Homework through a network:

Designing technologies to support learning activities within the home and between home and school

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Abstract

Government policy and academic research both talk about transforming learning through networked technologies – sharing newly available information about the learning context with new partners to support lifelong learning activities, and giving learners increased power and autonomy. This thesis examines how such learning opportunities might be supported. In order to ground these learning opportunities in current educational activity it studies homework, which is an example of a learning activity that spans multiple contexts and the current roll-out point of networked technologies in UK schools.

This thesis uses an ecological approach to studying homework practices and activities, and the views, needs and roles of stakeholders, working with ICT coordinators, children, and families.

Its core findings are twofold, and centre on the opening up and closing down of homework to involvement within the homework community. The first core finding is that children benefit from actively structuring their homework activities to involve or exclude other family members, and that the networked technologies which teachers plan to use in homework fail to mediate these processes successfully, unlike traditional homework technologies.

The second core finding is that details of homework activities transmitted across a network can include too much information about a child or a family's wider activities, violating privacy and leading families to reject technologies.

This thesis identifies design tactics which can help children and their families negotiate how and when information is shared, and provides evidence that these design solutions can be implemented successfully within homework, if designed to fit within the ecology of the home. It discusses the circumstances in which these tactics could be useful in supporting lifelong learning, and establishes the importance of considering how families will integrate any educational activity or technology within their everyday activities.

List of published papers

1. Fraser, K., Rodden, T., & O'Malley, C. (2007). *Trust, privacy and relationships in 'pervasive education': Families' views on homework and technologies.* Proceedings of the International Conference on Pervasive Computing, Toronto, Canada.

2. Fraser, K., Rodden, T., & O'Malley, C. (2006). *Home-school technologies: Considering the family.* Proceedings of the International Conference for Interaction Design and Children, Tampere, Finland.

3. Fraser, K. (2005). *Designing technology for homework: Sensitivity to context.* Proceedings of the Human Centred Technology (HCT) Group Postgraduate Workshop: Advancing the Potential for Communication, Learning and Interaction, Brighton, Sussex, UK.

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0 Executive summary

0.1 Introduction

This thesis will use the lens of homework to explore how increasing use of networked technologies might affect interactions across the ecologies of home and school. Chapter 1 will present the rationale for using this approach. From homework to lifelong learning, it will identify a need to support educational activities across home and school settings, with the primary aim of this thesis following: to identify issues that are likely to arise from the introduction of networked technologies into this ecology, and how these can be avoided or addressed.

0.2 Methodology

The methodology will introduce an ecological approach to studying homework, with ‘ecology’ used to describe the physical, social and cultural context in which homework occurs. This will provide the theoretical focus of the thesis, looking at the activities, subjective experiences and views of homework participants, the relationship between the ecology and these activities, and the way in which activities are mediated by technologies.

In addition, the chapter will present a literature review of previous studies relevant to homework, and discuss how previous research and the ecological approach are represented in the individual study chapters.

After the methodology chapter, five empirical studies will be presented to develop criteria for and processes for improving the design of technologies supporting learning in an educational context like homework. These studies investigated the view from the school, the view from children, and, in the three further studies, the joint familial process of homework, and technology's place within this.

0.3 The view from the school

A focus on the school, and teachers' views of the present and future of Information and Communication Technologies (ICTs) will be presented in Chapter 3. This chapter will consider how teachers view homework, the relationship between home and school in particular, and the current technological status of schools.

Questionnaires were sent out to ICT (Information and Communication Technology) coordinators in 200 schools. Of these 19.5% (39 coordinators) replied. In addition interviews took place with 6 coordinators in local schools, identifying the challenges which they had faced or foresaw facing in using technologies in homework. The questionnaires provided organisational views on homework technologies across a large number of schools, and recruited coordinators for the interviews. The interviews explored the issues covered in the questionnaires in more depth.

The questionnaires produced two main sources of data: the technological – current patterns of ICT use in homework – and the social – issues around technology use in homework, namely the barriers that the coordinators saw to ICT use, both currently and in the future. The simplest technologies were most frequently used in homework and overall coordinators reported using technologies ‘sometimes’ rather than ‘often’, reflecting a reluctance to implement mandatory technology use.

An expanded version of Mumtaz’s (2000) taxonomy of school barriers to technology use identified by teachers was used to categorise social issues identified in the questionnaires. Mumtaz’s ‘Resource-based’ (availability of ICT in school), ‘Institutional’ (availability of support in school) and ‘Teacher’ (personal motivational) factors were only mentioned by a handful of ICT coordinators, however. Four ‘Home’ barriers accounted for a far greater number of responses. The most common barrier overall was ‘Access to technologies in the home’, mentioned by 79% of ICT Heads. ‘Technical issues at home’ came second, mentioned by 31%. More complex family-level issues – ‘Socio-economic disadvantage’, mentioned by 8% and ‘Parental motivation’, mentioned by 5% – seemed to be overshadowed by equipment availability and capability. ICT coordinators viewed the lack of availability of appropriate equipment as a bottleneck which prevented wider ICT use.

The interviews were compared to the questionnaire responses. The original homework technology categories from the questionnaire were refined into five condensed categories, based on their applications. Basic homework technologies – straightforward uses of a personal computer such as the computer processing and online resource-use – were common in the questionnaire, but not discussed in the interviews. Enhanced websites and networks – homework technologies ranging from externally provided online tests to school-developed websites to virtual learning environments (VLEs) and intranets – were seen by the coordinators as the future of homework technologies, with complex home-school computer networks allowing the seamless transfer and sharing of information between home and school. Other commonly mentioned use of technologies included mixed transfer systems – portable media (CDs, floppy discs, etc.) and email used to carry information to and from school for cross-site editing and submission – and school-owned technologies – equipment provided by the school, from software to computers. Within the interviews the most common example of school-owned technologies was in-school computer use, but this seemed to provide a qualitatively different type of computer use to at-home computers. Equipment loan schemes were considered by a smaller number of the schools and seemed like a better strategy for increasing access. The popularity of enhanced websites and networks confirmed that the emphasis placed on networked technologies in policy was being transferred to practice. Overall, coordinators seemed strongly focused on ensuring access: using in-school access and traditional homework resources to try and ensure equality.

The revised Mumtaz (2000) taxonomy used in the questionnaires was applied again to the interviews, and again the ICT coordinators discussed ‘Access’, ‘Socio-economic’ and ‘Attitudinal’ barriers to ICT use within a broad ‘Home’ category. However, even the revised taxonomy was found too restrictive to represent all the barriers discussed in the interviews, and a new category of ‘Home-school’ issues was introduced, suggesting that problems could be encountered in bridging home and school, specifically through tensions between home and school values and needs.

Chapter 3 will not only use the questionnaire and interview data to confirm the importance of networked technologies in the future of homework, but also to examine the perspective of teachers on homework technologies. A focus on access at school level seemed to promote a narrow view of equality – so teachers met government guidelines by providing computers in-school, without considering what might be lost by moving homework out of the home. This thesis holds that the best approach is to proactively include rather than just avoid exclusion, exploring new ways to make technologies available to students without computers, such as through loan schemes. When such technologies are available, the challenge will be to make sure that they support home, school and home-school use effectively, as addressed by the thesis as a whole.

0.4 The view from children

Chapter 4 will present a move towards the home ecology, using discussion groups with children to ask them about the ecology in which they undertake homework and their activities. Discussion groups were conducted with 190 children from late primary and early secondary school classes (aged 9 to 13) talking about how they carry out their homework. Four specific aspects of homework – termed 'elements of context' – were identified as key to the homework process from a detailed inspection of previous studies of homework. These were the content of homework tasks, technologies used during homework (pen and paper, book, PC, laptop, television etc.), the type of family involvement, and homework locations. These elements were explored in the interviews by asking children to describe recent homework tasks, and discussing whether they identified with photographs of other children doing their homework and findings from previous homework studies.

A coarse descriptive analysis was applied to the discussion group data in order to identify the variety of homework practices children engaged in. A great diversity of activities made up homework. Technologies ranged from the common book to rare uses of photography; family involvement included everyone from parents to siblings; locations ranged from the commonly used bedroom, to vehicles, to the uncommonly used bathroom; and homework could be done at any time from the first opportunity to the home-school journey on the day the work was due.

Within these broad descriptive pictures, more detailed analysis looked at how the children navigated the home ecology in their activities. Technologies and families, for example, could be seen as both positive and negative influences in homework – helping children to get the work done, but also distracting them at times. While the television and siblings were primarily distracting, children indicated that both could be helpful in homework. Interactions between factors complicated matters further – parents were often helpful in homework, and the television was often distracting, but parents could often be sat watching television when homework help was needed. An overview of the data found that children presented themselves as balancing distraction and help so that their activities were appropriately socially and physically situated.

Chapter 4 will therefore present evidence of the wide range of approaches that are taken in homework activities, and argue that in a significant proportion of homework activities children are making strategic choices about where, when and how to do their homework.

0.5 Opening up and closing down homework: A video ethnography of the everyday practice of homework

A set of video diaries looking at families' current homework activities, and how various elements of the homework context support different homework aims, will be the focus of Chapter 5, which again focuses on the ecology of the home. Having identified a need for children to balance distraction and help, children were studied actively managing this process through the choice of domestic learning locations in video diaries recorded by seven families. Families were asked to record a range of activities – from chores to mealtimes to homework – and examples of homework activities were taken from the final tapes.

The video diaries were studied to identify video clips which showed predominantly collaborative work (with parents supporting the content of homework), or predominantly independent work (with parents acting to support the process of homework at most). The contextual elements which supported homework with family involvement were those which seemed to 'open up' homework to others. Six collaborative-work clips showed children working in parts of the ecology where joint activities were prevalent; for example, in the kitchen during breakfast, or in the living room in the evening while the family watched television. However, the types of technology used were appropriate for mediating joint activity: the children were using technologies which were highly visible and visually appealing, offering family members the opportunity and the incentive to become involved. The contextual elements which supported independent study were those which seemed to 'close down' homework from others. Six independent-work clips showed children working in parts of the ecology where independent activities were prevalent; for example, in their bedrooms, or in the kitchen outside mealtimes. Here, the technologies used were inappropriate for mediating joint activity, with the children using technologies which contained all the information that they needed to complete the activity, and visibility of the child's work being much lower, often due to small text or an angled computer screen.

Within the remaining video clips, children seemed to be located in places similar to those seen in work that had been 'opened up', areas of the ecology where joint activity was prevalent, but technologies which were inappropriate for the mediation of joint activity. These technologies offered poor visibility or could be manipulated to reduce visibility in some way, 'closing down' the homework. This process was described as 'huddling': using the properties of technologies to close down work in places where it was otherwise open to involvement.

Detailed analysis of this huddling tactic found that properties of technologies were critical for huddling. Technologies which were mobile at a micro-level allowed minor adjustments in the position and the orientation of the technology (micro-mobility), signalling the child's availability – for example, children could create barriers by arranging papers around themselves, or by orientating the technology away from a potential collaborator. Technologies which were mobile at a macro-level could be carried from room to room, meaning homework activities could be carried out in multiple locations (macro-mobility). This allowed movement between places where information sharing was well supported and places where distraction could be avoided – for example, children could move from the living room to a study. Finally, technologies which offered variability of expression allowed the child to involve a potential collaborator at a range of levels – for example, giving a collaborator a typed document to read allowed a helper to understand the content that the child had written, while viewing it from a distance allowed them to see how much the child had written and how they had formatted the document. Both variability of expression and micro-mobility of technologies could be used alongside ‘body moves’– gestures around or involving the technology (Gill, 2004, Gill et al., 2000) – allowing children to negotiate how much access to content potential collaborators were allowed. The natural interactions possible around traditional – pen and paper – homework technologies contrasted with more stilted interactions found around the desktop computer and laptop, which lacked variability of expression and had limited or no mobility. These analyses will demonstrate exactly how the physical properties and the social meaning of those properties make them appropriate or inappropriate for mediating joint activity.

Chapter 5 will consider how existent ‘negotiation-friendly’ mediating technologies – using visual properties such as visibility, visual appeal and variability of expression, and micro- and macro-mobility – can be imitated within novel technology design in order to preserve natural face-to-face interactions within the microsystem of the home. It will also consider how ubiquitous computing and mobile technologies, which can possess many of these ‘negotiation-friendly’ qualities, might represent a good alternative to the PC or laptop-based home-school computer networks envisioned by Heads of ICT. Lastly, it will consider how these face-to-face processes might be mimicked in a networked environment, for example by replacing the awareness of children’s homework activities provided through co-location with technologies which give peripheral ‘awareness’ of the timing and abstract context of tasks across a network.

0.6 Envisioning future alternatives: Technology lab tours to explore future ubiquitous computing arrangements

Chapter 6 will go beyond looking at face-to-face interactions around homework technologies, and expand the thesis, considering families’ responses to networked interactions through homework technologies within the ecology of the home and between home and school. In particular, it will consider the potential impact of the increased information sharing networked technologies could introduce into homework on the home ecology, particularly considering the huge amount of information that could be gathered about home and homework activities through ubicomp and mobile technologies.

This study was conducted with three families, a mother, father and 12 year-old son; a mother, father, 12 year-old daughter and 14 year-old son; and a mother, 14 year-old son and 16 year-old daughter. These families were invited into the university research space and shown three technology ‘probes’ – provocative and open-ended demonstrators of technological possibilities. These demonstrators were designed to elicit families’ concerns and enthusiasms about the sharing of information through technologies (both within and outside their homes) by collecting and using large quantities of information about their domestic and out-of-school activities. The demonstrators consisted of a wall-based display screen providing video conferencing with teachers in the home, a networked lounge that collected and displayed information about family activity, and a mobile tracking system that collected and displayed children's location. Families were encouraged to discuss which information collection types they did or did not find acceptable. Analysis will look at how the relationships between family members and between home and school influence how much information family members are willing to share.

There was some between-family variation in the quantity of information family members were willing to share within the home. Reticence appeared to be partly age-related: gathering information about young children was uncontroversial, but teenagers needed privacy. The relationship between child and parent was a delicately balanced feature of the ecology. Parents and children felt allowing children to complete work independently demonstrated that children were trusted, allowed them to develop responsibility, and respected their right to privacy. However, they also felt that children with nothing to hide would share information freely, and acknowledged that children would sometimes shirk their responsibilities, so allowing parents access to some information about the child's behaviours would be beneficial. These factors meant the home ecology was a complex and delicate environment in which to negotiate information sharing. Families appeared aware of the contradictions, but reasonably unfazed by them: for example, one girl stated that a child should be trusted to do their homework, although children often did not do their homework, an apparently contradictory statement, without either the girl or her parent making any attempt to resolve this. On the other hand, there was no apparent need for trust between the ecologies of home and school. On the contrary, there seemed to be a level of accepted distrust across the two settings: information could not be freely shared between home and school, and families were keen that information sent to the school the mesosystem would be strongly under their own control.

These two preferences – the wish to share information freely in the home whilst preserving a child's privacy and rights, and the wish to control information shared between home and school – will be connected to two potential design solutions in Chapter 6. Within the home ecology sharing partially ambiguous information could allow families to socially negotiate information transmission – for example, sending information about when a child's textbook is open records their homework activity in a more ambiguous manner than recording when the pages are turned, or using technology to track eye movements. Parents would not be seen to be 'monitoring' children, but information would still be available that could increase their awareness of when homework activities were taking place. Homework could still be 'opened up' across a network using this system. On the other hand, between home and school ecologies, information sharing could be concrete, but families were keen to have strong control over when information did and did not leave the home. Providing a system with easy-to-understand controls, and perhaps even giving family members direct case-by-case control over when information was transmitted, is a design tactic which could allay concerns about family privacy from outsiders in this way.

Chapter 6 will describe the ecology of the homes and its relationship to the ecology of the school in more detail, and specifically discuss how different the design space of sharing information is between family members – within the home ecology – and between home and school ecologies – outside the family.

0.7 Technological probes in the home

Chapter 7 will present the final cumulative study, examining how the design properties explored in the preceding chapters are likely to aid or prohibit the integration of technologies into the home ecology, and which additional aspects of placing technology into this ecology should be taken into account when designing homework technologies.

This study involved the same three families. The families were again introduced to three technology probes, this time designed to be used to mediate their usual homework activities. These were based on design tactics described in other chapters. The study investigated how technology probes using these tactics were brought into and used within the home. Four design tactics were in focus: *mobility* and *awareness* which were drawn upon to support transitions between open and closed work, and *ambiguity* and *control*, which were drawn upon to respect privacy and trust.

Probe technology 1 was two ‘Nabaztag’ rabbits – networked wireless devices in the shape of rabbits which could read out messages sent to a server from a computer and when ‘married’ copy each other’s ear positions via signals sent through the same server. The Nabaztags were used to provide *awareness* in an *ambiguous* manner; one ear position was set to indicate when homework was taking place, and when the child did their homework in an individual location, family members near to the other Nabaztag could see that this was happening. Messages could also be sent to the Nabaztag from any computer, from probe technology 2, a laptop set up primarily to send and receive messages, or from probe technology 3, a PDA. The computer, laptop and PDA message systems provided a more explicit information sharing alternative to the Nabaztags, and all the messaging systems were under user *control*, meaning information was only sent when required. Combining ambiguity and control in this way attempted to see if both solutions were useful to the family. The PDA provided additional micro- and macro-*mobility*, giving children an alternative message and study system to the home computers they already owned. No one technology embodied any one design tactic, but the ways in which the technologies were used were studied with the impact of the design tactics in mind. Alongside the design tactics, particular consideration was paid to how the *appearance* of the technology probes affected integration and use.

The impact of *mobility* was investigated by considering the contrast between ecological habitats – places where technology was kept – and activity centres – places where technology was used (see Chapter 7 itself for more details of these analytic concepts). Static technologies such as the Nabaztags and the laptop needed to be used where they were kept, and this meant that these homework technologies were limited. The PDA, on the other hand, could be used to support homework across a variety of locations, and still opened up the possibility for huddling more successfully than the Nabaztag did across areas. It therefore became apparent that an awareness system built into a mobile device – such as supported within the PDA – might link activities more successfully than the static Nabaztag, especially from the point of view of the child doing the homework, who would often be using a technology to mediate their work as well as communicate about the work.

Awareness did not seem a particularly important feature to the families, but this seemed to be due to the presence of prior awareness information in the home. Parents stated that when their child was upstairs they already had a good idea of what the child were doing through the vibrations travelling through the building infrastructure.

However, family members felt that an awareness system could be appropriate across different locations, such as between the child at home and the parent at work.

Ambiguity and *control*, when used together, were found to be an ineffective combination, as the quality of information was too low to be of any use. These design tactics seem more sensible to use separately: either it should be clear what the child is doing, with the child controlling when the parent / teacher can access this information, or the information should be sent automatically, but in a more ambiguous format.

Lastly, the *appearance* of the devices was studied for its contribution towards their ecological fit. There were many ecological niches within the home such as the computer area, different kinds of living room, etc. which had very different aesthetics, and while a technology designed to have a playful appearance like the Nabaztag seemed ideal for the home, its integration depended on its location. Therefore making more flexible 'skin-able' designs which allowed appearance to be varied seemed important.

Chapter 7 will discuss how these probe technologies successfully demonstrated that there is a place for networked technologies supporting homework in the home, and how design tactics can help define this place. Furthermore, it will discuss ecological 'fit' and the importance of designing technologies so they can fit into a range of homes.

0.8 Conclusions

Finally, the conclusions section will summarise these findings and look ahead to the future. It will outline how the findings of this thesis can be used by designers (and other stakeholders) to support children in their homework. It will look at the integration of design and learning, and what can be learnt about supporting different pedagogical theories through different homework technologies. Lastly, it will look to the future of applications beyond homework towards lifelong learning across home and school contexts.

1 Introduction

1.1 Why study homework?

Systems to support homework and homework-like activities take a central place in government and educational policy. Support for technology in this area is predicated on an argument that it offers the potential for radical educational transform. This argument has been made in government policy (Department for Education and Skills, 2005; Riley et al., 2000) as well as consultative documents from the academic world (Ainsworth et al., 2005; Taylor et al., 2004; NSF Taskforce on Cyberlearning, 2008). Two propositions underlie the argument. The first is that learning should be ‘lifelong’ (Secretary of State for Education and Employment, 1998): that in order for a nation to compete globally it is necessary to have a population equipped with a range of information skills in consuming, processing, manipulating and creating information. The second proposition is that Information and Communication Technologies (ICTs) are exceptionally well-placed to support this lifelong learning process.

UK government policy has promoted using computers to support learning since about 1980, as both Selwyn (2002) and Somekh (2000) note in their accounts of the history of ICT in education. Its original focus was on the potential for learning offered by the desktop computer. However, more recent developments in ICT offer new opportunities for interaction which are specifically relevant to lifelong learning. Computer networks can link devices at many different scales, from the local – for example a local area network (LAN) set up to connect two computers in a home office – to the global – for example the Internet, which connects multiple devices internationally, from home computers to mobile telephones. Ubicomp (ubiquitous computing) technologies are among the more recent devices to be added to these networks. These are technologies which can be accessed anywhere, usually in the form of computer systems and interfaces embedded into everyday objects and buildings – always available in the user's environment – or mobile devices which are carried by the user. Examples are varied. Embedded screens include screens fixed into walls and appliances used to display information anywhere around offices, homes and public spaces. Smart objects include physical objects which display information from the internet in a simple format, such as the Nabaztag, a rabbit-shaped device used later in the thesis, which connects to a wireless network and displays information about the weather, email and other minutiae through lights on its body, motor-driven ear movements and sound files. Mobile devices, such as mobile phones and personal digital assistants (PDAs), can sense location and provide personalised contextual information.

