied with hers. Gail used the Wii Fit occasionally but was not a keen games player.

Jasmine Searl
Jasmine liked imaginative play, drawing and colouring. She was cautious about what she could do with technology as she liked to succeed and so avoided things which looked difficult. She liked CBeebies on the computer and, when supervised, would use Skype and messaging. Jasmine's mother, Catherine, questioned the benefits of technology for learning although she reported that Jasmine had learned her numbers from the television channels. Overall, she felt that her children should interact with other people and develop social skills rather than sit at a computer or use a console: 'If she's going to have an electronic toy I would rather it is something she uses when she's with people, for example her music system. She can entertain people and have a disco.' Catherine was a school teacher. She had used flash cards to help Jasmine with reading and set up activities for the children, familiarising herself with instructions first and showing them the correct way to use things. She planned activities for her family to do together, such as playing the Wii with Jasmine's older brother or going on outings. Both Jasmine and her brother had a Nintendo DS and Catherine, an avid games player, would help Jasmine to get to new levels or past difficult stages, although she also limited the children's console play. Catherine had about 500 photos stored on her mobile phone and used it a lot; Jasmine liked to imitate her, using either a toy phone or pretending that another item, such as her MP3 player, was a phone.

Table 2 about here

Table 2 shows that both households had a fairly similar profile in terms of technology. Both of these children encountered a wide range at home but while one might assume that a parent whose views had led us to describe her as 'guarded' would limit her child's access to technologies, Jasmine used more than Arden, the son of an enthusiast. Jasmine spent more time playing the Wii, on the CBeebies website and messaging than Arden, although it was Gail Bain who was convinced of the benefits of technological play. However, both children demonstrated some timidity in trying out technologies on their own and liked to have support from another person. These brief vignettes indicate that individual factors such as SES or the levels of ownership do not accurately predict practices within the home. Indeed, in these cases, the espoused views of the mothers do not seem to relate closely to the children's activities either. As we found from multiple interviews and activities, the values and attitudes that influence children's encounters with technology may originate in diverse sources, including media coverage, childhood experiences, cultural norms, hearsay, or conviction.

There were also other factors: children had their own, individual, preferences for their play activities that did not necessarily reflect their parents' choices. Ruby Henderson lived with parents who were technological enthusiasts in the household with the highest number of computers but had no interest in

technology other than repeatedly watching Disney Princess DVDs. Across the case studies, family composition also shaped practices: Jasmine had an older brother and we found that the presence of older siblings could both increase and inhibit the take-up of technological activities, depending on whether they shared their own things and provided support or monopolised what was available. Arden's two younger siblings took up much of Gail Bain's time, so activities which would keep Arden occupied had a premium for her. Stephen, Stevenson and Adey (forthcoming) describe the ways in which values and attitudes can shape families' pedagogical practices. While Catherine Searl's career was revealed in teacherly interactions with Jasmine, Gail Bain took a non-interventionist approach in which Arden was expected to figure things out for himself.

Catherine Searl lightheartedly self-identified as 'addicted' to games consoles and wanted to protect her children from becoming socially isolated. As a single parent with a full-time job, she felt it was very important to promote family activities and this informed many of her choices. Gail Bain's husband worked away from home for weeks at a time and during these periods she cared for three children under the age of four and studied to be an assistant in a nursery. Like the other families, it was clear that Ms Searl and the Bains tried to engineer a balance between solo and shared, educational and playful, and screen and non-screen activities for their children. Parents also had to juggle their children's demands and desires with their own values and what they thought was in the child's best interests.

Thus an ecocultural approach helps us to uncover the ways in which fourteen families who have much in common, living within a small radius of each other and in a relatively homogeneous Scottish white culture, also differ in their practices around young children and technology. This variation concerned their experiences rather than what was available. Parents established the local culture of the home by resourcing and supporting play and learning, seeking to ensure a balanced range of activities, and involving children in the intergenerational practices that suffused family activities. These features, rather than specific technologies, were responsible for variation in children's technological encounters.

5 What are children learning through their interactions with technology?

We start this discussion about children's learning with technology with a brief detour to consider children's play. These children were at home rather than nursery when we saw them so most people would describe their activities as playing. Nevertheless, there is a strong relationship between play and learning in the Western tradition of preschool education with free play conceptualised as a mode of learning, and play described as the 'child's work' (Paley 2004), although this sits uneasily with the standard definitions of play which emphasise spontaneity, free choice, and fun. Pramling Samuelsson (2008) contrasts the ways in which adults usually initiate learning, whereas children usually initiate play.