Computer networks are valuable for lifelong learning as they can link learning resources and learner profiles across different situations. This allows learning to be supported both inside and outside the school. Learning inside the school is typically considered as 'formal' – and learning outside the school 'informal' (Coffield, 2000).

Computer networks offer the opportunity to link formal educational learning and informal learning opportunities situated in the outside world (Ainsworth et al., 2005; Taylor et al., 2004). Researchers have argued that changing learning to include more informal styles has the potential to increase learners' autonomy and control, empowering them by allowing them to access personalised material on their own initiative (Lewin et al., 2003; Somekh, 2000).

The proposed advantages of computer networks for learning are reproduced and expanded in ubiquitous computing. As Sharples (2000) notes, ubicomp technologies have great potential to support lifelong learning, providing learners with personalised information, a user / learner-centred and configurable interface, context awareness to provide situated information and support, and collaborative learning activities via networked connections. Together these features support potentially infinite learning opportunities and scenarios. Since ubicomp technologies are situated, collaborative and ubiquitous, they have the potential to open up homework across time and space (in new locations and across different sessions), to new partners (extended family, specialists and the community) and to a wider quality and quantity of information than previously possible.

Although some views of a networked future include ubicomp systems (Green et al., 2005), current UK government policy is focused on encouraging the development of home-school computer networks, systems that allow children to connect their home computers to information and resources provided by the school (Department for Education and Skills, 2005). Current government calls these systems an 'e-infrastructure', and aims to roll out this e-infrastructure in a five-year plan, although the ultimate goal of a fully supported personalised learning system is not likely to be implemented until 2020 (August et al., 2007). Within the five-year plan, the UK government's recent e-strategy report (Department for Education and Skills, 2005) sets deadlines for:

- building a common digital infrastructure to support learning by 2007
- providing information portals, giving parents the ability to monitor / support children's learning, by 2007
- equipping a personalised learning space, with the potential for an e-portfolio of learning activities, by 2007-08

However, in their follow-up to the e-strategy report, implementation partners BECTA (2008, p.4) note that "a significant proportion of providers across both the schools and FE sectors remain late adopters, and this has an adverse impact on the experiences and skills of learners". This is therefore the ideal time to identify the challenges that might be faced in designing and using such an e-infrastructure.

What challenges of design and use might networked technologies encounter? Increased information sharing offers children the opportunity to learn in and across a range of contexts, but this is inevitably more complex than supporting learning within a single context. Government and researchers talk about blurring the boundaries between home and school learning (Harrison, 2004), but it is important to consider why these boundaries exist, and what the consequences of weakening them might be. It is possible to imagine too much information about education entering the home – for example, with intrusive educational activities and values disrupting domestic life. It is also possible to imagine too much information about domestic life entering education – for example, with teachers privy to personal information about the day-to-day lives of pupils and their families.

This thesis uses the lens of homework to explore how the increased use of networked technologies might affect interactions within the home and between home and school. It will therefore explore the design space of homework technologies. Its primary aim is to identify issues that are likely to arise from the introduction of networked technologies into homework and how these can be avoided or addressed.

Homework is defined as activities with educational goals, set for children by teachers to be carried out at home, and it was chosen for study for three reasons. Firstly, homework is an established site of home-school learning links, therefore the literature on and around homework can act as an inspiration for the kinds of opportunities and challenges likely to be faced in the introduction of lifelong learning. Secondly, homework is a context of use with which both educationalists (teachers, government etc.) and families are acquainted, and on which they can comment knowledgeably. Thirdly, as this research will reveal, homework is the site at which networked technologies are already starting to be rolled out.

1.2 How to study homework

Homework, and the design of technologies for homework, is potentially a wide area for study. Before considering the work of the thesis it is therefore worth elaborating on the general strategy adopted in this thesis, and the particular aspects of homework technologies that seem the most fruitful to study.

The technologies of homework

Networked and ubicomp technologies are the focus of this thesis as:

- UK government policy is in the process of rolling out networked technologies to support homework
- Previous research indicates that networked and ubicomp technologies provide new opportunities for learning
- The research presented in Chapter 5 will indicate that ubicomp technologies can help children to coordinate and manage their homework activities

However, traditional paper-based resources – exercise books, text books, pen and paper – used to complete homework will also be studied as 'homework technologies', as the way in which they are used can reveal a lot about current domestic and home-school dynamics. When changing the technologies used for any activity the goal is to improve the activity as far as possible. Ideally, none of the core functions of the original technologies are lost, and the new technologies introduced should not introduce complications into the activity. Studying the traditional technologies used to do homework ensures that no core functions are lost through ignorance of their existence. Studying networked technologies makes sure that this choice of new technology does not introduce complications into homework.

Although this thesis focuses on addressing issues which might arise with the use of networked technologies, the research findings are likely to have implications for a wide range of 'homework technologies', from traditional textbooks to novel technologies yet to be designed.

Those involved in homework

As well as involving multiple contexts, homework also involves multiple stakeholders. The two central stakeholders are the teachers who set the homework and the children who have to complete the homework. However, parents are also heavily involved in organising and helping in homework and liaising with the school. Furthermore, other family members, the students' peer group, and the wider community can contribute. This thesis will focus on teachers, parents and children as the key stakeholders in the homework process; ICT coordinators, parents, and children were all consulted in the research to establish the issues that they faced and foresaw around the use of networked technologies.

This multi-stakeholder approach faced challenges in recruiting participants in both school and home contexts. In-school research with children required negotiation with gatekeepers such as teachers and parents, and buy-in from teachers could motivate child participants. Within the home, a typically private environment, making initial contact was a challenge, and again high buy-in was necessary to compensate for any inconvenience of participation. These challenges limited the majority of studies to convenience or opportunity sampling strategies, based on the willingness and enthusiasm of members of the target population. However, the length of the project meant there were increased opportunities for recruiting participants across the three years. For example, the school study that will be presented in Chapter 3 forged links with a school that later recruited the families involved in Chapters 6 and 7 for more detailed study. This improved ease of recruitment but meant that a concerted attempt had to be made to get to know the recruited families, and break down the roles of parent and student that might be inspired by too close an association between the school and home studies.

Understanding homework

The different stakeholders in homework all experienced the same homework activities, took different roles at different stages and were also expected to value completely different processes and outcomes. Therefore, this thesis does not attempt to triangulate findings across stakeholders – which would involve investigating homework from the same angle with each stakeholder group – but rather applies a targeted mixed method approach – tailoring the questions asked to each stakeholder group in order to focus on the different aspects of homework relevant to each.

In previous homework research educational outcomes were prioritised, and the views of families on homework were somewhat neglected. This meant that there are few established methods for studying the impact of homework across home and school. This thesis will explore and develop a number of strategies to allow such research. Chapter 3 will present interviews where ICT coordinators were targeted as those teachers who not only had the greatest contact with technology, but the greatest contact with parents, and feedback about the use of technology in homework and the home. Chapter 4 will present discussion groups where peers with a shared experience of a school, classroom and homework were asked to contrast their home experiences, exploring their diverse domestic experience from a shared base. Chapter 5 and Chapter 7 will use genuine homework activities from the school to explore families' thoughts about homework. Finally, in their discussions around technologies, to be presented in Chapter 6, family members were specifically asked to contrast their views on the use of devices in home and school ecologies. Together these different methods cross home and school by situating research in one context, with references to both.

As previous homework research involved minimal study of the home, this thesis will draw established methods for studying the domestic context from other research areas. Chapters 5, 6 and 7 will be based around methods taken from the domestic design literature which highlight social and spatial aspects of domestic life. This research strategy will be represented in the empirical studies of this thesis. The major background to and outcomes of these studies are given in Table 1a.

Table 1a. Showing the basic properties of each chapter

<table>
<tr><th>Chapter</th><th>Participants</th><th>Methods</th><th>Findings</th></tr>
<tr><td>2</td><td>N/A</td><td>N/A</td><td>This chapter will present the theoretical and empirical background of the work. It will outline the ecological approach to research taken in this thesis, focusing on the subjective experience and activities of stakeholders in homework, drawing from sociocultural and situated theories of computer use and learning. It will also present related research carried out in the study of homework, the home, education and design, outlining what is already known about homework, and where is still left to explore.</td></tr>
<tr><td rowspan="2">3</td><td>39 Heads of ICT</td><td>Questionnaire</td><td rowspan="2">The primary barrier to using homework technologies identified by ICT coordinators was children's limited access to ICT in the home. This barrier meant that teachers tended to avoid setting ICT-based homework, or that the ICT coordinators felt that they had to provide alternative access to ICT in school. However, several of the aims of homework described in the literature depend on activities taking place outside the school or in the home. This chapter will argue that the only solution is to increase access, and governmental policy is needed to improve access through solutions such as leasing ICT to less advantaged families.

Assuming that universal access could be achieved, ICT coordinators could remove their major barrier to the introduction to the home-school computer networks they were eager to introduce – linking the children’s home computers with school systems through a variety of different networking solutions. However, such systems were associated with new issues ICT coordinators had encountered. Different values and expectations placed on certain technologies in home and school contexts meant using technologies across home and school ecologies was a challenge. This challenge was identified as a potential problem to address through design.</td></tr>
<tr><td>6 Heads of ICT</td><td>Interview</td></tr>
</table>

Chapter	Participants	Methods	Findings
4	190 children (38 groups)	Discussion groups	Before looking at the new difficulties introduced by networked technologies, this study aimed to improve understanding of current homework practices in order to identify how networked technologies could support the range of activities involved in homework. Children indicated that their homework activities varied across five core elements of context: • Tasks – the kind of activity set by teachers for children to do • Technologies – the tools used in and around homework activities • Family involvement – the family members involved in homework activities • Homework location – the locations inside (and outside) the home where homework activities took place • Timing – the times when homework activities took place. A diverse set of homework activities and approaches to homework activities was seen. Within this diversity, however, children indicated that they were making strategic choices about where and when they did homework. They chose locations and timing of homework to balance obtaining help – the positive effects of family involvement – and avoiding distractions – the negative effects of family involvement.
5	7 families	Video diaries	This study investigated how traditional, paper-based, and computer technologies mediated homework. The study identified that children were engaged in two extreme kinds of homework: 'open work' where other family members were heavily involved in collaboration, and 'closed work' where the child worked independently on activities without family intervention. Both the places children attempted homework and properties of technologies used in homework were harnessed by children to move between independent and collaborative work. Children could 'open homework up' by choosing places to study where and when other family members were present, and / or by using technologies with properties that encouraged family members to share in their activities. Similarly, they could 'close homework down' by avoiding places where and when other family members were present, and / or by using technologies with properties that discouraged family members from sharing in their activities. In particular, properties of technologies enabled children to work independently within places that would otherwise better support collaboration. This style of homework was labelled 'huddling' as it often involved children huddling over the technologies they were using to shield their work from others. Properties of technologies which supported the opening up of homework included high *visibility* and *visual attractiveness* – these facilitated family members' involvement as they could see the content of the child's activities, and provided incentive to become involved by making the homework look interesting. Properties of technologies

Chapter	Participants	Methods	Findings
			supporting the closing down of homework included *self-contained* technologies – these were technologies with all the information needed to complete the activity available to hand, so children did not need to seek additional help – and low *visibility* – this impeded families' involvement by obscuring the content of the child's activities. Properties of technologies which supported transitions between opening up and closing down homework activities included *macro-mobility* – large-scale mobility, allowing technologies to be picked up and moved from place to place – *micro-mobility* – small-scale mobility, allowing the technologies to be adjusted and arranged to encourage or discourage involvement – and lastly *variability of expression.* A technology which had variability of expression allowed the display of varying amounts of information at different levels of engagement by the user – for example, paper offered good variability of expression, as up close the words could be read, but from a distance the structure of a document was still visible – as the level of engagement varied, so did the quantity and quality of the information available. Both micro-mobility and variability of expression could also be combined with actions, verbal cues and body moves (Gill, 2004; Gill et al., 2000) to encourage or discourage involvement. Finally, this chapter will discuss the possibility of using *awareness* technologies to provide information about which activities the child is engaged in when, in order to support the opening up of homework across a network, by making other parties aware of the timing and content of children's activities. The properties of macro-mobility, micro-mobility and variability of expression will be discussed not only as properties of current technologies, but also as design tactics to be used in novel homework technologies. In particular, these design tactics are more likely to be compatible with ubicomp technologies than desktop and laptop computers, so therefore the following studies were focused on the use of ubicomp technologies.
6	3 families	Demonstrator technologies	However, ubicomp technologies seemed more likely to be subject to difficulties emerging from clashes in values and ownership issues between home and school. This study asked families to give their opinions of demonstrator technologies testing this assertion. Sharing information across a network about when and where the homework activity was done or using video links to obtain help were seen as potential invasions of privacy for children and families. However, information sharing within the family and between family members and the school demanded different approaches to privacy. In the family information sharing and trust were related in complex ways, especially in the parent-adolescent relationship, where patterns of trust were inconsistent. Parents wished to encourage children to develop responsibility,

Chapter	Participants	Methods	Findings
			and wished to respect their child's right to privacy, a need emphasised by the children, indicating that information sharing should be low. However, children could show that they trusted their parents by sharing information, and parents wished to be aware of potential misdemeanours of their children, indicating that information sharing should be high. These inconsistencies meant it was difficult to design technologies to support the negotiation of information sharing between parent and child. Supporting these contradictions would make the inconsistencies explicit – for example, indicating when the child was not willing to share information with the parent, or indicating when the parent wanted to monitor their child, which would cause frictions. This chapter will discuss the possibility of using ambiguity as a design tactic to solve this problem, in other words sharing information about homework that could be interpreted in different ways. An example would be sharing information about when the child has a textbook open, allowing the parent to know when they were intending to do their homework, rather than monitoring the exact process and detail of their homework activity, such as through eye tracking. This can support involvement without suggesting monitoring. Between family and school the process of information sharing was simpler. Families were concerned about automatically transferring information to the school, demanding ownership of the information, and families did not feel it would offend teachers if the teachers were not implicitly trusted. This lack of trust meant it was important to design technologies that allowed control over the transfer of information between home and school ecologies. Explicit and configurable *control* of information sharing between home and school will be offered as a design tactic to make family members more comfortable.
7	3 families	In-home technology trials	Four design tactics developed in the thesis will be considered in the final study chapter: • Mobility – supporting transitions between open and closed work face-to-face • Awareness – supporting transitions between open and closed work across a network • Ambiguity – allowing social negotiation of the meaning of shared information across a network • Control – allowing control of the transmission of shared information across a network The study found evidence for the usefulness of these design tactics in allowing children to negotiate access to their homework activities with their parents face-to-face or across a network: • Mobility was shown to be useful in supporting huddled work within the home, with children successfully working on homework in family rooms. • Awareness was shown to be of limited use in the home – but this was because awareness information was already available through vibrations through the building infrastructure which indicated the types of activity

Chapter	Participants	Methods	Findings
			children were engaged in. Family members commented that awareness would be more useful between different buildings, for example, between the home and the parent's workplace. • Ambiguity and control were not successful together, as families felt that too little information was transmitted when the child had control over when information was sent and that information was still ambiguous. Therefore it was recommended that the two design tactics be used separately – for example, providing constantly transmitted ambiguous information, but controlled transmission of clear information. Lastly, the appearance of each device was shown to be critical to its integration – if technologies fitted aesthetically with their location, they were more likely to be placed in central locations and used frequently. This concept of 'fit' proved critical to integration, indicating that variety in home ecologies needed to be supported in design.

These six chapters will be brought together in two core findings, reflecting on how children and families can be supported in negotiating the involvement of others in their homework. This negotiation of involvement is achieved through the twin processes of ‘closing down’ and ‘opening up’ homework, which will be unpacked in more detail in the following section.

1.3 Core findings

As a background to the core findings of this thesis the following section will unpack the concepts of ‘closing down’ and ‘opening up’ homework, the processes by which children negotiate access to their homework activities.

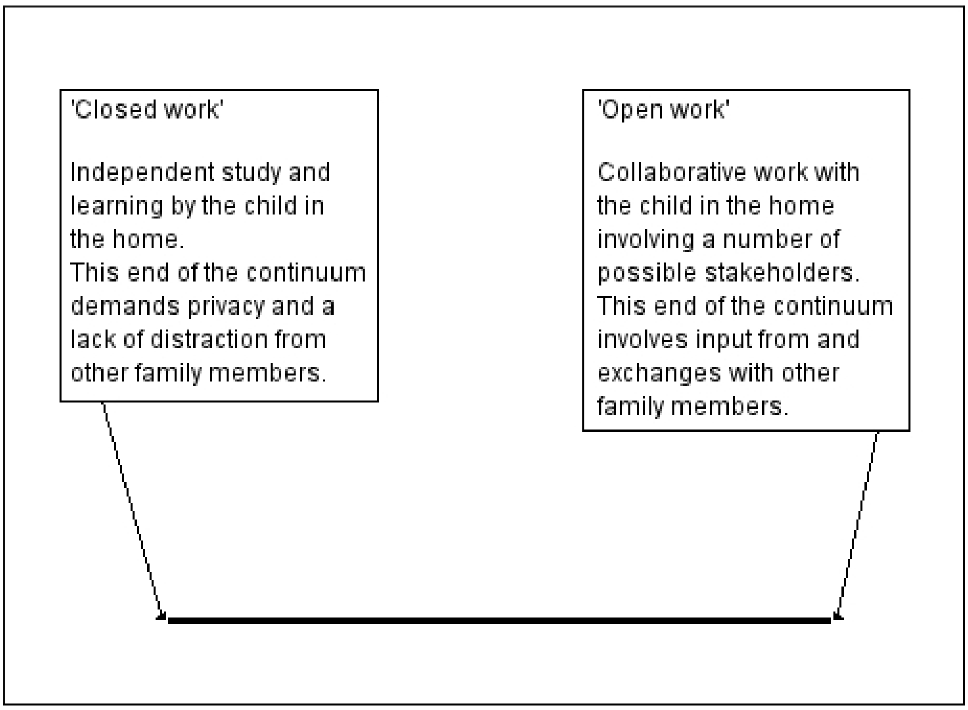
1.3.1 Closing down and opening up homework: A key concept

There are a number of reasons why stakeholders value homework, varying from the opportunity to allow children to attempt autonomous learning activities outside of school, to the opportunity for parents to become involved in schoolwork. However, this means there are two sides to homework – the side which involves children working on their own, and the side where other family members are involved. Independent learning and involvement of others are not necessarily contradictory aims of homework – any homework activity could involve both styles of work. However, this thesis argues that support is needed to maintain a balance between the two types of work, so that children benefit from either independence or collaboration when appropriate.

In lifelong learning maintaining this balance is just as important. Lifelong learning includes a similar range of potential outcomes to homework, aiming to give children autonomy in their learning and to involve a wider range of partners and contexts. The goal of lifelong learning is to make children even more independent in their activity, yet to allow them to explore new opportunities, which may require the involvement of even more partners in homework. Again, independence and collaboration will need to be supported.

Figure 1a shows independent and collaborative activities as two ends of a continuum. One end, ‘closed work’ represents completely autonomous work. In this thesis, the term ‘closed work’ is used to indicate that the homework activity is completely closed off from the involvement of others. The other end, ‘open work’ represents completely collaborative work, which could involve parents, siblings, the wider community or even teachers. The term ‘open work’ is used to indicate that the homework is completely open to the involvement of others. An analysis of video diaries of children’s homework activities in Chapter 5 will show the presence of these extremes in genuine homework activity.

Figure 1a. Showing the extreme ends of the homework activity continuum



However, this research is more concerned with exploring how homework activities can be moved along this continuum, focusing on the process of ‘closing down’ or ‘opening up’ work, and how children can be given support in doing this. Few activities in homework are completely devoid of interaction or completely collaborative – nor do they need to be. This thesis will argue that instead of focusing on the end-points of the continuum, the important thing is to empower children to choose when they want involvement, and when they do not.

These processes of negotiating access to information about homework activities, and the ways in which children and their families can negotiate the inclusion and exclusion of others in homework using technologies is central to this thesis as:

1. children need to be able to negotiate the involvement of their families in homework when they are in the same room
2. children need to be able to negotiate their family’s access to their homework activities through networked technologies
3. families need to be able to negotiate the school’s access to their homework activities through networked technologies

These needs will be discussed in the two following core findings: the first identifying the importance of being able to close down and open up homework in face-to-face settings, in order to gain an appropriate degree of engagement from the parent, and the second identifying the importance of being able to close down and open up homework across a network, in order to avoid privacy violations.

1.3.2 Core finding 1: Mediating homework face-to-face

Children benefit from actively structuring their homework activities to involve or exclude other family members, and the networked technologies which teachers plan to use in homework fail to mediate these processes successfully.

The strategy section argued that it is important not to lose any of the core functions offered by original technologies when introducing new technologies into homework. Opening up and closing down activity is mediated successfully by traditional technologies used in homework and it is therefore necessary for new technologies to offer the ability to open up and close down homework.

Children indicated that they actively managed their homework activities by strategically making choices about the structure of their homework activities. They chose places to do their homework where and when they could either avoid distraction or obtain help, as necessary, as they themselves argued in the discussion groups to be presented in Chapter 4. What is more, properties of the technologies were used to open up and close down activities without changes of location, as will be demonstrated with vignettes from video diaries in Chapter 5. A particularly interesting style of work was ‘huddled work’, which occurred when children used the properties of technologies to close down homework – discourage involvement – in a place where family members might otherwise have found it easy to be involved in activities.

Current homework technologies featured properties that made it easy to mediate the opening up and closing down homework, also to be illustrated by the video diaries.

Some properties of technology helped open up homework activities. Technologies could make the information in homework visually appealing – this made the activity look interesting, and tempted family members to become involved. Technologies could also make some degree of information visible – as giving an idea of what the child was doing could help the family member decide if they could contribute to the activity meaningfully. A few practical 'make and do' type activities will be seen in the video diaries in the 'open work' section, as these tended to involve technologies which were highly visually appealing and visible – they made the activity look fun, and it was easy for a family member to see what the child was doing, and how they might become involved. Other properties of technologies helped close down homework activities. Technologies could be very self-contained. This meant they contained all the information necessary to do an activity, and therefore made it difficult for a family member to provide help, and reduced the need of the child doing the homework to seek help. Technologies could also be poorly visible – this made it difficult for family members to tell what was happening in an activity, and therefore made it difficult for them to become involved. For example, one activity in the video diaries involved typing an essay into a word processor, which required little outside help – even spelling help could be obtained on the computer – with the large expanse of text displayed on the screen making it difficult for a family member to see what was going on and offer help, as a result of the poor visibility offered.

However, some technologies mediated the negotiation and renegotiation of access – both opening up and closing down activities. Children used a number of approaches to negotiate the involvement of family members. These included verbal cues – asking family members to become involved or indicating that help was no longer required –

and actions – such as passing over a piece of paper for the parent to look at – and finally 'body moves' (Gill, 2004; Gill et al., 2000) – gestures with and around the interface of the technologies which signalled to family members when they should and should not become involved. Some properties of technologies mediated these activities particularly well, and the two that will be discussed from the video diaries in Chapter 5 are 'micro-mobility' and 'variability of expression'. Technologies which offered micro-mobility were light and mobile, allowing small-scale gestures like turning the homework to obscure text or placing used sheets of papers around the work area like a barrier. Technologies could also offer variability of expression – this meant that different amounts of information could be gathered about the activity at many different levels of engagement. For example, the video diary study will examine a family tree drawn in an exercise book. The exercise book was passed to a family member to obtain their help, and then shielded by the child's body as he worked on the activity – both of these actions were made possible by the micro-mobility of the exercise book, which allowed it to be moved around in the area in which the family was sitting. The child also pointed at a particular part of the tree from a distance to draw attention to a specific family member's place on the tree (a demonstrative reference body move) before he passed the exercise book to the other family member – both of these activities were made possible by variability of expression as the other family member could see some properties of the tree from a distance, but could only become involved with the actual text when close up.

Current networked homework activity is usually conducted through personal computers, primarily desktop and laptop computers, and the analysis of interviews with Heads of ICT in Chapter 3 will show that they plan for the immediate future of such activities to involve personal computers as well. However, the home computer and the laptop did not mediate the opening up and closing down of activity at all well. Desktop computers were particularly problematic as they lacked portability – or macro-mobility – so children could not change their locations to open up or close down their homework activities. Previous research also shows that laptops, while macro-mobile, tend to be used in a limited range of places (Woodruff et al., 2007). However, the video diaries showed that both desktop and laptop computers were also poor at supporting negotiation of access within a fixed location. Both had screens that opened up the display of homework completely when faced directly – the screen made it easy to see everything the child was doing – and closed down the display of homework completely when viewed from the side – nothing on the screen was visible at an angle. Furthermore, both types of personal computer closed homework down completely from involvement, via the keyboard and mouse designed for one user alone.

Therefore the technologies that ICT coordinators are planning to introduce into homework did not support the opening up and closing down of homework activity efficiently. This thesis will argue that using technologies with these flaws in homework could seriously impede children's ability to study independently or collaboratively when appropriate, and effectively compromise the breadth of homework activities. Instead, it will recommend that alternative technologies are used which can support these processes, such as ubiquitous computing technologies, which can be set up to offer both micro-mobility and variability of expression.

1.3.3 Core finding 2: Mediating homework across a network

Details of homework activities transmitted across a network can potentially include too much information about a child or a family's wider activities, violating privacy and leading families to reject technologies.

The strategy section argued that it is important not to include any features, designed, or emergent and unintentional, which make users uncomfortable with the technology when introducing new technologies into homework. Networked technologies have the potential to share a lot of information about homework activities – many of their benefits include opening up homework to new partners and new sources of information. However, they also risk sharing too much information about the setting in which a child is doing homework, which can raise legitimate privacy concerns.

ICT coordinators had already encountered difficulties with using technologies between home and school, as will be discussed in Chapter 3. Firstly, technologies used across home and school were viewed differently in each ecology – families and teachers had different needs and associated different values with each technology. For example, family members could see a USB drive mp3 player as primarily an entertainment device, whereas the school could value them as portable media for carrying information home. Secondly, when a technology was used across different contexts it was difficult to determine who had 'ownership' of the two technologies. To return to the mp3 player / USB drive example, if the drive was to be used to transfer homework, who should buy it – the school or the family? If the school bought it, would that mean they could specify that it could only be used for homework? If the family bought it, would that remove the right of the school to inspect the drive in order to see if it was carrying viruses? These ownership issues could therefore be financial, but also social and personal.

However, this thesis will argue that what is most important for families in the use of networked technologies is the ownership of the information carried through these devices. Chapter 6 will present families' reactions to several demonstrator technologies which deliberately gathered information about their environment and the context in which homework activities were attempted.

The analysis of families' discussions of the technologies will show that family members were particularly worried that information about homework activities carried through homework networks could reveal a lot of information about their activities. By recording information about where, when and how a piece of homework was attempted networks offer the potential to share information about less than optimal homework practices. Knowledge of less-than-perfect practices – such as completing homework at the last minute – might be viewed poorly by parents or the school, even if they were not necessarily a sign of a lack of effort or motivation.

Family members discussing the demonstrators indicated that they had different concerns about sharing information between themselves, and sharing information with the outside world. These seemed to be based upon the existence of two separate approaches to trust and privacy found in these relationships.

Within the family the relationship between parents and children could be affected by the sharing of too much information about homework. Family members presented a complex picture of the relationship between parents and children, and the obstacles which need to be navigated in conveying trust and preserving privacy and rights in the home. Parents did not wish children to feel monitored, and wished to support them in developing their own sense of responsibility. However, they felt somewhat accountable for making sure homework was at least attempted. On the other side of the equation, children wished to show their parents that they could be trusted by allowing them access to their activities. However, they also felt they had a right to rebel, and to preserve their right to privacy even if homework was not always completed. These different needs and rights were represented as uncomplicated properties of the parent-child relationship, and while they might appear contradictory to a logical analysis, families appeared to be able to understand and digest them the majority of the time. This created a context for the sharing of information in homework that was difficult to navigate.

Between home and school family members were also worried about sharing too much information. However, the relationship between the family and the school was comparatively simple, and seemed to drive a different approach to preserving privacy. There was not a great need for family members to display trust to the school, or vice versa, and therefore information sharing could be managed much more simply.

Analysis of the family members' reactions to technologies will show that the privacy concerns they mentioned about the sharing of information in this two ways could potentially lead to them rejecting technologies – not wanting them within their home

– neglecting the technologies – failing to use them within their home – or sabotaging the technologies – misusing the technologies so they report false information.

The introduction of networked technologies, and particularly ubiquitous computing technologies, into homework has the potential to vastly increase the amount and type of information gathered about how, when, where and with whom children do their homework, and therefore open up homework dramatically to the involvement and inspection of others. This thesis will argue that failing to allow children and families to close down some kinds of access from parents and schools could lead to poor uptake of the technologies, and either a lack of use or potential misuse of the systems. Therefore, it will recommend that technologies are designed to enable the closing down of homework activity across a network. The way that these processes can be supported in the different relationships involved through both the design space of homework technologies and design tactics will be discussed in the novel features section.

1.4 Novel features

This section will present three novel features of this interdisciplinary research. The first is the development of specific design tactics to support the opening up and closing down of homework face-to-face and across a network. The second is what the core findings and these design tactics reveal about the design space of homework technologies. The last is the research strategies that can be used to expand the understanding of homework in future work.

1.4.1 Specific design tactics to support homework

The first novel feature of this thesis is the design tactics offered to allow the closing down and opening up of homework and avoid the complications warned against in the core findings. This thesis will offer specific design tactics which could be used with home-school computer networks and with ubicomp and mobile technologies to meet the needs identified. These are given here as heuristics for designers working within this context.

Face-to-face mediation of involvement

A major need within the design space of homework technologies is support for the negotiation of involvement of family members in co-located homework.

This could consist of a need to mediate interactions around homework technologies, 'opening up' work. Specific design tactics which already allowed children to do this face-to-face, as discussed previously, included making technologies easy to see and become engaged with for those outside the activity – giving good visibility – and packaging the activity in a manner that stimulated interest – making the technology visually appealing. Equally, support for negotiating involvement could consist of a need to discourage interactions around homework technologies – 'closing down' work. Specific design tactics which already allowed children to do this included packaging all the information needed for a homework activity within one medium, so that consultation of multiple sources was not necessary – making the technology / activity self-contained – or making the technologies difficult to get involved in without high proximity to the activity, e.g. through small text – giving technologies poor visibility. These same design tactics could be used in the development of novel technologies to support the opening up or closing down of homework in face-to-face scenarios. What is more, with digital technologies, designers have the option to provide different modes of display and interaction, so technologies could be switched between highly visible content and interaction and poor visibility through the use of different modes, as appropriate to an activity.

Any homework technology could be designed to allow children to solely ‘open up’ or ‘close down’ homework activity. However, a more complex challenge was to mediate the ‘opening up’ and ‘closing down’ of homework – the length of this dimension of the design space – using a single technology. Children needed to be able to easily move between sharing their work and avoiding sharing their work using actions, dialogue, and / or gestures around the technology – ‘body moves’. Specific design tactics are already available that allow children to do this. Making sure that different levels of information about an activity were available at different distances from the technology so that a child could display the overall layout of an activity without a helper being able to see the details, or so that the child could draw attention to a specific feature to draw the helper’s attention in to more detailed involvement was described as ‘variability of expression’. Making technologies light and flexible so the child could make small adjustments in what the helper could see, hand over the technology, or use the technology to create barriers around them also helped the child indicate when involvement was and was not welcome, and this property was described as ‘micro-mobility’. These properties of technologies allowed a child to alter their parents’ ability to interact with their technologies and activities without having to make large switches between different modes – primarily, both these properties allowed the child to fine-tune the visibility of the activity they were working on.

In a face-to-face environment, ubiquitous computing technologies were identified as a way to allow negotiation of involvement as they allowed the display of information in a wider variety of locations and forms than the desktop or laptop computer.

Identifying when it is possible to negotiate access across a network

Networked personal computers do not usually support 'chance' encounters. In face-to-face homework scenarios, a child has to carefully manage when others are involved in their homework, as encounters are easy. However, allowing involvement to take place across a network needs homework to be opened up to some extent.

Future chapters will discuss how opening up homework across a network could be achieved by using the design tactic of awareness – giving information to one person (or group) about the current activities of another person (or group). This could be used to allow different stakeholders in homework to be aware of which activities are carried out and when they are carried out. Within the family, awareness technologies could provide the potential for 'opening up' homework across a network, providing an indication to parents (and other family members) of what kinds of activity a child was involved in at any one time, and even providing opportunities for the parent to attempt involvement in the child's activities when they were not co-located.

Negotiation of access across a network

Awareness systems can indicate possibilities for interaction at a distance through networks of personal computers and laptops or ubicomp and mobile technologies, but these systems do not allow face-to-face processes of negotiation, and create privacy concerns. The core finding that there was a need for children and families to negotiate access to homework activities across a network identified different privacy needs within the home and between home and school. This thesis will suggest two design tactics to address the different needs of relationships within the family and between home and school.

In order to preserve trust, privacy and the child's rights, families were keen to avoid parents monitoring children. One design tactic that could achieve limited information sharing without invading privacy would be to provide ambiguous information about what children are doing. This would allow children the possibility to explain their activities, and negotiate the degree of disclosure with which they were comfortable. It might also allow children to 'fake' homework activity – much as children could claim to be doing their homework if they went into another room to work on the computer, they might be able to 'fake' homework activity by opening up a document and typing into it. However, children that were producing poor quality work would still be caught out, and the opportunity to take responsibility would at least have been offered. In addition, with these systems parents would not be lulled into thinking that the technology was accurately recording behaviour, whereas more accurate systems seemed more vulnerable to sabotage to produce socially acceptable results.

Between home and school, families wished to have strong control over what information was shared and when. Although families had strong ideas about which kinds of information they were and were not happy about sharing, this was somewhat context dependent and so automatic privacy and security settings were not accepted. One design tactic would be to make sure that families had easy-to-use, straightforward, and configurable privacy controls which indicated what information could and could not be shared. Another, more extreme, design tactic would be to make sure information was only shared with the school on a case-by-case basis, requiring permission from a family member each time. Either way, control would be offered to the family.

Again, these approaches were developed specifically to address the privacy concerns raised by networked and ubicomp technologies which record and share a lot of information for use in the family or for use between home and school. However, the implications from these privacy-related needs could be applied to novel technologies developed in the future, or even to an understanding of difficulties that are encountered in the limited information about home activities collected by traditional homework technologies. For example, even apparently innocuous homework technologies such as homework diaries, which schools often require parents to sign to indicate they are aware of children's required homework activities, can reveal sensitive information about domestic life, such as a change in a parent's partner indicated by a change in signature on the diary.

These tactics for facilitating the face-to-face negotiation of access and the negotiation of access across a network in a socially acceptable manner could improve the design of homework technologies, increasing the applications and acceptance of both home-school computer networks and ubiquitous computing devices. The novelty of these design tactics does not lie in their conception, however. It is their application to these specific and novel design challenges that is new.

1.4.2 A broader approach to studying and supporting homework

As the next chapter will outline in its summary of previous studies relevant to homework a broad ecological approach has not been seen in the study of homework. This thesis addresses this by studying the activities of homework in some depth, going beyond the majority of research by considering the ecologies of school and home, going into particular depth around the home, where the majority of homework activities occur.

In particular, study of homework activity occurring within the home is something that has not been attempted before. The use of video diaries to record homework activities allowed an understanding of how the division of labour between members of the community of homework is mediated by traditional and current homework technologies. In addition, working with a small number of families allowed both interviews and trials of potential new homework technologies to take place, when the majority of academic thought in this area has been speculative, and focused on the benefits that new technologies could bring, rather than their potential downsides.

Finally, towards the end of the thesis in Chapter 7, the idea of ecological 'fit' will be introduced to highlight the importance of using technologies which adapt to, rather than suffer from, the variability of the home ecology. Although educational policy makers may be used to a one-fits-all approach to technology use, and are capable of enforcing such an approach within the ecology of the school, the need for technologies to adapt to the needs of the home ecology in order to ensure acceptance are much greater. Only a study looking at genuine homework activities, and the values and needs of stakeholders in homework can start to map out the different aspects of the home ecology a technology needs to fit within, from the physical structure of the building, to the routines of the family, to the aesthetic trends of the rooms the devices will be entering.

The following chapter, the methodology, will introduce the ecological approach in more depth, and explain why the study of genuine activity is so important in the design of new homework technologies. It draws inspiration from the methods and concepts previous studies have used to study homework, the family, the home, and technologies.

2 Methodology

In order to understand how networked technologies might affect the way in which homework is completed it is important to establish a theoretical basis for the role of technology use in homework. First, it is necessary to make predictions about how networked technologies might fit into homework as it already exists, and secondly to make predictions about how networked technologies would be likely to alter homework from its current state. This will be achieved by a theoretical stance on how technologies fit into the homework process, with a focus on their role in activity and learning.

The theoretical basis for these studies is an ecological approach. ‘Ecology’ is used to describe the physical, social and cultural context in which homework occurs, and the thesis is therefore guided by the following principles:

- The activities of humans originate from and occur under the influence of the ecology (or ecologies) in which they are embedded

- Understanding of this ecology can be achieved through study of the everyday activities of humans and their subjective reports of the meaning of these activities
- These activities are mediated by tools, or technologies, which themselves form a culturally meaningful part of the ecology

By studying the current practices which form homework and by observing how stakeholders talk about homework, therefore, it is possible to understand the meaning of homework activity for those stakeholders, and how current tools and technologies support and shape it. In addition, it will make it possible to predict how networked technologies might alter the balance of homework activity, and the frustrations that might ensue or changes that would be necessary alongside their introduction.

As this thesis is concerned with the mediation of learning activity, it is also important to consider how learning occurs. However, the goal of this work is not to specify a pedagogy for homework. Its focus is on the practices of homework: what might be defined as ‘school-learning’ taking place within the home. The aim is to find out how activities within this category are mediated, and how the introduction of new, but inevitably culturally meaningful tools, might change this process. A teacher setting the memorisation of a list of spellings as a homework task is unlikely to be using a sociocultural pedagogy – rote learning has the appearance of quite a dry cognitive task. However, the way in which the words are learnt will be understood from a sociocultural viewpoint: focusing on the meaning of the task for the student, the role of school and home cultures in its completion – such as expectations and direct involvement from parents or siblings – and the way in which the tools used to complete the task mediate the process.

In order to explain the basis for the ecological theory, its broader theoretical context, and its application to the concerns of the thesis, this chapter will first examine the major sociocultural, situated and ecological theories which have influenced this work, through their origin in the work of human-computer interaction (HCI) and learning.

2.1 Theories of computer use

Early theoretical approaches to the study of people using computers drew heavily from cognitive psychology, with its dominant information processing paradigm (see, for example, Lachman et al., 1979). The basic premise of the information processing paradigm is that the processing of information by the brain is the essence of cognition. Studies under this paradigm acknowledge the environment only in its role of providing output and input for the brain to process. This means that interaction with computers was understood as providing and responding to structured information in predictable ways and led to such theories of HCI as the popular GOMS model (Card et al., 1983) which understood individuals approaching a computer system in terms of the goals that they had before interaction, and the strategies they were likely to use to obtain those goals.

However, as the study of people interacting with computers continued, dissatisfaction with such theories emerged. One of the first major objections towards theories such as GOMS was raised by Suchman (1987) who noted that the assumption that humans approached a device with a particular plan in mind – a particular goal and set of steps to complete it – was inherently flawed, and that interaction with the machine is instead constantly subject to change. She called this idea 'situated technology use', holding that technology design needs an understanding of how feedback from the machine can alter use on a moment to moment basis. Indeed, she held that users do not just change their plans and goals based on this feedback, but are mostly unaware of such plans at all. Plans can be formulated before an action, but are then subject to change based on the actual circumstance in which activity takes place, or can be used retrospectively (and misleadingly) to explain the actions that were chosen. The majority of the time activities are guided by socially obtained 'scripts' – a series of appropriate behaviours in a particular situation, such as attending a meeting, dining at a restaurant, or word processing a document. The tools used in these activities can disappear entirely when they work appropriately, with awareness of the tool only emerging when attention is drawn to them by unexpected behaviours such as breakdowns. The importance of the theory of situated action for the study of homework is that it is not possible to look at homework practices as a unit, and then decide the way in which a technology might support such practices, but it is necessary to focus on the way in which the technology shapes the activity in an ongoing fashion.

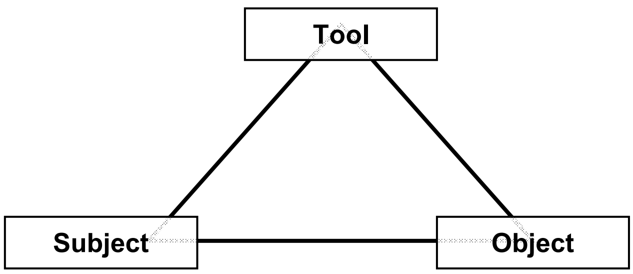
Since the theory of situated action was introduced further theories been constructed or adopted in the computer design world, attempting to explain the social construction of technology use, and the effect of tools in mediating activity. Dourish (2001) explored these ideas further under the umbrella of 'embodied interaction'. Embodied interaction is again seen as situated or embodied in the everyday world –

in other words, use of technologies needs to be understood in terms of the activities in which the user is engaged. These activities are embodied in a physical and social world. Dourish used a wider definition of the social world than Suchman, referring to the direct influence of the social – immediate others – and the cultural – the wider societal norms and values which affect behaviour. He further pursued the idea of the tool 'disappearing' when used successfully, stating that when a tool is used successfully and habitually, it becomes 'coupled' with the task being performed. It is the tool in the hands of the user which achieves coupling, and not something that can be built into the tool – the tool only 'disappears' for a user when use is smooth, trouble-free, but most importantly when it fits with their understanding of the situation and how the tool is to be used. This means that the role of designer is not necessarily to design a tool which 'disappears' but to indicate through design in which activities the tool might be useful. Therefore, in homework it is important to identify which activities are to be supported by the homework tool, and, when new tools are developed, to guide users towards the appropriate choice. Tools which are already embedded and understood in a particular ecology – for example, pen and paper within homework activity – do not require such cues, as their meaning is already available and understood within the ecology.

The drawback to these situated and embodied approaches is that they offer a good theoretical basis for research, but lack a representation of the role of culture in activity to use in analysis. This problem has been addressed with the uptake of Activity Theory in HCI as a framework for understanding technology use. Activity Theory developed from the broader sociocultural perspective of Vygotsky (1978), who will be discussed further in the Learning Theory section, and Leont'ev (1974).

These Russian theorists emphasised the role of culture in activity, with tools seen as a culturally inherited resource in the 'mediation' between the subject and object of an activity, as depicted in Figure 2a. Here the subject, or the person involved in the activity, can work through the tool to transform the object of the activity. The object of an activity can be either a tangible item, such as a log, or something less tangible, like an opinion. Acting on the object with the tool results in the final outcome. The tool is used to transform the object into something new – the log chopped into firewood with an axe or the opinion changed with a persuasive argument, in these examples.