5.1 Playing and learning

We have found it easier to define what we mean by learning than what we mean by playing. As educational researchers, we were able to reflect on learning but this was something that parents found much more difficult. However, we found that parents could report on learning if prompted in a way that made sense within their own terms of reference so we asked whether they had noticed any differences in their child's encounters with technologies between our previous visit and the current one, typically a period of two months. Parents found this an interesting question to ponder and could usually respond with an example, such as their three-year-old child understanding and using specialised technical terms, controlling a DVD to watch it in slow motion, or selecting television programmes from an on-screen guide.

Our interest then is not so much on play and learning as abstract concepts but on *what is played* and *what is learned* in these particular contexts. This is compatible with the ecocultural approach underpinning the study: identifying 'what is played' or 'what is learned' is an empirical question that depends on observation and interpretation of the data that we collected. Nevertheless, we could not claim to come to this completely fresh: we had already engaged in research in this area which had shaped our expectations (Plowman, Stephen & McPake, 2010) and while we felt that the oft-cited equation of play and learning (Singer, Golinkoff & Hirsh-Pasek, 2006) needed problematising we willingly acknowledged that play contributes to learning – the thorny question is what form this contribution takes.

5.2 Learning

In the fields of technology-enhanced learning and computer-assisted learning the emphasis is more often on the technology or the intervention being described than it is on the manifestations of learning. Aware of this omission, we have been working at developing a framework for understanding more about learning over a number of years, refining it as we collect and analyse data from different settings and with different technologies. This framework was originally based on a fine-grained analysis of video recorded in preschool settings, supplemented with notes and observations from staff, and has since been extended and revised. We are not claiming a direct or exclusive relationship between playing with a particular technology and a specific learning outcome, but that opportunities to play with some technologies can extend possibilities for children's learning. The data from *Young children learning with toys and technology at home* has helped us to develop this framework. Our analysis of family practices, combined with parental report and observations, suggested that interactions with technologies could support the four main areas of learning at home outlined here.

Acquiring operational skills refers to understanding the functions of items such as the mouse, touch screen or games controllers as well as the ability to operate them, which often relies on motor skills. Operational competence also develops children's concepts of technological interactivity and makes visible their understanding that taking an action can produce a response. Children usually needed adults or older siblings to help them acquire specific operational skills, after which they could move on to become independent users. They might need help with finding the right setting to look at photos on a mobile phone, or the sequence of operations required to colour in a picture on the Cbeebies website, for example.

Extending knowledge and understanding of the world encompasses learning in areas such as mathematics, language, and knowledge about living things, people and places, typically gained through the content in software, websites and talking books. This dimension of learning is often the focus for the marketing of technological toys, with claims made for links to the curriculum and an emphasis on preparing children for the transition to school by developing their familiarity with letters and numbers.

Developing dispositions to learn encompasses socio-emotional and cognitive features that make a difference to a child's capacity for learning. This includes increasing self-esteem and the confidence gained from success, as well as supporting independence, persistence and patience in the face of initial difficulties and developing self-knowledge about how they learn. In a family context, these dispositions include learning to share and managing frustration through self-control, aspects that were often remarked upon if siblings were involved.

Understanding the role of technology in everyday life includes learning about the role of technology for a range of social and cultural purposes. These may include communication, employment, study, and entertainment. For instance, Jasmine used the emoticons on MSN Messenger to communicate with her mother's partner as she could not write yet; other children learned to take part in phone calls, Skype conversations and to share photographs by email or mobile phone with family and friends.

The domestic context offered opportunities to prepare children for a life in which technologies would play an important role and to develop an awareness of these cultural practices, whether children were directly involved in these activities or observers of them. These activities were not necessarily associated with typical preschooler needs or interests, catered for by age-appropriate toys or tools for early learning, but with practices that had value and significance to the family. The children were thus being inducted into various cultural practices ranging from taking and printing digital photos of the family pets, sharing memories by watching family video recordings of special events or using old computers and non-functioning mobile phones as props for play in imaginary offices, shops and schools. However, it is important to emphasise that these were not the only ways that children learned while at home; indeed, technologies played only a small part in their lives, as the mobile phone diaries illustrated. Although Arden and Jasmine learned their numbers with the aid of a play laptop and the television, Leo Irwin learned them from playing bingo with his family and from the kitchen clock.