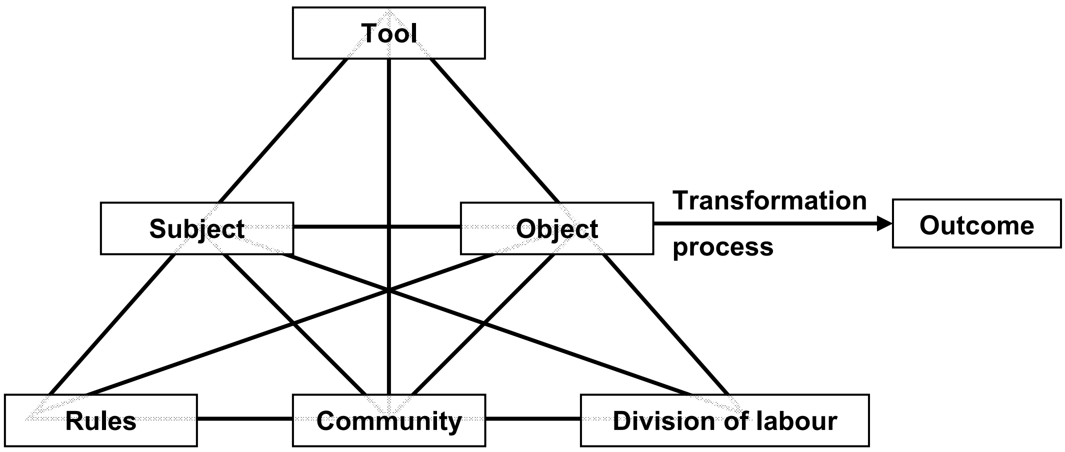
Figure 2a. Showing the mediated relationship between subject and object. Adapted from Engeström (1987)



Vygotsky in particular concentrated on the use of language as a cultural tool. This is a particularly good example of how a tool is culturally developed and transmitted, central to the idea of the cultural-historical theory, as it demonstrates how historical tools enhance human activity across generations through culture as well as immediate teaching of tool use at a social level. Homework technology is a more concrete example of a tool, but the same principle applies – the tool used to complete homework is culturally embedded, be it pen and paper or networked computer system, and it shapes and is shaped by the task and the user.

More recent developments of the Activity Theory model, known as Scandinavian Activity Theory, due to their development by Scandinavian researcher Engeström (1987), emphasise the cultural place of this tool use by expanding the activity triangle to include the community, the rules the community has for the task, and the division of labour among members of the community, with relationships between each element, as shown in Figure 2b.

Figure 2b. Showing the mediated activity within a wider social context. Adapted from Engeström (1987)



In homework, therefore, the subject is usually the child, the object the homework task, the tool can be one of a wide range, and the community, rules and division of labour fall across home and school. Identifying the importance of these different aspects of the activity helps ensure that all aspects of the ecology are considered. This approach has been converted into an Activity Checklist (Kaptelinin et al., 1999) to be more easily applied to design scenarios. While it is possible to consider multiple tools within an activity, or compare activities which share most components but differ in their tool use, however, activity theory does tend to encourage a focus on one technology at a time. Homework currently uses a wide range of technologies, as will be seen in Chapter 4, and it seems neither likely nor desirable that this will change in the near future, given the diversity of tasks it encompasses. However, as work into multi display ecologies (Russell et al., 2002; Huang, 2006; Huang et al., 2006) has demonstrated, when technologies are used together within a single ecology, then considering them in isolation creates a poor picture of their use.

In order to get a wider picture of how a range of resources are embedded in an activity, it is possible to draw on the more holistic descriptions produced by ethnography, an approach which has been popular in the study of the home and the workplace for design. Ethnography comes from an anthropological background, and is the production of a study of people through writing. In anthropology it was developed for the study of unfamiliar cultures, such as tribes, and involved full immersion into the culture of study and the composition of a detailed written study of the cultural precepts and ways of a people. The basic theoretical statements of ethnography are that culture should be understood as a holistic system – it is not possible to break down a culture into meaningful parts and study these in isolation – and that fieldwork is of paramount importance in developing this holistic understanding. Participant observation – participation within the everyday life of the culture – is the major method used within this anthropological tradition. Ethnography entered design through participatory design strategies developed to improve the design of technologies for office work (Kensing & Blomberg, 1998; Kuhn & Muller, 1993). Participatory design uses methods to uncover the unspoken rules of everyday life, such as the contextual design approach, which asks participants to talk to designers about or while participating in their day-to-day lives. It has since been used to tailor designs to the social, emotional and situated aspects of the domestic environment in many recent studies from the UK and US (Bell et al., 2003; Bell et al., 2005; Brush et al., 2005; Crabtree et al., 2001; Crabtree & Rodden, 2002; Gaver et al., 1999; Grinter et al., 2005; Hindus, 1999; O'Brien & Rodden, 1997). Generally in HCI a modified form of ethnography, known as 'design ethnography' (Bell, 2001) uses a relatively rough and ready approach to understanding culture. This is partly because an interdisciplinary design team rarely has the time available for a full ethnographic study and partly as in domestic design research full immersion into a family via participant observation is a near impossibility: a researcher cannot be seamlessly integrated into a family that is not their own (O'Brien et al., 1999). Design ethnography is often used alongside theories such as Activity Theory to structure findings – see, for example, Nardi (1999) – as while it hold principles about how society should be studied and understood it provides little framework for reporting these. In this thesis it provides impetus for study of the home ecology and the use of technologies as part of, rather than separated from, the social world of the home.

2.2 Learning theories

The same situated and cultural themes seen in human-computer interaction (HCI) are behind the way learning is understood in this thesis. As mentioned above, learning theory is useful to the design of homework technologies for its descriptions of how learning takes place, as it is important to understand the key environmental inputs into the learning process. The intent of this thesis is not to prescribe a certain approach to learning. However, in analysing the different types of activity that homework entails various implications for matches between pedagogy and technology type will emerge, to be considered in Chapter 8.

As described at the start of this chapter, the need to understand the homework context encourages a focus on the social and cultural aspects of homework as critical to design, and two related theoretical themes have been used to study learning within a social context. These are situated cognition / learning and sociocultural learning theories.

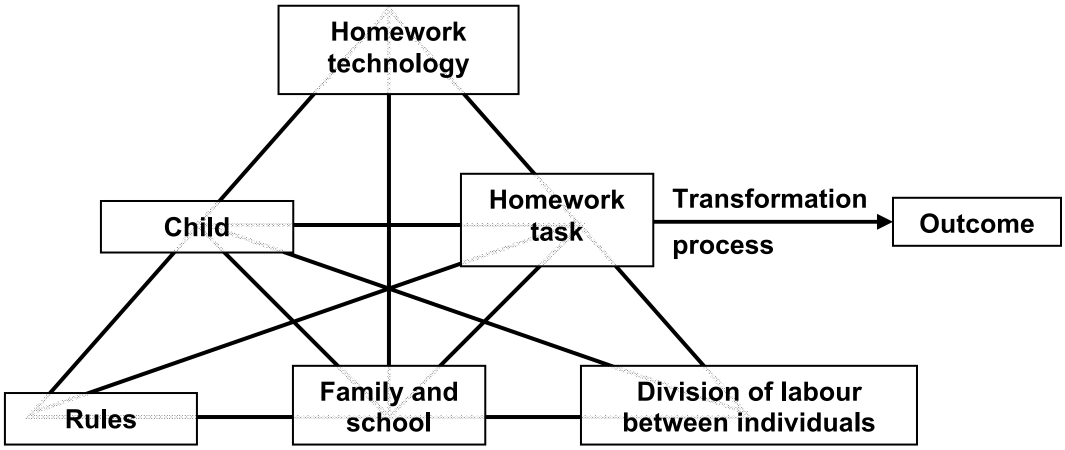
Situated learning theory sits alongside the theory of situated action in its description of behaviour, in what Greeno and Moore (1993) call 'situativity theory' with the claim at its core that "cognitive activities should be understood primarily as interactions between agents and physical systems and with other people" (Greeno and Moore, 1993, p.49). In the field of learning theory, however, situativity has been connected strongly with the use of apprenticeship as a model for learning. Lave and Wenger (1991)'s book on situated learning is the major proponent of this theory. For them, learning is described from the point of view of 'legitimate peripheral participation' the idea that previous to a learning experience one is a novice, but through legitimate, authorised, but peripheral participation in a 'Community of Practice' with experts at the centre, core behaviours of that community can be acquired.

Lave and Wenger take a similar stance on their use of learning theory to this thesis, holding that legitimate peripheral participation is "an analytical viewpoint on learning rather than a way of understanding learning" (1991, p.40): it is seen as a way of describing and understanding learning activity rather than a pedagogy. However, attempts have been made to base more a prescriptive model of learning on similar grounds. Brown et al. (1989) argue for the study of ‘cognitive apprenticeship’ claiming that the disconnection between schooling and the Community of Practice can render acquired knowledge inadequate. For example, a child learning geography in school will never be taught to ‘think’ like a geographer; they are taught the outcomes of geographers’ work instead of the way that geographers arrived at their conclusions. They recommend that schooling is replaced with an apprenticeship model which teaches children how to model the forms of thought of relevant disciplines, and therefore how to solve discipline-based problems themselves. Generally, schooling seems difficult to reconcile with situated learning theory. Lave and Wenger note that when the school is viewed as a Community of Practice children are no longer learning skilled behaviours which apply to the outside world, but are merely learning to behave as ‘schooled adults’: the Community of Practice is the school itself or ‘educated society’ rather than their future workplace. However, ‘schooled adults’ do have an advantage on entering the workplace, giving a common starting point for their entry into further Communities of Practice. Certainly, from the point of view of this thesis it is useful to think of both school and home as ecologies with certain expectations of learning and behaviours which may be taught, or acquired through observation and imitation.

The sociocultural perspective of Vygotsky (1978) offers a more sympathetic view of the role of teachers in learning. Primary in his work was the concept of the Zone of Proximal Development (ZPD) which held that learners could be supported by more experienced others in their learning, to achieve results which were just out of their reach. For example, a child might not be able to memorise a list of words, but her parent might support her by providing some strategies for memorisation, or helping with rehearsal. This ‘zone’ where the child is unable to reach a certain standard unaided, but can do so with support is the ZPD, and the idea is that learning takes place as the child learns to achieve the same results unaided in time. Again, this is relevant to homework as the child will always be learning with the support of the teacher – although not always a physically present one – or the parent. There are links here to the concept of legitimate peripheral participation, seeing the child as a novice, the parent as an expert, and the ZPD as the distance between the periphery and centre of a Community of Practice. In both theories the role of an ‘expert’ is important: in a Community of Practice the child is not always actively supported by an expert, but can learn through methods such as observation to behave as a member of the community; in the ZPD the child is actively supported by the expert. In this thesis, the role of expert can be either active or passive, in fact the degree of involvement of the parent or supportive sibling in homework seems to be strongly linked to the technology type used in a homework task, as will be illustrated in Chapter 5.

The Activity Theory triangle, used with a learning perspective, offers the potential to view the role of community in these two different ways. The community of family and school can be seen as impacting upon the child directly, or indirectly through the rules of the activity, division of labour, technology and so forth. This comes closer to a more comprehensive model of the many ways in which culture can impact on activity through the community. It is possible to see the object of the activity as the homework itself, which can be transformed into a tangible outcome – for example, a completed worksheet – or an intangible one such as knowledge.

Figure 2c. The expanded Activity Theory triangle as used in homework: the outcome can be as tangible as a completed worksheet or intangible as knowledge



One additional concept of importance in more recent formulations of Activity Theory – which Engeström (2001) has called 'third-generation activity theory' - is the consideration of diversity. Representing Activity Theory in its common triangular model helps make the interrelatedness of activity and its cultural aspects concrete. However, it has the danger of suggesting quite a rigid form for the elements of the activity and a natural, almost inevitable progression to the outcome given the correct circumstances. Principles which emphasise change have therefore been added to the model: the multi-voicedness of the community (as emphasised by the division of labour between different members of the community with different view, skills, and interests), the vulnerability of the activity to historical change, the role of contradictions within and between different activities in change, and the possibility of expansive change in which the activity is redefined by its participants. It is the multi-voicedness of the community that is particularly relevant in homework as it is not located within one, but two ecologies, home and school. Bronfenbrenner (1979)'s ecological theory provides a helpful perspective on this. Bronfenbrenner described children as functioning within a 'macrosystem' – the wider cultural beliefs of society, which homework also includes. However, he also said they move between different 'microsystems', specific settings with norms and values – home and school are good examples of this. In fact, Bronfenbrenner would describe homework as taking place across a 'mesosystem' – these are two settings linked by the child, where the transfer between two separate cultural systems can cause difficulty. The division of labour between home and school is likely to differ across homework activities but the social influence of school on homework, for example, does not have to entail direct involvement in a particular homework activity – as Crook (2001) points out, all learning is embedded in a grounding of "social relationship and accountability" (2001, p.28). Therefore it is important to acknowledge the impact of the school in homework as well as the impact of the home in situations where direct involvement is not always possible or desirable, but where its cultural influence will still be felt.

In addition, it is worth referring to the broader cross-cultural development of sociocultural theory by Cole (1996) which discourages the view that any culture is more advanced, or progresses from another: instead acknowledging that different kinds of skills may be valued in one type of society and not another, or even present in both, but difficult to compare as they are grounded in very different practices. Although Cole's work relates to the relationships between Western and other societies, it can equally be applied to the difference between home and school modes of learning, especially considering that much of his work involved the comparison of indigenous tribe cultures and Western educational values as promoted by schooling.

The ‘school’ way of doing things should not be assumed to be more valid than the ‘home’ way of doing things.

2.3 Computer use and learning theory combined

In summary, then, this work draws from a tradition of the study of situated and sociocultural technology use and learning. This is referred to as an ecological stance to research. The term ‘ecology’ does not just refer to the physical spaces of homework, the home and the school as separate domains, but to the social and cultural side of an ecology – approaches to understanding the world shared by the actors within a cultural ecosystem.

Each of the principles outlined at the start will be revisited here in light of the theories discussed above.

The activities of humans originate from and occur under the influence of the physically and socially meaningful ecology (or ecologies) in which they are embedded

The theories presented above map out a path through situated and sociocultural theories of computer use and learning – and it is worth emphasising that these two sets of approach are largely compatible, with situated theories tending to move from a focus on activity outwards to culture, and sociocultural theories tending to move from a focus on culture inwards to mediated activity. This is not a particularly meaningful distinction, conceptually speaking, but it does account for the slight differences in focus evident between these traditions.

Models such as Activity Theory and Embodied Interaction encourage the simultaneous study and understanding of culture, individual and tool, and from these this thesis carries forward the message that neither culture, nor individual nor tool should be studied in isolation, with the effect of each on the other mapped and taken into account. The term 'ecological' has been drawn upon in particular to highlight the combination of physical and social factors in constructing the world of homework.

Understanding of this ecology can be achieved through study of the everyday activities of humans and their subjective reports of the meaning of these activities

The meaning of the activities for actors defines and shapes what they do, and this has important consequences for the study of homework activities. Firstly, it is important to investigate the subjective worldview of the stakeholders in the homework process. Secondly, as homework takes place across two ecologies – the home and the school – it is important to investigate both settings, and to acknowledge that the practices of homework – and the children involved in both settings – will be affected by two separate cultural influences.

From situated theories and Activity Theory this thesis draws the idea that the study of everyday activities is essential to understanding behaviour. However, it does not solely concentrate on the observation of activity alone, drawing on ethnographic style explanations of the meaning of these activities in the culture as a whole to discover which aspects are important to stakeholders.

Activities are mediated by tools, or technologies, which themselves form a culturally meaningful part of this ecology

Lastly, in a study of homework technologies, it is important to highlight the role of the tools, or technologies. As asserted above, these cannot be understood in isolation from the individuals using them, or the culture which produces them. This thesis is unusual in that it studies technologies which are not yet in use in homework, but as seen in Chapter 1, they are technologies which have been suggested by educational policy makers, and therefore have a root in the broader cultural setting.

One convention that will be followed in this thesis regarding the view of technologies as tools is to refer to all tools used within the ecology as technologies. For example, Crabtree et al. (2002, p.268) stated “we construe technology in the broad sense of the word to include such things as the humble pen and paper, tables, notice boards, windows and doors etc., as well as sophisticated computing systems”. There are two main advantages to applying this term so broadly. Firstly, as Venkatesh and Nicosia (1997) noted, it is only in understanding the way families relate to a range of ‘technologies’ in the home that a subset of them can be understood. Secondly, using shared terminology – ‘technology’ – to refer to traditional and modern tools encourages comparison of the advantages and disadvantages of traditional and new technologies on a level playing field. This tactic can be seen used throughout the thesis and particularly in the consideration of ‘traditional’ and PC-based homework activities in Chapter 5.

2.3.1 Theory into methodology

The ecological approach taken in the thesis can be seen reflected in the layout of the empirical chapters, which move from a broad examination of the kind of activities which children might be involved in, and the culture in which those activities are sited, to a more in-depth study of those activities as they happen in everyday life. A large number of activity-focused studies commence with a tight focus on a small number of participants, allowing an in-depth understanding of everyday practice and activity. However, this thesis aims to map out the school and home ecologies in the UK, and requires evidence that homework activities share similar properties at a broad-brush level in more than the families studied in detail to support some claim for generalisability. Chapters 3 and 4 therefore present some survey-type data about use of homework technologies alongside their investigation of the ecologies of school and home, whereas Chapters 5, 6 and 7 are more concerned with a narrow focus on the activities and meanings of homework within the ecology of the home, and how these might be affected by technology use.

The questionnaire / interview study, to be presented in Chapter 3, investigated the school ecology with two main goals. The first was to provide evidence for the emergence of networked homework technologies in homework. The second was to investigate the meaning of homework technologies within the school ecology, specifically their meaning for teachers. Two main methods were chosen to accomplish this. A questionnaire was chosen to gather data about the current use of technologies in schools, to get an idea of how teachers felt about homework and its place across the home and school ecologies, and, pragmatically, to obtain contacts for the interview stage. The questionnaire began with a brief quantitative section, obtaining figures about technology uptake, and then some free response boxes asking about homework and home-school contact.

The discussion groups were designed to collect data about the kinds of activity which homework included, including family members involved in homework, the technologies which currently mediate homework, and the role of family members in homework. They provide some understanding of the cultural prevalence of certain kinds of activity: confirming the wider penetration of the technologies seen in use in the video diaries of Chapter 5. The discussion groups also provide an understanding of how children navigate the home ecology in their homework activity: which resources they draw upon, and how they see them. As this study took place within the school ecology, but focused on the home, it allowed the children to compare their activities from the perspective of the shared ecology of the school, and is therefore useful in establishing similarities and differences of approach.

As mentioned above, design ethnography avoids participant observation as a method because of its intrusiveness. To make this possible, other methods of observing activity within the home have been developed. Video diaries are the first 'design ethnography' method used in the thesis. They originated with Morrison et al. (2000) who set up fixed cameras to produce video recordings of everyday household activity. Crabtree et al. (2001) have used a similar approach, but with participants asked to film mail travelling through their home. The research presented in Chapter 5 used a similar format to the Crabtree et al. study, with video cameras provided for families to record their homework activities. This meant that the boundaries of the homework activities could be specified by the families themselves, avoiding the difficulty of having to locate the end points within a constant recording, and also alleviated some of the ethical problems of recording in the home, which will be discussed below. In terms of the theoretical stance of the thesis, the goal of these diaries is to be able to directly view the process of mediation in genuine homework activities. The study of mediation was achieved by the categorisation of homework activities into loosely defined types of homework activity – open and closed work – with the main focus of this study being how successful technologies were in mediating these different styles of working. In addition, the actual process of mediation will be studied in detail, looking at how the physical and social cues offered by technologies can affect the execution of a homework activity.

The final two studies, presented in Chapters 6 and 7, used technology probe studies as inspiration. These again are design ethnography influenced techniques. Alongside video methods ethnography has used less direct techniques to find out about everyday life in the home. These have included primarily informal home-based interviews, (Blythe & Monk, 2002; Dalsgaard et al., 2006; Forlizzi & DiSalvo, 2006; Mateas et al., 1996; Rode et al., 2004; Taylor & Swan, 2004, 2005; Vetere et al., 2005, Westerlund et al., 2003) but also taking of fieldnotes during tours or participation in easily shareable family activities such as meals (Blythe & Monk, 2002; Mateas et al., 1996; O'Brien & Rodden, 1997; O'Brien et al., 1999; Taylor & Swan, 2005) and the collection and photography of domestic artefacts (Taylor & Swan, 2004, 2005). One method specific to the home is the cultural probes method. Gaver et al. (1999) introduced these kits of disposable cameras, postcards, maps etc. which attempted to elicit information about the families' cultural values in a way that reflected the 'ludic' nature of the home, asking them to perform playful and abstract tasks, such as taking photos of 'your most private object'. Similarly Hutchinson et al. (2003) used technology probes, technologies which are reasonably open-ended and simple in function, and easy to implement, but suggest the kind of links and functions that a fully implemented technology might include, to find out how domestic culture adapts to new technologies.

The lab visit, which will be detailed in Chapter 6, used a combination of interviews and technology probes to find out how families reacted to the idea of networked technologies within the domestic ecology. Although this study took place inside a research space at the university, the focus was on the home ecology of the families. Conducting the study outside the family's homes served two purposes. The first was to remove the families to a 'futuristic' environment: to allow both the set up of technologies which could not be transported into the home, and to encourage the family to see the demonstrators as something new and exciting. However, the study also fitted nicely with the idea of ethnographic researchers as 'guests' within the family homes which has been used to establish rapport between researchers and participants. The researcher visited the families initially, then the families were invited to a reciprocal visit to the researcher's 'home' before the research moved out to their homes again. More about the benefits of this 'guest' metaphor will be discussed in the ethics section.

Finally, Chapter 7 will describe a study employing technology probes within the home ecologies of the families consulted in Chapter 6. The technology probe study tested the design solutions identified for technologies mediating homework activities both face-to-face and across a network, to see how these operate within the home ecology. The goal was to see whether and how families used these technologies in their homes, and what new issues using the technologies to mediate genuine homework activities within genuine homes generated.

2.4 Previous studies relevant to homework

Although there are no previous studies looking at the design of technologies for homework in general, some relevant research can be found. This thesis is based on work conducted in the UK, and as this work is using a cultural focus it makes sense to focus on work from cultures likely to be relevant. Therefore the majority of these studies are taken from UK research. Although no study tackles the complete picture of the ecology(ies) of homework relevant to this thesis, each has a contribution to make to understanding part of it and giving this research a platform of knowledge to work from.

2.4.1 Homework and community

The activity of homework is not thoroughly understood. Considering its central part in schooling, it is interesting to note that the jury is still out on whether homework even improves learning: extensive studies and reviews by Cooper et al. (1989), Cooper and Valentine (2001) and Trautwein and Köller (2003) found evidence for both success and failure of homework across the literature. In an extensive review of the homework literature Cowan and Hallam (1999) identified societal / cultural factors, student characteristics, school factors, home factors, nature of the task, presentation of the task, and the homework process as variables which can influence effectiveness. However, as yet, no comprehensive model has established the relative contributions of these factors or empirically investigated relationships between all these elements, explaining why such a varied picture of homework success has emerged. Certainly, understanding homework's place within the ecology of home can help understand the relationship between these factors in more detail, but is unlikely to improve learning directly.

However, there have been convincing arguments offered for the role of homework beyond learning gains. Cowan and Hallam (1999) included the development of generic skills, particularly the development of independent learning skills as a core outcome. Hughes (2001), in a sociocultural investigation of UK homework, found that parents and head teachers valued the development of independent learning skills as a major homework outcome. Independent learning skills were strongly related to the autonomy and increased empowerment for children that networked lifelong learning systems are supposed to encourage, and take advantage of the opportunity children have to study on their own in homework – as they are working away from school. On the other hand, other homework outcomes take advantage of the community of the home. Cowan and Hallam identified several outcomes related to family involvement – better home-school liaison, encouragement of within-family communication, and improved school image and resources might be expected to be positive influences on the child's development through non-academic means. As discussed above, the involvement of the community in a child's learning can therefore be direct, impacting on the learning itself – as in the Zone of Proximal development (ZPD) model – or indirect, through their participation in a wider community of schooled adults – as in the legitimate peripheral participation model.

The majority of work into the role of the community in homework has focused on direct involvement in homework activity, particularly on the part of parents. Hoover-Dempsey et al. (2001) provided an international review of parents' homework motivations, activities and the positive effects of their involvement. They noted that better home-school liaison, encouragement of within-family communication, and improved school image and resources have all been attributed to greater parental involvement in a range of empirical studies (Balli et al., 1998; Cooper, 1989, Ekstrom, 1986; Hoover-Dempsey et al., 2001; Hughes et al., 2003; Levin et al., 1997) and policy documents produced by the UK government (Department for Education and Skills, 1998, 2003). However, rhetoric (Bempechat, 2004; Cooper, 1989; Coutts, 2004), empirical studies (Hong, 2001; Hong & Milgram, 1999; Hong et al., 2004; Xu, 2006; Xu & Corno, 2006) and even the same policy documents (Department for Education and Skills, 1998) also emphasised the benefits children could gain by taking responsibility for their own work. There need not be a conflict between independent and facilitated learning, as Crook (1987), Livingstone and Bovill (2001) and Wertsch and Tulviste (1996) all point out in other contexts, it may just be necessary for different styles of work to be encouraged at different times. Hughes (2001) found a mix of these different types of activity in his study of homework in the UK, with a fifth of children stating that they had received family help on the specific tasks investigated. However, 'family help' is not necessarily easy to define – Chapter 5 will demonstrate that involvement is not always so immersive that children may be aware of it, or consider to have received significant help.

The ecological focus of this thesis demands a broader definition of community impact on learning than 'involvement', however, and it is not appropriate to assume that parents who are not directly providing help to their children are not fully involved in shaping the meaning of the homework activity for those children. As part of the community in which homework takes place, parents are likely to convey their views on the importance of homework, which can affect motivation and can be instrumental in deciding the parameters of the activity which the child engages in, such as its timing and structure.

The relevance of an ecological approach to understanding the home for homework can be seen in the interactions between these social aspects of the home and its physical aspects. Both Hughes (2002; Hughes & Greenhough, 2003a, 2003b) and a survey by MacBeath and Turner (1990) identified the bedroom and public 'family' rooms – the kitchen or sitting room in MacBeath and Turner's work – as the two locations in which homework usually took place. Hughes found that the bedroom was generally preferred, but that parental involvement was far better supported in family rooms. However, the role of the parent in ensuring that quiet places are available to study is also important, with some reports suggesting that these areas are not always available (Students 'lacking homework space', 2006). Within the ecology of the home, therefore, it appears that there are certain ecological niches which are appropriate for study, and this thesis will further explore the meaning of these niches for those involved in homework. The likelihood is that both the bedroom and family rooms offer beneficial areas for study, but it seems unlikely that the private bedroom and public family areas offer the same benefits. Looking at the use of technology in the home might help understand this further.

2.4.2 Technology in homework and the home

There is also evidence that technologies are integrated into the home ecology in a similar way to homework activities, particularly from work on the personal computer, and its place in the home. The two-year UK-based 'ScreenPlay' project looking at computer use in the home (Facer et al., 2003) found that parents' views on the computer, and the roles they take in relation to the computer were explicitly linked to their choice of its location. Parents saw the computer in three ways: ‘for children’, ‘an interloper’, or as ‘the heart of the home’. When the computer was viewed as an interloper it was located in areas where it could be monitored, or access could be restricted. When it was viewed as the children’s machine, it was placed in the bedroom, or other ‘child room’, with parents more or less abdicating responsibility for it. When viewed as the heart of the home it was assigned to areas where all could access it, or areas that became used for universal access as a result of the positioning of the PC. Kerawalla and Crook (2002) analysed parents’ rationales for choosing computer locations, and found choices fell on two main dimensions. Computer locations could be central – easily accessible to all, and highly visible – or peripheral – inconspicuous for security and aesthetic reasons, and encouraging respect for it as a tool. They could also be public – encouraging interaction and supervision – or private – allowing the user and the rest of the family to work with a lack of distraction. These factors showed two kinds of reason behind location choice, physical access and privacy, which were more conflated in the dimensions seen in the ScreenPlay study. The ScreenPlay survey found that 53% of home computers were located in family spaces and 43% in bedrooms, a dichotomy echoed by Holloway and Valentine (2001). This split between bedroom and family room is similar to that seen in the location of homework activities above and therefore the choice of location of homework and of the computer might be driven by similar considerations of traffic around the home. Chapters 4 and 5 will look into this relationship between location and activity further, and also explore the possibility of using mobile and ubicomp technologies to allow more flexibility.

Mobile technologies have been investigated in homework, but not to a great extent. The 'HomeWork' project (Luckin, 2006) was based on a tablet PC, allowing children to carry their work around many locations, and in this way it avoided many of the limitations that might have been faced by a static technology, although as it was focused on a limited age group and single homework topic, it cannot really reveal a lot about the interaction between this choice of homework technology and the ecology which can be applied to homework more generally. Certain locations are both socially and physically (in terms of plug points and surfaces etc.) advantageous, regardless of the mobility of a technology. Woodruff et al. (2007) looked at laptop use in the domestic and showed that users chose locations which were either open to the involvement of other family members or closed to their involvement. Similar terms will be used in this thesis. However, Woodruff et al. used these dimensions to describe locations that supported a style of work (or play) rather than the style of work itself. In their study, families chose locations for laptop use based on their need to interact, however, families still preferred to use the laptop near a plug socket where it could be charged. What is more, while the desktop was more likely to be located at ergonomic workstations such as desks, and while the laptop could be used in more relaxed spaces, there were still families and occasions where use of a 'proper' ergonomic workspace for a mobile technology like the laptop was preferred. This illustrates that mobility does not always mean ultimate flexibility of location, and that finding an appropriate niche for homework activity within the home ecology cannot simply be achieved through mobility.

Properties of the ecology – both physical and social – do not just influence the location of technology use. Research into computer use in families has found evidence for many direct social constraints as well. The ‘ScreenPlay’ project (Facer et al., 2003) discovered that parents established rules to allow access to the PC, based on equal use between children, time limits, or the type of activity that children were planning – specifically, and interestingly for this project, homework was identified as the greatest priority. Kerawalla and Crook (2005) also discovered rules for PC use, and found that rotas and age-based systems were used to control order of use. Again, a particularly interesting rule established priority for educational use against limited recreational use. Similar rule-sets were found in Australia by Downes (2000).

As mentioned in connection with the methodology, many studies have looked at ‘domestic design’ – the development of technologies for the home, and this is an area in which study of the ecology of the home as a holistic concept is better established. Gaver (2001; 1999) developed the idea of the home as a ‘ludic’ space: an ecology in which the idea of play is emphasised. This term was used to emphasise the contrast between the office contexts for which technologies had been previously developed, and the new challenges posed by the home context. The idea that different aspects of technology design need to be emphasised in the home has been taken up in research projects. The ‘interLiving’ project (Westerlund et al., 2001, 2003; Hutchinson et al., 2003) studied the support of intimacy in the home based on similar ideas: supporting the emotional side of home life. The ludic approach has been used to develop new methods of looking at the home and its ideas have been embraced by a wide range of design studies focusing on unique family concerns, such as intimacy, interactions between loved ones and communities, and the elderly (Bell, 2004; Dalsgaard et al., 2006; Mynatt et al., 2001; Van Rompaey et al., 2005; Vetere et al., 2005; Westerlund et al., 2001, 2003), or entertainment and service devices (Beckmann et al., 2004;

Blythe & Monk, 2002; Forlizzi & DiSalvo, 2006; O'Brien et al., 1999). This has proved successful in moving the study of the home away from methods established in the workplace, but has also meant that the domestic design literature has tended to be very inwardly focused, looking at what can be done in the home, for the home. This thesis is therefore somewhat unusual in trying to take some of these themes and apply them to technologies which cross ecologies.

Some approaches in the domestic design area have taken a more specific lens to understanding the home. The 'Equator' project's domestic strand looked at the development of novel technologies, starting with Gaver's idea of ludic design. However, it also drew from architectural backgrounds, looking at the repeated social interactions and behavioural patterns of everyday life seen within the home (Crabtree et al., 2002): an approach based on the pattern language work of Alexander (1977) which looked at the typical behaviours of people at citywide to domestic scale, and how architectural design could take inspiration from these patterns. The architecturally-influenced description of the home that is particularly relevant to this thesis, however, is that of ecological habitats and activity centres (Crabtree & Rodden, 2004). Crabtree and Rodden described patterns in the way technologies are used within the home. Ecological habitats were identified as the places where technologies (and other artefacts and media) live, and activity centres as the area where they are used. The Equator project found merit in distinguishing between where technologies were kept, and placed, and where they were actually put into use, an idea which will be drawn upon in Chapter 7. Together, these ways of understanding the ecology of the home, specifically developed for the home, provide a starting point for the work of this thesis, moving from the idea of specific 'places' within the home, or ecological niches, to the idea of how technology is actually used – the structure of activities – within these culturally meaningful niches.

This gives a picture of what is known about technology use in the home ecology. However, this thesis is concerned with links between the home and school ecologies: what Bronfenbrenner (1979) calls the 'mesosystem'. Research into current home-school technology used suggests that this is a less well developed area. The 'ICT and Home-school Links' project (BECTA, 2001; Lewin et al., 2003; Somekh et al., 2003) looked at the ways in which schools were linking to children's homes. It identified six categories of technology which could link home and school: electronic communication (such as email), a 'basic' school website (e.g. providing information about the school or homework tasks), a resource-rich / interactive school website, online learning, ICT loan schemes, and finally local / digital television (BECTA, 2001). These categories overlap convincingly with the systems which ICT coordinators mentioned in interviews in this research. In terms of the networks that this project focuses on, uptake was low in 2001: the 'Home-school Links' report showed odd case studies of schools using e-mail and websites, and around 25 schools with dedicated home-school computer networks allowing some transfer of files and linking to school from home.

The limited uptake seen in the 'Home-school Links project' was among schools with high ICT use, and frequently advantaged socio-economic profiles. However, the authors stated that "the roll out of networked technologies in the UK educational system had not yet led to radical reform; rather, it indicated an educational system in transition" (Lewin et al., 2003, p.33). Use was rather more developed among secondary schools, with 83% of schools having a school website, but only 27% of providing access to an intranet from home, and under half of these actively encouraging use students to use the system. Other technologies were in use, such as digital television, and 23% of schools making laptops available to some of their students. All these schemes were fairly new, however, with the authors referring to "the initial experiences of early adopters of technology" (Lewin et al., 2003, p.45) rather than established systems. Even more up-to-date reports suggested that such facilities were emerging slowly, with a DfES paper from 2005 finding that home-school links were still poorly developed (Valentine et al., 2005). The DfES paper showed that only 10% of pupils visited websites frequently, and over 50% had never used them, often because websites were uninteresting or inappropriate for homework use. Only one of the schools investigated by Valentine et al. maintained a school intranet that could be accessed by children. Altogether, reports into ICT use gave a picture of limited ICT uptake and use.

One common explanation suggested for low uptake of home-school ICT is the 'digital divide' – the gap between the 'have's and 'have not's in technology use. The character of the digital divide in the UK was illustrated by the 'UK Children Go Online' (UKCGO) project, a two-year research project begun in 2003 (Livingstone and Bober, 2005). This looked at use of the Internet for 9 to 19 year-olds, involving a face-to-face survey with 1511 children and 906 parents. Of those studied, 75% of children had accessed the Internet from a computer at home. However, the total access figure was split by class, 88% of children had accessed the Internet from home among the middle class and this figure fell to 66% among working class children.

Information and Communication Technologies (ICTs) have been promoted for their ability to improve inclusion in schoolwork. However, if only more advantaged socio-economic groups are able to afford any, or high quality, ICT, it merely increases benefits for the already advantaged. Prior work related to the 'UKCGO' project (Livingstone and Bovill, 2001) found that it was not just the financial inability to afford technologies that produced inequity, but that cultural capital – education and knowledge – and social capital – social support – which facilitated their uptake and use, were strongest among those from advantaged socio-economic groups. Lewin et al. (2003) noted that the best practice examples of home-school links through ICT were successful because parents' priorities matched with the schools' priorities – again, a situation more likely to arise in educationally-focused groups. Valentine et al. (2005) provided particular evidence that inequalities could be exacerbated through ICT use, noting that those children who owned computers at home were also the most likely to use computers in other locations. This suggests that socio-economic status is likely to impact strongly on the feasibility and success of any attempt to support homework with technologies.

However, the 'Already at a disadvantage?' project conducted by McPake et al. (2005) looked into these assumptions and questioned the helpfulness of assuming that ownership of technology was an all-or-nothing state, a divide between the 'have's and the 'have not's. Their survey data of families with diverse socio-economic profiles from nurseries in central Scotland suggested that access to technologies was not as limited as the concept of the divide suggested: all respondents possessed televisions, video players, and CD or cassette players; four fifths owned mobile phones and computers. Meanwhile, possession of televisions, DVDs, digital cameras and games consoles, amongst other ICTs, were unrelated to income. Although disadvantaged families were likely to be less educated and have less experience with ICT, many were enthusiastic users, and either possessed or had access to high levels of technical knowledge through their community. Furthermore, the researchers concluded that it was far easier to separate the cultural differences between the parents of advantaged and disadvantaged families than the children of these groups.

More detailed taxonomies suggest that there are layers of complexity to the division between socio-economic strata. DiMaggio and Harittai (2001) split the divide into five levels of inequality: in technical apparatus, autonomy of use, skill, social support and purpose of use. Longley et al. (2006) produced a detailed taxonomy of user types, splitting citizens into eight major types of household: the e-unengaged through to e-experts. These categories were applied to adult residents – looking at the interactions between their age, employment and technology use – and are therefore inappropriate for understanding the digital divide in children. However, they still illustrate that the division is far more nuanced than it at first appears.

In addition there is evidence that the digital divide is far less evident among families with children than society as a whole. The ‘UKCGO’ report (Livingstone and Bober, 2005) stated that the majority of children used the computer for homework and 90% of high Internet users (those who used the Internet every day or every week, 84% of the total children) used the PC for work or college, marginally below the 94% that used the PC for any other purpose. The ‘ImpaCT2’ study of technology use and its impact on school outcomes found 90% of children had access to a PC, and 75% access to the Internet (Harrison et al., 2002); however, National Statistics figures at this stage showed only 46% Internet access in the general population (National Statistics, 2006). Meanwhile, in more recent studies Livingstone and Bober (2005) gave figures of 87% overall computer ownership and 71% Internet access and Valentine et al. (2005) gave computer ownership at 89% of families. However, even recent figures from the National Statistics Office (National Statistics, 2006) gave only 57% Internet connectivity in the UK population as a whole. There is evidence that part of the high uptake of ICT among families occurs because educational rhetoric has proved a useful device for selling computers over time (Buckingham et al., 2001; Selwyn, 2002). However, regardless of its origin, the important point to take away is that the digital divide is less obvious in the population this thesis studies than in the UK population as a whole. This makes arguments for its centrality in low uptake of home-school links unconvincing. The Livingstone and Bober (2005) and Valentine et al. (2005) study ran at similar times but found 75% Internet access and 50% school website use: another explanation is need for the lack of use of these websites. Part of the reason for this is doubtless poor website build and content, but this thesis will also explore the idea that a mismatch between home and school ideas of what information should look like, and how it should be shared, is partly responsible, and will certainly become more important as home-school computer networks become more pervasive. This thesis holds that an understanding of the whole ecology of the home, and the relationships between home and school, might allow for better understanding of the reluctance to link home and school.

Generally, these studies form a background to the research presented here. In some cases this background is pragmatic and acknowledged, where particular frameworks or findings are used or used for inspiration. However, more broadly they provide an understanding of the interdisciplinary research agenda into which this thesis fits.

2.5 Ethics

Finally, when working closely with families, and children in particular, it is important to ensure that an ethical stance is taken towards research, and the collection of data. Both educational and domestic settings are notoriously sensitive for study, and the primary difficulties of study in these areas will be discussed below.

In education, there are two major aspects of ethics for schools and educational researchers to consider. The first is the danger that the process of studying children's learning and development might affect the process of development itself. In the majority of educational technology studies in the real world context, the introduction of new technologies is seen as a danger as it may affect the amount that children learn. On one hand there is the danger that a new technology may not teach the children as well as the old one – that there will be some kind of negative impact on their learning. On the other hand there is the danger that the new technology will be so successful that denying access to it for other children leaves those not under study at a disadvantage. However, when technologies were provided to children in this research, in the technology probe trial in Chapter 7, they were not associated with a new pedagogy, and were specifically chosen as technologies which were available to purchase. In normal homework, the mediators of the homework activity are varied and chosen by children based on appropriateness and availability. Although the concept of the digital divide records how socio-economic disparity can leave some children at a disadvantage, it was not felt that the children in this study were given advantages outside the usual range of advantage / disadvantage within homework, nor were the use of these devices of long-term advantage to them, given the one week length of the technology trial.

The second aspect of educational ethics to consider is the responsibility towards children as social citizens. Schools are considered *in loco parentis* and, as such, have to take on the role of a responsible parent, looking after the concerns of the child. For schools, this primarily involves a consideration for children's safety, and therefore a series of practical steps were carried out: obtaining consent and Criminal Records Bureau (CRB) clearance, and compliance with the BERA (British Educational Research Authority) Ethical Guidelines for Educational Research (BERA, 2004), described further below. In addition, a broader approach to responsibility towards the children was taken, hoping to ensure their appropriate representation and empowerment in the work. In particular, it was felt that given the importance placed on the meaning of the activities for all stakeholders, children included, it was compulsory to treat children as independent agents. This reflects Thomas and O'Kane (1998)'s comment that reliability, validity and ethical acceptability of such research is improved when children have control over research, and when the methods that are used are in tune with the way they see the world. Practically, this was managed by asking children for their own consent for participation, by using semi-structured discussion which allowed them to control the direction of conversation, and by giving them control of the right to withdraw from the study.

The domestic, as this thesis will highlight, is a private setting, and one where external scrutiny needs to be sensitive. Research within the domestic context, as highlighted above, takes place in this thesis using design ethnography methodologies, and these have been specifically derived to take account of some of the difficulties of domestic study. As Morrison et al. (2000) noted a traditional ethnographic approach of direct observation or participation is entirely inappropriate for the world of the home. However, the alternative they suggest, static video cameras, also seemed too intrusive, especially as homework often takes place in rooms such as the bedroom. This is not only an area in which it would be generally inappropriate to film, for decency, but also a particular private and sacred area for teenagers and pre-teens (see James, 2001, for example). The use of video diaries in Chapter 5 was a direct attempt to allow children and their families control over the access of the researcher to areas such as these.