The development of operational skills continues to dominate thinking about young children's learning with technology. Over the course of a sequence of studies, we have questioned this narrow conceptualisation, in which learning is seen in terms of hand-eye coordination and knowing how to use a mouse. Although it is clear that successful interaction depends upon children developing such skills, we saw that children easily picked them up from their parents and older siblings, either as a result of explicit instruction or by watching and copying (Plowman, McPake & Stephen, 2008). In their early

years, children learn to use technologies by watching others, by trying things out for themselves, and by wanting to do the things which technologies make possible. With assistance from others, they glean the operational skills they need to achieve these ends.

6 Conclusions

The ecocultural approach has enabled us to draw on multiple sources of data (only some of which are discussed here) to understand more about the role of technology in children's learning. An analysis of the interplay of people, places and things, along with the less visible values and attitudes, challenges notions of the homogeneity of family learning and sheds light on the differences between children with apparently similar backgrounds and how these shape possibilities for learning. Ecocultural studies are not so well suited to identifying learning if it is understood solely in measurable cognitive or functional terms but the approach we adopted illuminates the role of the resources made available and the support offered or sought, showing how learning with technologies at home is the product of local circumstances. The large-scale studies of media use cited earlier tell us something about the amount of screen time to which children are exposed but they are less proficient at showing changes over a period of time or what else is happening simultaneously. Data on the levels of product ownership also have value, but the assumption that household ownership leads to use is not borne out by this study of young children. The case studies enabled us to see beyond the headline findings of such surveys to gain a more nuanced understanding of the ways in which children, families and technology interact in the home and to move beyond an approach to learning that only recognises operational skills towards a more expansive account which includes knowledge and understanding of the world, learning dispositions, and understanding the role of technology in everyday life.

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Table 1: The case-study families

	Socioeconomic status	**Technology ownership**	**Attitude to technology**
Name of target child (gender in brackets)			
Amy Collins (f)	high	high	guarded
Kelly Fletcher (f)	high	high	guarded
Leo Irwin (m)	high	high	well disposed
Robert Johnson (m)	high	high	well disposed
Rachel O'Dare (f)	high	high	well disposed
Jasmine Searl	high	high	guarded
Liam Stewart (m)	high	high	well disposed
Arden Bain (m)	low	high	well disposed
Ruby Henderson (f)	low	high	well disposed
Elsa Mason (f)	low	high	guarded
Alan McLean (m)	low	low	well disposed
Olly McNally (m)	low	low	guarded
Ewan Sharp (m)	low	low	guarded
Katie Simpson (f)	low	high	guarded

Note: All names are pseudonyms. Jasmine Searl and Arden Bain are described in the vignettes.

Table 2: Jasmine Searl and Arden Bain

	Jasmine Searl	**Arden Bain**
Family	Lives with mother (age 35, a school teacher) and brother (Jake, 8)	Lives with mother (age 36, studying for a vocational qualification), father (age 32, an offshore worker), sister (Anna, 3) & brother (Jon, 1)
	Socioeconomic status: High	Socioeconomic status: Low
	Main informant: Jasmine's mother, Catherine Searl	Main informant: Arden's mother, Gail Bain, but Colin, the father, often participated
	Mother's attitude to technology: guarded	Mother's attitude to technology: well disposed
*Technology**	Technology ownership: High	Technology ownership: High
	3 computers, 3 televisions, 4 DVD players, 3 digital cameras, 3 games consoles, 1 mobile phone, Nintendo Wii	3 computers, 3 televisions, 2 DVD players, 3 digital cameras, 1 games console, 2 mobile phones, Nintendo Wii
*Toys**	Technological toys included electronic piano, a DJ set and microphone, VTech camera, VTech laptop, LeapPad, Nintendo DS and games. Approximately one fifth of the toys were technological.	Technological toys included VTech laptop, LeapFrog counting game, Scalextric racing game, child's digital camera. Approximately one eighth of the toys were technological.
	Other toys included a wide range of dressing up clothes and accessories, small world items, outdoor play items such as a paddling pool, blow-up castle, and play house, plus books, jigsaw puzzles, and dolls.	Other toys included a play kitchen, binoculars, some puzzles, a dartboard, a football and several Thomas the Tank Engine themed items. Outdoor play items included a bike, a scooter, two trikes, a wheelbarrow and a slide.

* The lists of technologies and toys are indicative rather than exhaustive.