The other side of conducting research in the home, however, is it is a far less formal and structured setting than the school, with far fewer members of the community to be consulted about access. Research with children inside a school necessitates consideration of the safety of a wide number of children, but also of the views of an equally large number of parents, to be taken into account by both researchers, and the teachers who may be acting *in loco parentis*. This should not be taking as saying that negotiation of access and boundaries within the family is not extremely delicate. However, negotiation can be conducted on a more individual basis with the family members, and, particularly in small samples such as used in the later studies of this thesis, can lead to a more tailored approach to respecting the privacy and wishes of the individual family. While it would be unsuitable for researchers to behave as friends of the family, the introduction of researchers into the domestic environment can be seen as analogous to a home visit from acquaintances and appropriate and inappropriate behaviour can be estimated using the host-guest metaphor: such as the impropriety of investigating rooms in the house without a direct invite. Many domestic design studies have found this metaphor useful, for example, by starting the process of research with the researchers turning up with pizza as a ‘getting to know you’ exercise which encourages informal communication, as with family friends arriving for dinner (Brush and Inkpen, 2007; Frohlich et al., 2001, Mateas et al., 1996). However, a further advantage of the host-guest metaphor is that it places the host in a position of power, meaning that the family can maintain control of the situation.

Generally, in research with children, Morrow and Richard (1996, p.98) note that the biggest challenge is “the disparities in power and status between adults and children” with Thomas and O’Kane (1998) developing this to emphasise that it is not just the power balance between child and researcher that is a potential issue, but the power balance between the child and important adults within their own lives. This research addresses the child-adult power balance in two different ways. In order to minimise the power balance between child and researcher attempts were made to equalise the relationships involved: for example, the discussion groups in Chapter 4 spoke to children within groups of their peers, and some of the discussion about the technology probes in Chapter 7 was conducted one-on-one. Similarly, every effort was made to make the discussions as informal as possible, and to emphasise that the concern of the project was with what homework was really like, rather than educational achievement. However, there was also an awareness, drawn from the ecological stance of this thesis, that the power relationship between children and significant adults within their lives was part of the situation under study. Therefore access to children came through both school and home, and it was accepted that understanding the child’s actions in these ecologies involved understanding their roles in these relationships. To try and remove 'biases' in child's responses based on these relationships completely therefore seemed unwise and illogical.

The practical side of these ethical considerations is unpacked further below. This research was undertaken in full compliance with the BERA (British Educational Research Authority) Ethical Guidelines for Educational Research (BERA, 2004). These procedures were also applied where work was carried out with teachers and parents. The following sections will cover how procedures were derived from BERA's 'Responsibilities to Participants' under their headings. In addition, further ethical steps taken in each study are outlined in each individual chapter: the exact sections are detailed at the end of this chapter.

Voluntary informed consent

Voluntary informed consent was obtained in all studies. For those studies conducted with teachers, participation was entirely voluntary, questionnaires and interviews were opt-in only, and every effort was made to make the aims of questions asked as transparent as possible.

A slightly different approach was taken with research with children. The ability of children to give informed consent has been debated across the research literature, and particularly in educational research (David et al., 2001). In order to ensure children were fully represented as active participants in their own development, and to ensure compatibility with the BERA guidelines, children were included in the consent process, informed of the aims of the research, and asked if they were willing to take part. This process was either directly undertaken by the researcher or parents were encouraged to discuss participation with their children. However, acknowledging the legal status of children as minors, official consent forms with parents' signatures were also obtained. Consent forms are attached in Appendix 4.A, 5.A and 6.C.

Right to withdraw

Participants – both adult and child – were also reminded at every phase of the research that they were allowed to withdraw at any time. Again, this right to withdraw was expressed formally on parental consent forms, and emphasised verbally in interactions with children. In addition, where participants were engaged in more than one phase of research, the option to opt out was made clear at each stage.

Special responsibilities applying to children

As an overall precaution researchers received Criminal Record Bureau (CRB) clearance prior to working with children. Specific procedures were also undertaken where sensitive interactions were possible, such as undertaking research in more 'public' areas of the school and home.

Incentives

No specific payment was given for participation in the studies. However, some incentives were available. These varied from the unintended – time out of lessons was seen as a major incentive for participating in discussion groups – to the more explicit – rewards for taking part in research, framed as a 'thank you' from the research team.

Privacy

All records were stored according to the Data Protection Act. Where particularly sensitive information was gathered – such as the video diaries discussed in Chapter 5

– specific sections of the consent form were dedicated to parents' preferences for the handling of information.

Ethnographic research, particularly as conducted within the family home as seen in Chapters 6 and 7, is a particularly challenging area in which to establish ethical procedures. A major principle of ethnography is that of participant observation, but participation in a family is more or less unachievable for an external researcher. No formal guidelines exist for balancing these needs. However, the primary rule observed in this research was that parents had ultimate authority in the process, and were looked to for approval of procedures and the setting of boundaries.

Disclosure

Only one study – the discussion groups outlined in Chapter 4 – was identified as a particular concern for disclosure, as these involved children discussing their home and school life frankly and without the presence of guardians. In all other studies involving children, their parents were nearby during discussions. The approach taken was that any sensitive information would be revealed to parents or teachers, as appropriate, although consultation with the child would be the first stage of this process, as recommended in Alderson (1995).

Feedback

Feedback to participants was seen as an important stage of the research. This took place through three major channels. Firstly, participants were contacted and thanked for their participation immediately after each study, with details of how analysis of data would proceed – this was done by email, phone call or letter, according to how the participants had made initial contact with the researcher. Secondly, participants were mailed a report of the research on its completion, with an overview of the entire research project summarised, in order to highlight major findings of the project. Thirdly, and perhaps most importantly, participants were given the address of an internet website for the project, which hosted information on its progress, and links to reports and other deliverables. In addition to these stages access to the final version of this thesis will be made available online for download through the University of Nottingham's eTheses Archive and details sent to all participants.

Further ethical procedures

As the studies conducted in Chapters 4 and 6/7 were of particular ethical concern, ethical approval for the research conducted in these chapters was obtained from the Department of Psychology at the University of Nottingham. Specific details of how the ethical principles and procedures were applied in each chapter is available in the ethical subsection in each chapter, and some of these areas will be discussed in further detail, as issues relate specifically to a particular method taken.

These details can be found in Sections 3.1.1, 4.2.2., 5.1.2. and 6.1.1 for their respective chapters, with the ethical details for Chapters 6 and 7 dealt with in Chapter 6.

3 The view from the school

This chapter will present the views of ICT coordinators, obtained by questionnaire and interview, identifying the ICTs schools use and plan to use in homework, and the major issues with using ICT for homework as perceived within the school ecology. It will serve two main purposes: justifying the concentration of this thesis on a particular type of homework technology – networked homework technologies – and starting to identify challenges for the integration of homework technologies in general. This chapter will therefore describe the most popular technology being introduced to manage homework – complex networks linking home and school – and discuss how clashes across these ecologies may play a large part in determining whether such technologies are welcomed into the home.

Previous research into the ICTs schools use has focused on best practice (e.g. Lewin et al., 2003; Valentine et al, 2005). This chapter will consider a wider picture of current ICT use in the questionnaires – gaining a picture of where schools currently are – and move on to the future of ICT use in the interviews – gaining a picture of where schools would like to be. This chapter will concentrate primarily on ICT use in homework – whereas most studies have taken a broader approach, studying a range of home-school connections. Both questionnaires and interviews will be used to investigate issues that ICT coordinators have faced or foresee facing.

This chapter will go some way towards presenting the opinions and attitudes of the school ecology. Later chapters will focus more on the home ecology, with this chapter only representing the organisational, school-based view of the important factors in homework, and the issues in implementing homework technologies.

3.1 Outline of Method

An initial questionnaire was used to obtain some general data on uptake across a range of schools, and also to recruit participants for follow-up interviews. The interviews were used to investigate the school side of homework in more detail than the questionnaires, and to explore the meanings assigned to homework technologies within the school. The questionnaire collected quantitative data about the types of technologies which schools currently used, and some comments about the difficulties and feedback they had encountered. The interviews collected opinions, experiences, and plans.

The teachers focused upon were ICT coordinators – chosen as the teachers most likely to have an impact on school ICT policy, the likely point of contact for parents who wished to discuss issues with technologies, and as experts in the everyday issues with technology use in homework. An exhaustive list of the 200 schools that had had previous contact with the Education Department at the University of Nottingham was sent the questionnaire, addressed to the 'Head of ICT' at the school's mailing address. This meant that a convenience sample was taken, covering mainly the

Midlands, with the addition of a handful of schools from other locations in England. Most schools in the Nottinghamshire and Derbyshire region were included, meaning that a reasonably diverse socio-economic profile was obtained. The interviews were conducted with six ICT coordinators taken primarily from schools which replied to the questionnaires. More details about the specific sampling strategies and participants for each stage can be found in the questionnaire and interview method sections.

3.1.1 Ethics

No ethical concerns beyond those identified as fundamental to this research in general were identified for either of these studies. However, as can be seen in the correspondence in Appendix 3.A: Letter and questionnaire to Heads of ICT, the aim of the research was made transparent to teachers and both the questionnaire and interviews were opt-in, with teachers only participating if they were willing / interested. Standard privacy and feedback were provided, as discussed in Chapter 2.

3.2 Questionnaires

The two studies will be presented separately, as each used different methods, and different, but overlapping, samples. The first was the questionnaire, which was used to gain an overall picture of the technologies which schools were currently using to support homework, and the issues ICT coordinators had faced.

3.2.1 Questionnaire Method

The questionnaire investigated a wide range of technologies used to support homework, and schools from a broad socio-economic base, in an attempt to provide a balance to the previous ‘best practice’ studies conducted in home-school ICT link research (e.g. Lewin et al., 2003; Valentine et al, 2005).

Participants

Of the 200 questionnaires sent out, N=39 ICT coordinators replied, making a 19.5% response rate. Full demographic details were not gathered, but among the 38 schools which gave details / identified themselves:

- Six schools were based in Nottingham City LEA (Local Educational Authority).
- Ten schools were based in Nottinghamshire LEA
- Four schools were based in Derby City LEA
- Six schools were based in Derbyshire LEA
- The remaining twelve schools were made up of ten spread across Lincolnshire, Coventry, Gloucestershire and Leicestershire LEAs in the Midlands area, and one each from Doncaster and Dartford LEAs in the north and south.

Two of the thirty-eight schools giving details were independently funded ‘private’ schools, employing a selective admissions policy; the remaining thirty-six schools were maintained by the LEA. Thirty-four of the LEA schools employed a non-selective admissions policy; the remaining two were a school providing for pupils with special educational needs, and a school with religious foundations.

Both the location and the type of school were therefore quite varied. The schools’ exam results also indicated a varied profile of respondents: the mean number of pupils obtaining five or more grades A* to C in the GCSE (General Certificate in Secondary Education) examinations was 58%, and the range was between 17 to 100% A* to C GCSEs.

Design

The questionnaire was designed to be quite quick to fill in, in order to encourage responses, and therefore consisted of two sides of A4. Each questionnaire was accompanied by a letter explaining briefly the background to the research, and a freepost return envelope for return. The questionnaire and letter can be found in full in Appendix 3.A: Letter and questionnaire to Heads of ICT.

The first section of two focused on current uses of ICT. ICT coordinators were asked to tick boxes indicating whether their school used each of the following technologies 'often' or 'sometimes', as appropriate, with no tick taken to indicate that these technologies were not used:

- Homework relying on online resources (e.g. Internet searching)
- Requiring computer processed work from students (e.g. word processed documents)
- Setting of homework involving external websites (e.g. SAM, BBC Bitesize)
- Setting of homework through an internal website (e.g. school webpage)
- Homework completed with school-owned or sponsored ICT resources (e.g. CDs, DVDs)
- Homework completed with other school-owned or sponsored equipment
- Submission of homework by email
- Submission of homework by portable media (e.g. CDs, floppy discs etc.)

- Homework completed with school-owned or sponsored laptops
- Other homework submission / setting / completion using ICT (please give examples below).

The technologies chosen reflected a multidisciplinary team's subject knowledge, experience of, and intuitions about the types of technologies commonly used in homework. The order of presentation reflects their intuitions about the likely frequency of use of these technologies, starting with general uses of the home PC, and moving towards more specific devices. This order was chosen in the hope that the majority of respondents would be able to tick a few initial boxes, motivating coordinators at schools with low ICT use to see the work as relevant, again to maximise the response rate. An additional section allowed respondents to add the details of any technologies not covered, in order to identify further uses of ICT in homework.

The second section focused on issues with using current and future homework technologies. Given the lack of research in this area so far, this section was formatted using freehand comment boxes to allow respondents to identify the issues they considered most important or salient. These asked:

- What barriers do you foresee or have you encountered in setting homework using ICT?
- How do you think parents would react / how have parents reacted to use of ICT in setting homework?

However, as the responses to the parental reaction question either overlapped with the barriers, or consisted of vague comments like ‘generally well’ only the barriers section will be included in analysis.

In addition to answering the questionnaire, ICT coordinators were asked to provide contact details if they were willing to participate further in the research – a selection of respondents who left contact details were followed up in the interview study, as will be described in the interview method.

Analysis

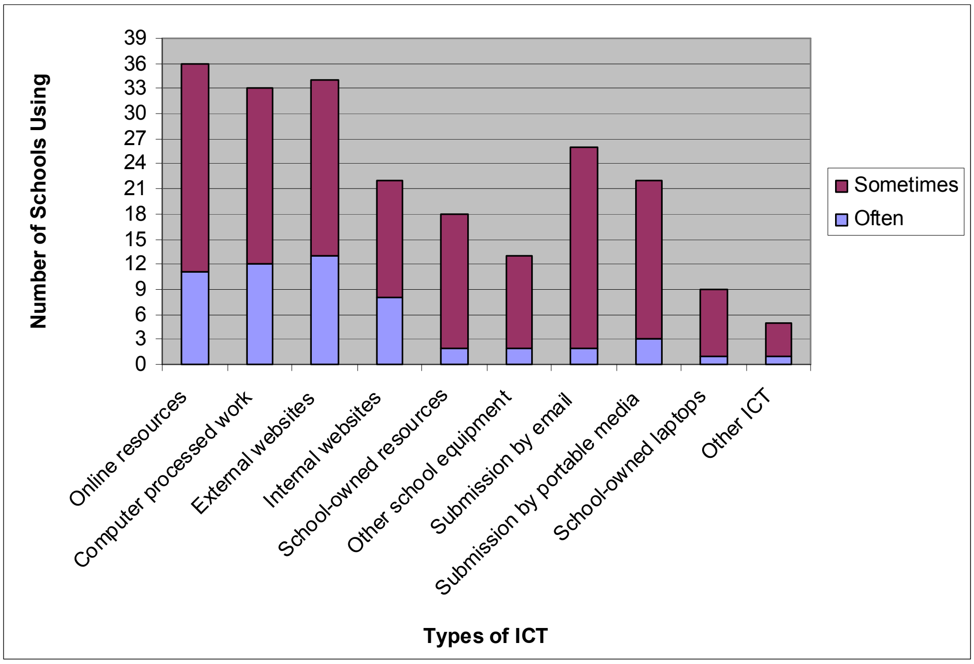
Simple descriptive statistics were used to present the quantitative data gathered in the questionnaire. Content analysis (Krippendorff, 2003) was used for the qualitative data: using the frequency of responses in well defined categories to give a basic idea of the relative importance of each theme to the coordinators. Each new barrier mentioned by the coordinators in the comments box was counted as a separate code-able instance, and every new barrier occurring in the set of responses was coded as a new theme. Finally, common themes were grouped together. Groupings were based on Mumtaz’s (2000) work on ICT use. Mumtaz’s study found that teachers identified three categories of barriers to ICT use in schools: resource barriers – areas in which provision of technologies by the school was lacking – institutional barriers – failures of the school as an institution – and teacher-based barriers – individual-level barriers for each teacher. These categories were used as a framework to allow the identification of issues which were unique to home-school ICT use, over and above the usual barriers teachers faced every day.

It should be noted that the categories revealed were not mutually exclusive: each teacher was free to mention more than one issue in each questionnaire section. The percentages represent the proportion of respondents mentioning each theme, so they total more than 100%. The categories were also not exhaustive: in fact, as will be seen, additional issues were uncovered in the interviews. However, the questionnaires did explore a larger population than possible in the interviews, and provide evidence that similar types of concern were held by ICT coordinators in general.

3.2.2 Which basic ICTs do schools use?

The responses of coordinators to the usage section of the questionnaire are given in Figure 3.2a. As can be seen, the majority of assumptions about the frequency of use of these types of ICT in homework were upheld: in other words, the most frequently used technologies were generally those mentioned towards the start of the questionnaire. However, there was a greater frequency of schools using submission by email or portable media such as CDs or floppy discs than expected.

Figure 3.2a. Showing frequency of ICT use across schools



The majority of technologies were used 'sometimes' rather than 'often'. Figure 3.2a shows that the pattern of frequent use was similar to, if at a different magnitude to, the pattern of occasional use. Only online resources, computer processed work, external websites and internal websites were used frequently in anything except a handful of schools. While it was possible that different schools interpreted 'sometimes' and 'often' in different ways, the general trend suggested that technologies were only to be used 'sometimes', probably reflecting concerns that not all students would be able to access resources.

Only five of the thirty-nine ICT coordinators indicated that they used other types of ICT in homework. These were:

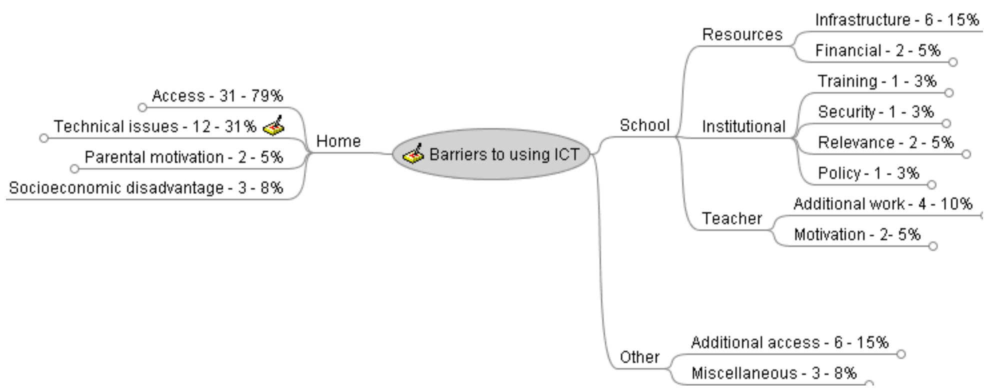
- submission of work via the school website
- access to the school network area from home
- two incidences of completion of online tests
- two instances of use of a virtual learning environment (VLE)

One teacher mentioned both network access and online tests, and it is interesting to note that all of these categories focused on networked connections provided by the school, suggesting that home-school computer networks were beginning to be used in practice.

3.2.3 What are the main issues schools face?

Following Mumtaz (2000)'s categories of schools' barriers to using ICT in general, the school-related barriers to ICT use in homework were first split into three categories: barriers through lack of resources; institutional barriers; and teacher-based barriers. However, analysis discovered a further four barriers to ICT use within the home, and a few additional comments, as shown in Figure 3.2b. A full diagram of responses by category can be seen in Appendix 3.B: Barriers.

Figure 3.2b. Showing barriers mentioned by ICT coordinators



The 'home' category contained a range of responses, which represented related but distinct themes around children's ability to use technologies. This 'home' category was, as can be clearly seen, the most common category mentioned, and consisted of the following themes:

- 79% of the coordinators mentioned pupils' access to technologies – whether or not they had and could use ICTs in their home. A high number of ICT coordinators independently mentioned this issue, and it accounted for almost half (31 out of 76) of the total number of comments.
- 31% of the coordinators mentioned technical issues – compatibility and reliability of systems, and the availability of software at home, again focusing on pragmatic issues.
- 8% of the coordinators raised the issue of socio-economic disadvantage – that they were limited in their ability to use ICT in homework because this could further disadvantage already disadvantaged groups. This suggested that the practical issues – whether access was available – were more salient for coordinators than the impact of the digital divide. However, it is possible that coordinators felt issues of socio-economic disadvantage were implicit in discussions of access.
- 5%, only two of the coordinators mentioned an additional barrier of parental motivation.

The home-based issues were separated into quite fine-grained categories, to investigate coordinators' particular views on the home ecology. The resource, institutional and teacher-based barriers were mentioned at much lower frequencies:

- 15% of coordinators mentioned the lack of an infrastructure to support homework.
- 10% mentioned the additional work that these innovations could involve.

- Several issues were mentioned by one (3%) or two (5%) ICT coordinators: a lack of financial resources, training, relevance of ICT use, good school policy, and teacher motivation.

As well as commenting on barriers, 15% of coordinators mentioned that they had put into place additional access procedures, in other words, were providing computer room access outside teaching hours for children in addition to any ICT resources they might have available at home. This further emphasised the importance of providing access.

From these results, it seems reasonable to conclude that ICT coordinators saw the availability of ICT in the home as the principal barrier to ICT use in homework. This chapter will go on to show that coordinators do recognise a wider set of difficulties around the implementation and use of ICT resources in homework. However, this survey showed that access was at the forefront of coordinators' minds.

3.3 *Interviews and Questionnaires*

In-depth interviews with a subset of the ICT coordinators followed this questionnaire. This section will present the findings from these interviews, alongside a comparison of the issues raised in the questionnaire and those raised in the interviews.

3.3.1 Interview Method

The interviews were used to explore issues at a greater depth than was possible in the questionnaire. The main aim of the interviews was to examine which technologies the ICT coordinators saw entering homework in the future, and to study the issues coordinators had experienced or anticipated in ICT use in homework.

Participants

As a primary concern of the interviews was to learn more about the future of ICT, schools were ranked in preference for interview based on their degree of ICT use. Ranking took place when only a proportion of the questionnaires had been returned, meaning preference was shown for respondents who replied quickly, who used high ICT (at least six types), and, for convenience, who were situated near to the University of Nottingham. Five of the twenty-five ICT coordinators who were willing to participate in interviews were identified as key respondents in this way, and interviews were arranged with these individuals.

As can be seen in Table 3.3a the schools (School A to School E) identified in this manner were predominantly from advantaged socio-economic groups, as judged by the percentage of free school meals available to pupils. It is not unusual for schools with this profile to be the highest users of ICT, however, in order to provide balance, a sixth school, School F, was recruited. This was a recently established Academy school in a less advantaged socio-economic area which had received considerable funding for the purchase of new technologies. This purposeful sampling did not necessarily identify a representative group, but meant that diverse schools and opinions were represented.

Table 3.3a. Showing ICT use and other background information on the Secondary Schools in which ICT coordinators were interviewed

School Name	Number of types of ICT used in questionnaire[1]	Year of Ofsted Report	School rating	Percentage of pupils qualifying for free school meals (age 11-16)
School A	9	2001	Very good	5%
School B	7	2001	Good and improving	4%
School C	8	2000	Very good	3%
School D	6	2004	Very effective	See note[2]
School E	8	See note[3]		0%
School F		2006	Satisfactory and improving	36%

As coordinators were self-selecting – both in returning the questionnaires and agreeing to the interviews – and because of the purposeful but limited sampling method chosen, discussion will focus on the implications of common themes that coordinators raised, rather than their typicality.

Design

A semi-structured interview was conducted with each coordinator. The interview had a conversational tone, and explored issues as they arose, making sure that three main areas were explored.

[1] This refers to the proportion of items selected as used 'sometimes' or 'never' in the questionnaire, as listed in the questionnaire method.
[2] A figure for free school meals could not be obtained from the Ofsted report or directly from the school. However, the report states "Pupils come from a broad range of socio-economic backgrounds but, broadly, these backgrounds are above average".
[3] School E is an independently funded school: pupils in such schools are not eligible for free school meals. It is vetted by the Independent Schools Inspectorate who note in their report that the school has "many strengths and no significant weaknesses".

The first area to be covered was current ICT use, with the interviewer asking coordinators about current systems to provide background understanding of the current school set up, using questions like:

- How do you use ICT in homework currently?
- Is ICT use in homework a coordinated school policy, or down to individual teachers?

The second area was future ICT use and their plans for their school in particular, with the interviewer asking questions like:

- Are there any areas you / your school would like to see ICT used in?
- How would you like to set up the school technologically?

Lastly, the interviewer explored the issues that coordinators had faced with homework technologies so far, with questions like:

- What are parental reactions to the use of ICT in homework like?
- What are child reactions like?
- How do home practices mesh with school ones?

In two of the six schools that took part (Schools C and F, see details below) the coordinators were keen to provide a tour of the school while the interview took place. In these cases, results are based on the interviewer's field notes of the conversation, rather than a full transcript. An example of a transcript response is available in

Appendix 3.C: Example interview transcript and a screenshot example of document coding can be seen in Appendix 3.D: Example NVivo screenshot of interview transcript.

Analysis

The analysis consisted of two stages. The first stage focused on the technologies which were being used, or were proposed for future use. Tables 3.3c to 3.3f show which schools indicated they were using which technologies, alongside a little qualitative information about the way the ICT coordinator planned to use each technology in each school. The technologies discussed in the interviews were based on the categories used in the questionnaire. However, the coordinators tended to group certain types of technology together, and so the original ten technologies were collapsed into five categories of technology, as shown in Table 3.3b.

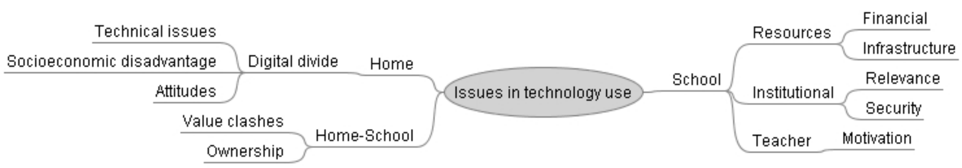
Table 3.3b. Showing the relationship between categories used in the questionnaire section and the interview section

General category	Questionnaire categories included
Basic uses of technology	Online resources Computer processed work
Enhanced websites and networks	External websites Internal websites
Mixed transfer systems	Submission by email Submission by portable media
School-owned resources	School-owned resources School-owned laptops Other school equipment
Other	Other ICT

Each interview was checked to see if the coordinators commented on their current use of, or their plans to use, each technology. The first section of the analysis will provide details of this usage, alongside quotes from the interviews which illustrate plans in more depth.

The second stage used a similar content analysis template to that described for the questionnaires in Section 3.2.3, using the Mumtaz (2000) classification scheme, and the home-related issues mentioned in the questionnaire as a framework. However, analysis of the interviews identified the need for an additional category to be added to this framework: home-school issues, issues which related specifically to the position of homework technologies across home and school as seen in Figure 3.3a.

Figure 3.3a. Showing issues mentioned by ICT coordinators interviewed



As with the technology types, these issues will also be discussed using quotes from the interviews to illustrate agreements and disagreements, and the presentation of different arguments within the interviews by different coordinators.

3.3.2 Which ICTs do schools use now and plan to use?

Each technology will be presented with a quick guide as to current and future plans for use in each of the schools, information about the differences between the questionnaire and the interview responses, some discussion of what the ICT coordinators said about each technology, and the major issues arising from the coordinators' discussion of each technology.

Online resources and computer-processed work

Online resources and computer-processed work were the two most often used technologies according to the questionnaire, each mentioned by at least 33 of the 39 respondents as ‘sometimes’ used in homework.

However, the interviews lacked any reference to these ‘basic’ uses of technology in homework. The coordinators were not prompted to discuss any particular technologies in the interviews, but to discuss their current and future plans in detail, so it seemed that neither of these core uses of ICT was important to their plans.

It is worth asking why such high use technologies were not mentioned in interviews. One possible explanation is the ubiquity of such systems: word processing and Internet search applications are available, as standard, on the majority of online PCs. To provide access to these, coordinators needed to make sure a child had access to a computer, but this was discussed as a wider issue.

External websites, internal websites, and beyond

External websites were also among the most popular technologies considered in the questionnaires, but this popularity was limited to only two schools in the interviews, as seen in Table 3.3c.

Table 3.3c. Showing external website uses

	Current uses	Future plans
Schools A & D	Subscriptions to two online systems with subject content and evaluation tools.	
Schools B C E & F	Not using any subscription-based services.	

The interviews suggested that the use of external websites indicated a less integrated approach to ICT use than internally developed sites. Schools A and D, which were using external websites as a core part of their homework delivery, were still happy with them:

> *"For staff, it's quite easy to say 'your homework is [commercial system], section plop plop plop' and you can post that on the website. We don't have to get involved in creating worksheets or video-links or weblinks onto our website, because we've got that, it really is reinventing the wheel…"*
>
> ***ICT Coordinator, School D.***

However, in School E, where the school website was well established, developing the school's own resources was preferred:

> *"Other schools are looking at the individual learning programmes, where students can log onto systems and use them. We've not been down that route as yet, we'll wait and see"*
>
> *"Is there any personal reason why?"*

"Erm, we think the teachers are important [laughs]. To be honest. And I'm afraid, with a lot of the online material, some of it is what you want and some of it isn't, like everything you haven't done yourself…"

***ICT Coordinator* and Interviewer, School E.**

The majority of schools were interested in the development of complex internal websites and content / access delivery systems, as will be seen. This suggested that these external websites might be a stop-gap until tailored systems could be developed. More tailored solutions were presented as the ultimate in homework support by these ICT coordinators, and featured on their wish lists.

In the interviews coordinators certainly seemed keen to go beyond simple internet use. The BECTA (2001) report into home-school links looked at two kinds of website: 'basic' and 'resource rich' sites. However, the interviews concerned even more complex types of homework support and delivery, as shown in Table 3.3d.

Table 3.3d. Showing internal website uses

	Current uses	**Future plans**
School A		Access to school filespace, marking through website.
School B		Access to school filespace, VLE (Virtual Learning Environment) maintained by school.
School C	Access to school filespace, file transfer, family login to website.	
School D		Access for students to school webspace from home.
School E	Access to school filespace and learning resources written by teachers.	
School F		Better integration of homework.

These systems, or home-school computer networks, allowed children to share and access school files easily, and provided simple access to quality information. At the time of interview, only schools C and E had such systems. However, the other schools were looking at providing varied but equivalent systems. The only exception to this was School F, where, as will be discussed in later sections, a need to get children online at all overshadowed such plans.

ICT coordinators' plans for these home-school networks were the most detailed, perhaps driven by the targets for implementing online learning systems by 2008 mentioned in Chapter 1. The ICT coordinator at School A discussed how such systems were at the centre of his ideal plans for developing their website:

> *"One of the basics that we'd like to be able to provide with the website is that students would be able to access all of their files in-school from home… also some kind of means for setting work… some form of electronic marking… we don't even have a website at the moment, but once it's built, I'd like to see it having that kind of functionality, rather than just being an information place where people can look up when the next inset days are…"*
>
> ***ICT Coordinator, School A.***

However, not every home-school network was imagined similarly. The ICT coordinator in School D, for example, preferred a web-based store of materials, rather than access to school stores from home:

"we want to provide kids with not only attachment facilities, but webspace, so that they can actually store significantly more... something like 10 MB of webspace to each user"

ICT Coordinator, School D

and the ICT coordinator in School B was more interested in providing a fully integrated technological package for children:

"What would our dream set up be? Every kid to have a laptop, a wireless connection, Internet access from home, a managed learning environment they could access from home, so that you could post materials onto that."

ICT Coordinator, School B.

The different technologies which could support similar goals gave vast choice. From the interviews it appeared that these choices were largely informed by personal preference: described as the personal dreams of the teacher, rather than the result of any nationwide strategy.

E-mail and portable media

Submission of homework by email and portable media were more common than expected in the questionnaire, used 'sometimes' by around half of the respondents. In the interviews, it became clear that there was pervasive use of these systems throughout homework, as seen in Table 3.3e.

Table 3.3e. Showing email and portable media uses

	Current uses	**Future plans**
School A	Individual staff use email for submission, children transfer files; floppy disks, CDs and USB pens, school selling USB pens.	
School B	Individual staff use email for submission, children transfer files; floppy disks (fading out), CDs and USB pens.	
School C	Children and staff have email accounts, send files according to individual preferences; any floppy disks checked by staff.	
School D	Children transfer files by email, floppy disks banned, no other system in place	Email accounts for staff, pupils and parents.
School E	Portable media and email are in use.	
School F	None mentioned.	

Email and portable media were used by children to send assignments to staff, but also to transfer information between home and school. This seemed to be an important homework support mechanism. However, use of email and portable media was patchy across all the schools. As shown in Table 3.3e, only a proportion of ICT coordinators accepted email, and a range of different portable media were used, encouraged, and discouraged in different schools.

Current practices were patchy and ad hoc: managed by individual pupils and teachers according to their individual needs and preferences. In many cases the coordinators presented these ad hoc solutions as stop-gap measures, to be used until the ‘proper’ systems were in place. However, such measures were also used in schools where home-school networks were already in use. It is possible they persisted due to their popularity, but likely that a flexible set of approaches could be used to surmount the different ICT set ups and needs of the children involved better than a one-fits-all solution.

School equipment

The final element from the questionnaires explored in the interviews was the use of school equipment in homework. Generally, there was a low use of school-owned laptops, resources and equipment in homework shown on the questionnaires. As can be seen in Table 3.3f, however, the only forms of school equipment mentioned in the interviews were computers. These were used to provide access for children who did not have resources available at home, and it is interesting to see that the provision of computers at school was mentioned by all the ICT coordinators as part of their ICT strategy, showing that it was viewed as important in addressing the digital divide.

Table 3.3f. Showing school equipment use

	Current use	**Future plans**
School A	Computers after school, lunchtimes.	Leasing
School B	Computers before & after school, lunchtimes.	Leasing
School C	Computers after school, lunchtimes.	
School D	Computers after school, lunchtimes.	
School E	Computers 8am to 5pm; laptops for children with learning support issues.	
School F	No in-school access, computers through local library after school.	Loans to children and allowing after school use, but experiencing difficulties in these.

Future plans revolved around families leasing PCs and / or laptops, or, in the case of School F, the possibility of loaning school equipment (each child had access to their own tablet PC in-school during school hours). These schemes seemed like a positive way of increasing access in an affordable manner, although it should be noted that only School E, which had the most advantaged students, was currently able to provide a scheme of laptop loans.

The problem with providing in-school access to computers for children was that a divide between ‘haves’ and ‘have-nots’ was still in place. Using computers to complete homework in school would mean that children were losing the opportunity to complete their homework within the home ecology. While in-school provision of ICT might seem like a step in the right direction, then, it still maintained the inequality of experience that constitutes the digital divide. The strategy of arranging leasing of technologies or a related solution mentioned by the ICT coordinator in School B – providing families with low-powered terminal computers which relied heavily on the schools’ servers to provide services – seemed like a much more egalitarian solution for children who had no home technology access.

Other: Television

Television was not discussed in the questionnaire, as its use in homework had not been encountered by the development team. However, the provision of learning content through digital television was mentioned by School F as a potential solution to some of the access problems they faced. School F was the only school looking into provision of homework through digital television, providing good evidence that some schools might require alternative homework technology solutions.

It is noticeable that School F, the school based in the most disadvantaged socio-economic area, seemed to be taking different approaches to ICT use than the other schools. Digital television was one such example. School F faced difficulties in implementing homework technology use due to low access levels, but was also unable to lend out school-owned technology because of fear of crime. However, after this study was conducted, a return to the school found them adopting a leasing system through a commercial provider. This showed that although School F might have to be more imaginative in its strategies for increasing ICT use, such schemes did have a place in disadvantaged communities. Therefore, although introducing technology into disadvantaged households was more of a challenge, it could be met.

The interviews therefore showed that schools were keen on introducing networked technologies into homework. ICT coordinators were keen to use computer-based networks to link home and school, and coordinators in schools which had advanced uses of technology wanted to develop their own catch-all systems. However, they were not always taking sensible steps to address the issue of access, and counteract the digital divide, instead providing poor quality in-school alternatives to ICT-based homework.

3.3.3 What other issues do schools encounter?

The questionnaire analysis suggested that the major issue ICT coordinators had encountered, or expected to encounter was children's access to technologies. In both the questionnaires and interviews coordinators indicated that they attempted to address this issue by providing computer resources in school. This thesis, however, is focused on homework, and providing in-school resources cannot support homework activities within the home – in fact it encourages children to do their homework at school, losing many of its benefits. In the interviews, the problem of access was raised again as a major difficulty, but further issues were also discussed.

School-based issues, as with the questionnaire, replicated those identified by the teachers in Mumtaz (2000)'s study of general ICT use in schools in introducing ICT in general. Therefore, the study of homework technologies did not reveal any new school-based issues in ICT use.

Home issues

Under the 'home' category, issues of the digital divide were again a common theme, particularly among Schools A, B, C, D and F – School E being fee-based, and therefore attracting more advantaged families. The majority of ICT coordinators estimated the percentage of uptake of computers among their students, and in School A this was 'about 70%', School B 'probably 95% plus', School E 'probably most of them have got broadband', but in School F 'only 40% of students'. As with the national surveys of computer use among families, uptake was generally high among families except in School F.

As in the questionnaire, ICT coordinators focused on the practical limitations that insufficient technology brought. However, three themes were encountered that were evenly spread across the interviews of different coordinators. To take examples from a single school, these were problems of access:

> *"it's a common problem for students that they produce work at school and they have difficulty getting it home"*
>
> ***ICT Coordinator, School A***

the difficulties of difference in socio-economic status:

> *"the more we use technology, the more that e-gap becomes an issue… typically the more well off families who often, but not always, tend to be*

involved in the educational process with their children, are going to benefit more"

ICT Coordinator, School A

and the difficulties of differences in families' attitudes towards technology:

> *"Those students who haven't got that kind of access at home, and also, perhaps, haven't got that level of parental support… we're benefiting the students who've already got a lot of benefits."*

ICT Coordinator, School A.

The same range of comments was seen in Schools B, C, D and F. However, twice as many comments in interviews referred to pragmatic technological implications of the divide as to either socio-economic or attitudinal differences. Further fitting with the questionnaire responses, the digital divide was mainly discussed in terms of the constraints it placed upon ICT coordinators. Coordinators were aware that not all students would be able to complete technology-based homework, and so they dealt with this by avoiding compulsory ICT homework. As with the use of in-school computers, avoiding setting compulsory ICT homework was another poor strategy when viewed in terms of homework, as it meant that children were failing to reap the potential benefits of in-home technology use.

Home-school issues

In addition, home-school issues – issues around the transfer of information to and from school – were identified by ICT coordinators in the interviews. These varied from school to school depending on the systems which were being used to transfer information and the coordinators' experiences.

In Schools A and B, coordinators were concerned about the difficulties of systems which were used to complete work at home and at school. From the point of view of the ICT coordinators, challenges arose when the use of home technologies meant the transfer of home values and priorities to homework, as seen in this quote from School B:

> *"if mum and dad sit you down at a table, and you've not got the telly on… you've got a piece of paper, and you've got a textbook in front of you, the level of discipline for maintaining that task isn't too bad. If you know that at the click of a button you can put music on, you can email your mates, whilst you're doing your homework, then the temptation is always there"*
>
> ***ICT Coordinator, School B.***

In School A, the teacher discussed the problems of children bringing mp3 players into school as USB pens, and the potential intrusion of home values into school life in this way. However, the clash between home and school values that applied here might equally apply to a possible intrusion of school values on the home.

In Schools B, C and E, the major issue discussed was establishing ownership of the day-to-day management of technological activities when technologies were used across home and school contexts. In School E the most complex analysis of this problem was presented, with the ICT coordinator telling the following story about School X, another independently funded school in the UK:

> *"[School X] say, you buy the machine, and we'll put on our management software, so that, that was okay, wasn't it? Unfortunately, the kids then go home in the holidays, and say 'I want to install such and such, I can't, but*

it's my machine', so the parents say 'we bought this machine' so they then take the software off, I'm afraid lots of kids… came back off their Christmas holidays and they all had viruses on their machines, guess what, put them all on the network"

ICT Coordinator, School E.

In order to deal with these issues, schools had to create a dialogue between home and school, but Schools A to E all experienced difficulties in managing this process, as can be seen in the field notes from School C:

"Getting into dialogue with parents about recommended systems is seen as a problem as you increase ownership by the school of problems."

Field notes from tour with ICT Coordinator, School C.

School C was concerned about the difficulties of recommending which computers families bought, and the extent to which this increased the ownership of the family computer by the school. Some schools refused to give this information at all, and some produced gentle guidelines, or focused on aspects such as the placing of the PC, rather than its purchase.

Home-school issues were only encountered in the interviews, and seemed to be just emerging as schools experimented with technology use which reached between home and school ecologies. The school with the greatest awareness of home-school issues was School E, which had been using technologies between home and school at the highest level for the longest time. What is more, all incidents described as relating to issues of ownership and clashing values came from new technologies, such as USB pens and laptops. If wider ICT access was available, it seems likely that these clashes would increase in both number and importance. What is more, they are likely to have strong consequences for families as well as for schools, where a dominant voice – the educational organisation of the school – is pitted against a variety of different practices in the home. These home-school issues therefore need to be considered in terms of their impact on the ecology of the home. The importance and potential consequences of home-school issues needs to be considered to find out what the impact on home life might be, if more efficient strategies for introducing ICT into homework are to be used.

3.4 Conclusions

This chapter has presented the ecology of the school through the thoughts of ICT coordinators on the use of technologies in homework, both present and future. A brief summary of the key findings of the chapter will be listed below, with some indication of how they will be carried forward in the thesis.

The emergence of home-school computer networks

In the interviews home-school computer networks were seen as the ideal future technology, with ICT coordinators keen to include these systems in their provision of services, and alternate services, such as external websites, apparently shrinking in popularity. Evidence from the interviews suggested that ICT coordinators had visions of complex interconnected systems, and the fact that all the additional forms of technology in the 'other ICT' section of the questionnaire focused on this issue suggests that they were a key element of home-school connections.

No single networking solution was chosen – all coordinators had different ideas about how such systems should look and function. However, a common theme was that these networks would connect personal computers. The limitations of personal computer-based systems of this sort will be further considered in Chapter 5. Already, however, it is easy to see that limiting homework to a rigid delivery method could be risky. It appeared from ICT coordinators' interviews that there were benefits to flexibility – for example, using a range of portable media and electronic delivery systems – even when this flexibility could sometimes lead to disorder. At the time of interview the schools, through choice or chance, were using a variety of approaches to send information between home and school, and while ICT coordinators complained about the systems, this mixed approach did seem to work, and reflect the different needs of different children effectively. The organisational view from the school was that these ad hoc and patchy provision systems needed replacing in order to make sharing information easier. However, this would also remove choice and flexibility from children and their families, and there may be reasons why this diversity is a good enabler of activity in the home ecology.

Providing a basic level of access

There was a good deal of concern over providing access to technologies, and this heavily constrained the ICT coordinators in what they could do, according to both questionnaires and interviews. However, schemes such as leasing could provide access and give computer support in the home, where families could potentially gain all the benefits of parental involvement. This thesis argues that providing such schemes is the future of ICT between home and school: it encourages families to use technology in their own homes, which providing in-school computer access does not, and it allows teachers to set ICT homework for all, rather than avoiding ICT use altogether.

The digital divide should not be used (however unintentionally) as a rationale for the avoidance of or impoverishment of technology use, but rather as an argument for increasing the accessibility of technology. This thesis will therefore focus on what could be done if access to technology was achieved, through leasing or other schemes. Once access is increased, it is just quality of usage that needs to be improved. Positive steps to increase the accessibility of technologies can benefit families who already own such systems, improving their use, and benefit families who do not already own such systems, avoiding intimidating families new to technology use in this area.

When looking at home-school networks, home-school issues are likely to become more pronounced. Firstly, a good deal of adjustment may be necessary when homework moves from a patchy set of ad hoc solutions to one overall solution. This does not just refer to the email and portable media homework technologies discussed in this chapter, but also the wide range of traditional technologies which are used in homework, including several varieties of pen and paper systems. On top of this change in quantities of solution, a different quality of solution is offered by one integrated data gathering machine. A home-school computer network – or any other kind of networked technology – shares a large amount of information between home and school, and this seems likely to increase and complicate clashes in values and needs between home and school ecologies. Chapters 6 and 7 will present evidence that the trend begun by this increased sharing of information may demand new understandings and negotiations of privacy and trust. They will show that the introduction of a poorly designed homework technology might affect home values and home life, and be likely to be met with resistance.

Generally, the importance of focusing on the home as well as the school has been reaffirmed by this chapter. A lack of certainty around exactly how current systems may operate in the home ecology suggests that there is still much to learn about families using homework technologies. In the following Chapter 4, the first stage of learning about the family will begin, with a set of interviews moving the thesis towards the home ecology: interviewing children together to discuss their homework practices, and looking at the key aspects of technology mediated activity within the home ecology which might affect design.

4 The view from children

Chapter 3 presented evidence for the growing importance of home-school networks in homework, and Chapters 5 to 7 will investigate how analysis of homework activities can lead to design strategies for new technologies. This chapter will bridge these sections with a study asking 190 children in 38 discussion groups to describe their everyday homework practices. The ecology in which children complete homework has been sparsely explored, so knowledge of how families currently manage homework is needed to help design new technologies, and this chapter will present a large-scale background study into children's current homework practices to do this.

Five elements of context were recognised as important to the completion of homework: the tasks which constitute homework, the technologies which are used in and around homework, the family members who are involved in homework, the location of homework and the timing of homework. This chapter will look at how these different elements combine, and in particular at how independent and collaborative work take place in relation to these aspects of the home ecology.

4.1 Known properties of homework

The first four elements of homework tasks, technologies, location and family listed in this section are taken from Hughes (2001), who identified them as key aspects of the context of homework. The fifth element, timing, was added based on feedback from the groups, suggesting this was also a core element of homework for the children involved. As the following sections describe, questions within the homework literature still exist around these elements.

4.1.1 Tasks

Hughes (2001) produced a taxonomy of homework tasks, including practice, reinforcement, production and creation, research, and revision in his work. However, it is possible that these tasks differ in schools between age groups. Cooper and Valentine (2001) found that the relationship between time spent on homework and achievement is not as strong for primary school children as secondary school children. They suggested a number of factors which might explain this, including the types of homework set by teachers, and found partial support for a basic difference between skills being taught. Any difference in task frequency between primary and secondary school would therefore be interesting to identify, and this will be considered. Therefore children's general descriptions of the kinds of tasks which are set will be the first element considered.

4.1.2 Technologies

Chapter 3 showed that ICT coordinators envisioned homework moving to computer-based networked technologies from their paper-based forms. However, paper-based and computer-based technologies support different patterns of interaction. Sellen and Harper (2001)'s work on the paperless office found that computer-based technologies could limit physical and social interactions as they are more difficult to share than paper technologies. Crabtree et al. (2003) uncovered similar issues in the home looking at mail: paper mail was carried around the home and used as a reminder system but this could not be done with a computer. Kerawalla and Crook (2002) also found that display of children's work was important to families, but that this display tended to be in paper form, even when work was generated by computer. These studies indicated that the current set up of computer-based technologies might be inadequate for supporting sharing and display. Therefore the kinds of technologies which children use to do their homework will be another element of context considered.

Research into homework suggests that the technologies that are used around homework are also important. A range of studies have shown that television and radio are integrated into homework activity (Beentjes et al., 1996; Cooper et al., 2000; Pool et al., 2003; Wober, 1992), so technologies used both for and during homework will be considered as elements of the context.

4.1.3 Family

Chapters 1 and 2 indicated that one of the major benefits of introducing technologies into homework is the increased opportunities for family involvement they offer, but that this is not universally desirable. Research into the mixed benefits of family involvement does exist, with a factor analysis conducted by Cooper et al. (2000) finding that parents' reports of their involvement fell on three core axes – whether they helped complete the assignment when needed, whether they helped regardless of need (failing to support the student's autonomy) and whether they eliminated distractions from the homework environment. However, there is still much to learn about parental involvement, with Hoover-Dempsey et al. (2001, p.206) stating that "the most critical need is for theoretically and empirically grounded research focused specifically on the content, processes and outcomes of parents' involvement in homework". The context and process of involvement will therefore make up the third element of context. However, in addition to looking at parental involvement, this chapter will consider involvement from the family as a whole. Research has shown that it is not just parents who are involved in homework, but also siblings and other members of the immediate family (Hughes, 2001) who give homework help, and therefore this element of context is expanded to include family members in general.

4.1.4 Location

The likely location of technologies is a major element of context, as demonstrated by the wide research into placing the home computer outlined in Chapter 2. The location of technologies such as the home computer may mesh or clash with the demands of homework. Hong (2001) found that homework location could be a determinant of students' achievement, with students who preferred to do their homework by themselves in a 'bright home environment' coming out as better academic performers. Hughes (2001) found that homework was carried out primarily in students' bedrooms, as opposed to 'family rooms' which were more public, suggesting that homework benefited from more private locations, although this thesis will argue that this is only the case for some styles of homework and homework outcomes. This is the final element of context identified from the literature.

4.1.5 Timing

The last element identified as key to homework was not drawn from the literature, but children in the first primary and secondary schools involved in this study brought up the issue of timing independently for discussion. In particular, children referred to timing in terms of homework's relationship to other events – for example whether they did homework upon arriving home from school, or at the last minute. There was some evidence from the literature that children differed in the extent to which they controlled the timing of their homework (Xu, 2006). Location, types of technology and activity seem likely to interact with this factor. Thus, given that timing was obviously an important element of homework completion for children, this was added as a final element for analysis.

4.2 Studying the 'homeworkers'

The children were therefore studied to see how these elements of context played out in their homes, and how they managed homework practices.

4.2.1 Participants

Participants were recruited from four local schools – two primary and two secondary schools. The details of these schools are given in Table 4.2a.

Table 4.2a. Showing background information on the participating schools from Ofsted reports

School Name	Year of Ofsted Report	School rating	Total percentage of pupils qualifying for free school meals
Primary School 1	2003	Good	5%
Primary School 2	2006 / 2000[1,2]	Effective[1]	16%[2]
Secondary School 1	2004	Adequate and improving	14%[3]
Secondary School 2	2002	Good and improving	7%

The schools were local to the university, and quota sampling was used to obtain participants: calling around the local schools until two primary and two secondary schools agreed to take part. Contact was made with a teacher (the deputy head or head of year) in each of these schools, who arranged for the groups to take place, and selected the children for the interviews in groups of five children. The teachers were encouraged to select the children for groups randomly, with the proviso that the children within each group should know each other well to encourage a relaxed atmosphere. To obtain a spread of children across primary and secondary schools, the top two years 5 and 6 in the primary schools were chosen (ages 9 to 11), and the lower two years 7 and 8 in the secondary schools (ages 11 to 13). Each teacher was asked to select five lots of five groups per year, making a total of 40 groups, and each group attended two sessions, making a total of 80 sessions.

[1] The 2006 Ofsted report stated that the school was 'effective' but had no data on free school meals.

[2] The 2000 Ofsted report stated that the school had 16% eligibility for free school meals, but did not give an overall rating of school quality.

[3] The 2004 Ofsted report only stated that the number of free school meals was 'average', and no further reports were available. However, the average spread of free school meals for secondary schools in 2004 was 14%, so this was taken as the approximate figure.

Due to absences of children for sickness or extracurricular activities, and a small number of poor recordings, data was only available for 38 total groups and 13 groups (65 children) consisted of only one session. It should be noted that the absence of dual interviews for some children may have occasionally affected the percentage of groups mentioning themes, as these are presented at the group level. However, the majority, 25 groups (125 children), participated in both sessions, and the lost data was spread between the two sessions (seven session 1s were missing and six session 2s) so frequencies are still comparable across the sessions.

4.2.2 Ethics

As children are not traditionally considered able to provide their own consent, parental consent forms were used to gain consent for the participation in the study, as included in Appendix 4.A: Consent form. These forms were sent to parents through the traditional school letter service and returned to form teachers. In addition, the schools agreed to let children participate in the groups, providing a second layer of consent. Finally, children were informed in the study that "It's really useful for me that you're here, but if for any reason you don't want to answer any of the questions I ask, or if you don't want to take part in this group just say so and you don't have to. I'll be recording what we say on this tape recorder to help me remember what we talked about if that's okay with you." Children did have to return to class if removed from the group, but in practice, no child asked to leave.

The discussion groups were identified as a particular danger for disclosure: talking about everyday homework practices, technology use (including their online activities) and relationships could reveal sensitive information about their lives. Therefore the details of this study were sent to and approved by the Ethics

Committee at the University of Nottingham School of Psychology. As part of this procedure it was agreed that any information which suggested potential danger to the child would be revealed to the school / parents as appropriate, after informing the child and discussing the need for this process with them.

Criminal Records Bureau (CRB) clearance was obtained by the interviewer, and made available to schools. Finally, the interviews took place in a semi-public area, a corridor, library or teacher's office, in order to ensure children were comfortable with talking with the interviewer alone. Standard privacy and feedback were provided, as discussed in Chapter 2.

4.2.3 Discussion Groups

Discussion groups were chosen for the interviews as previous studies have shown that children are more comfortable with groups than one-on-one interview formats (David et al., 2001). Interviewing children in a peer group might also lead to more candid details of their homework activities: minor issues like the range of locations they used in homework, or more serious ones such as cheating or avoiding homework completely being more likely to emerge in a comfortable peer context.

To avoid tiring children, discussion groups were split into two sessions, conducted on separate days. The interviews were semi-structured, with key points to cover in each interview, follow up questions for less talkative children, and the ability to pursue interesting avenues that came up. The children and interviewer sat in a circle with a wide-area microphone in the centre to record the conversation.

Session 1 began with an introduction of the interviewer and the purpose of the study. There was also an opportunity for children to withdraw from the study if they wished, although no children chose to withdraw. This was followed by a short getting-to-know-you exercise, where children and the interviewer introduced themselves and their interests. Semi-structured questions followed in an informal style, with the interviewer asking the main question in Table 4.2b, and then following up on what the children had talked about, or with the additional follow-up questions in italics if children were reticent, or failed to cover certain aspects of the question.

Table 4.2b. Session 1 questions

Theme	**Main question**	**Follow ups**
Task	I'm not just interested in stuff that your teacher sets you, like spellings, but it can be other stuff too, like projects… Do you know the kind of work I mean?	*Can you all think of some examples of what you do generally and how you do it?*
	Did you do any work like this last night?	*Can you all think of some examples of what you do generally and how you do it?*
	Is that typical of the kind of work you usually do?	
Technology	What resources do you use?	
Family	(refer to any previous mention of people) Now, some researchers like me – a Dr. Cooper and the people who worked with him, asked a lot of parents and most of them said that they give their children help with their work. Would you say that's true for you?	
Location	(refer to any previous mention of places) So, do you usually work in the same place?	*Where is that?* *Does it depend on what kind of work you're doing?*

In addition, both sessions were followed with opportunities for the children to ask questions or make comments about elements which they thought were important.

This was the basis of an additional question about timing added to Session 1, asking "When do you do your homework?"

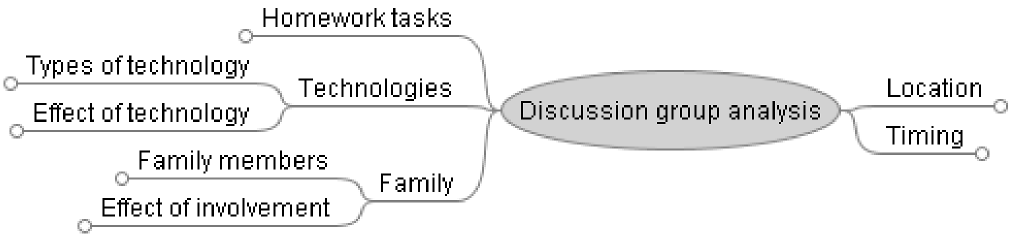
4.2.4 Analysis

The discussion groups were transcribed verbatim, with the final transcription checked by the interviewer for accuracy and consistency. The unit of analysis was one utterance in the conversation by a child which ranged from a short speech on a subject to a single word answer. Each utterance referring to an element of context was coded as that element. Answers expressing agreement that an element of context was involved in the children's homework were also included as code-able references to a particular element of context, as were responses to the cue pictures that agreed that a picture was good, i.e. representative of homework practices.

Original template analysis: Elements of context at the group level

In order to look at the spread of each element of context, the first layer of analysis, a template thematic approach was taken to the data. The five elements of context listed as important to homework and design were applied to the transcripts. Initially, the groups were coded in terms of the range elements of contexts they described. Flexible codes were used: any time a new task, location, timing, technology or family member was discussed by a group, a new category was added to these codes. The categories presented are therefore not exhaustive: elements of context potentially still existed which were not discussed in the groups. An example transcript can be seen in Appendix 4.C: Example discussion group transcript, and a screenshot of a coding example can be seen in Appendix 4.D: Example NVivo screenshot of discussion group transcript.

Figure 4.2a. Showing the major themes elicited



As seen in Figure 4.2a, the role of technologies and family in homework were further categorised according to their effect on the homework process: whether technologies were involved in completing work, interfering with work, or neutral in work, and whether family members were making a work-based contribution, an organisational contribution or a distraction to the homework activity; for example, by making noise or giving unhelpful suggestions. These categories were exhaustive, and designed to cover all possible effects of technology use and familial involvement in homework. Neither set of codes was designed to be exclusive in application: several utterances contained references to more than one element of context.

Coding was the responsibility of the interviewer, meaning that although only verbal responses were transcribed, the coding was informed by a wider understanding of the context of the discussion. The themes were applied using the NVivo 2.0 software package. The categories were initially created from the discussion groups with Primary School 1 and Secondary School 1, and then reapplied to the second half of the data, with Primary School 2 and Secondary School 2. No new categories were seen in the second recoding, suggesting that while codes were not necessarily exhaustive, they still represented good coverage of the most common elements of the homework context for the children involved in the groups.

A coding guide was developed to define the content of each code, and each section will contain the coding notes for that particular topic. The guide to each code will contain the definition of that code, and notes on the handling of ambiguities in the data. A full list of the codes used can be found in Appendix 4.B: Elements of context.

Further template analysis: Elements of context at group and utterance levels

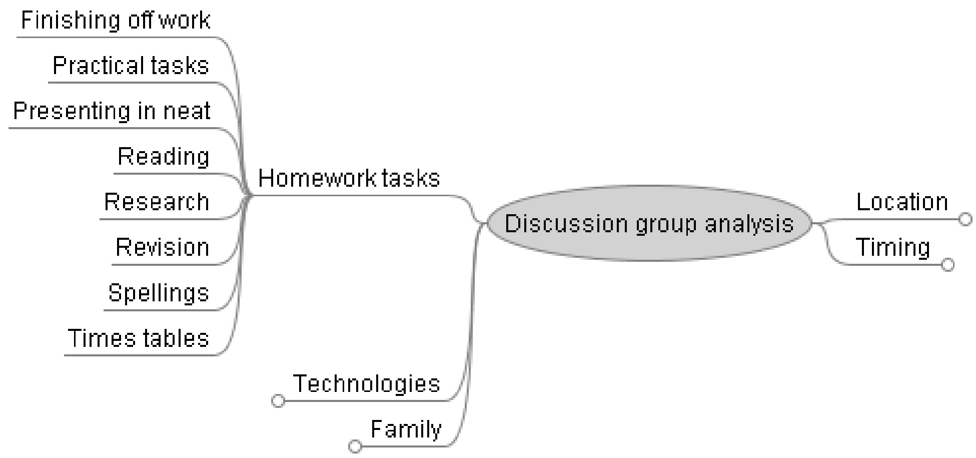
The frequency of the codes will be given at two levels of detail. The major approach will be a broad summary of the frequency of each code at the group level, i.e. the number of discussion groups containing a single instance of a child mentioning that code. In addition to this, quantitative and qualitative analysis of the data will be presented to flag up issues which recur in Chapters 5 to 7. The spread of homework tasks across different school years and interactions between technology types and technology will be presented at discussion group level in Sections 4.3 on tasks and Section 4.4 on technologies. More in-depth codes at the level of utterances will be seen in Section 4.5 on family involvement and Section 4.6 on locations. In addition, Sections 4.3 to 4.7 will contain quotes illustrating how the children discussed these themes as part of the ecology of their homes.

Each section of the findings will discuss one element of the homework context, and lay out the major findings and implications.

4.3 Tasks: "English, maths, stuff like that"

The tasks mentioned by children in the discussion groups are presented in Figure 4.3a below.

Figure 4.3a. Showing homework tasks mentioned in interviews



Coding notes

- A homework task is any mention of a specific type of work or the general type of work that children in the groups had to do. It refers to the nature of the task that the child has to complete, rather than the materials used when completing it. Any utterance that refers to a kind of work that the child has done or generally does is to be coded.
- This is a flexible code: new categories should be added as new homework tasks are mentioned.

Table 4.3a shows the number of mentions of each homework task in the groups, along with a brief description of the types of task each category involved.

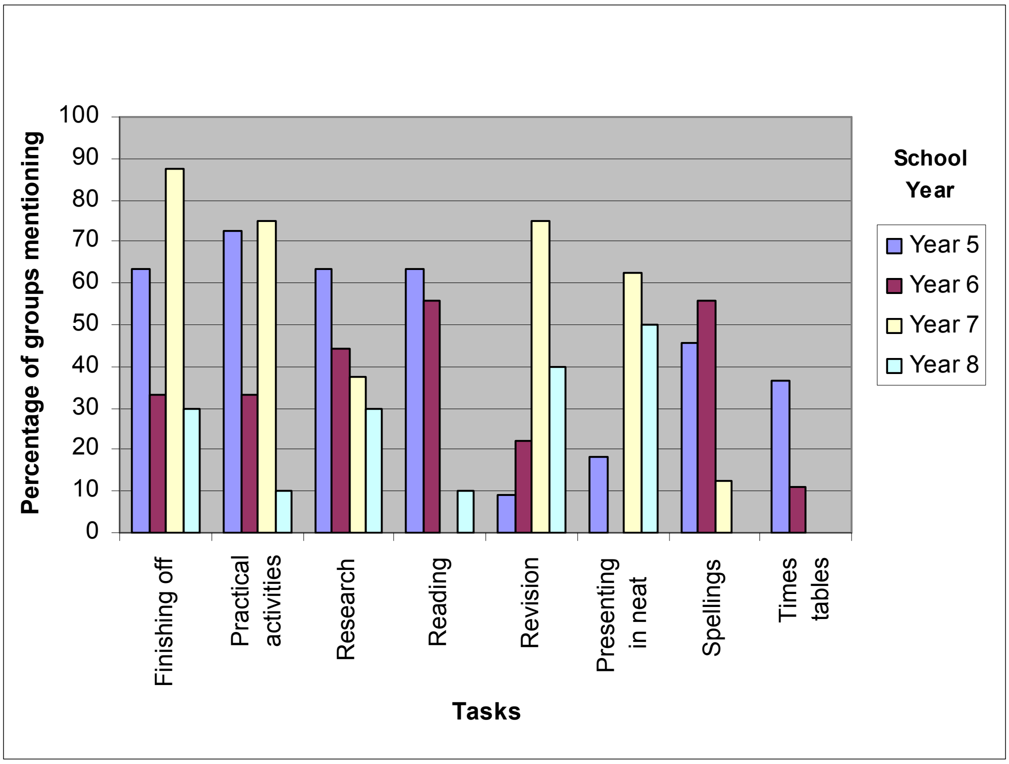
Table 4.3a. Showing the percentage of mentions of each homework task at group level.

Homework tasks	% of groups mentioning
Finishing off work *(any continuation of work started in class)*	52
Practical tasks *(creative tasks e.g. practical science, drawing)*	47
Research *(researching a topic)*	45
Spellings *(learning lists of spellings)*	39
Reading *(reading as a general task, or reading a specific book)*	34
Revision *(revision for tests or exams)*	34
Presenting in neat *(writing up work in neat books or coursework folders)*	32
Times tables *(learning multiplication tables)*	14

These tasks overlapped with Hughes' (2001) taxonomy of homework tasks to some extent. Practice and reinforcement tasks were represented by spellings and times tables, production and creation by practical tasks and both lists contained research and revision. The categories uncovered in the discussion groups added an extra dimension, however: finishing off work and presenting work in neat. These were mentioned by over half and over a third of groups respectively.

Figure 4.3b shows some differences in the types of homework task mentioned by the groups according to their school year. Finishing off, practical tasks and research, the three most commonly mentioned tasks, were spread across most year groups, and revision and presenting in neat were mostly mentioned in the secondary schools. Reading, spelling and times tables were common to only primary year groups, and these are reasonably simple tasks, suggesting the need to integrate school and home information might be less strong for younger children than in the secondary school group.

Figure 4.3b. Showing the percentage of groups mentioning each task, split by school year



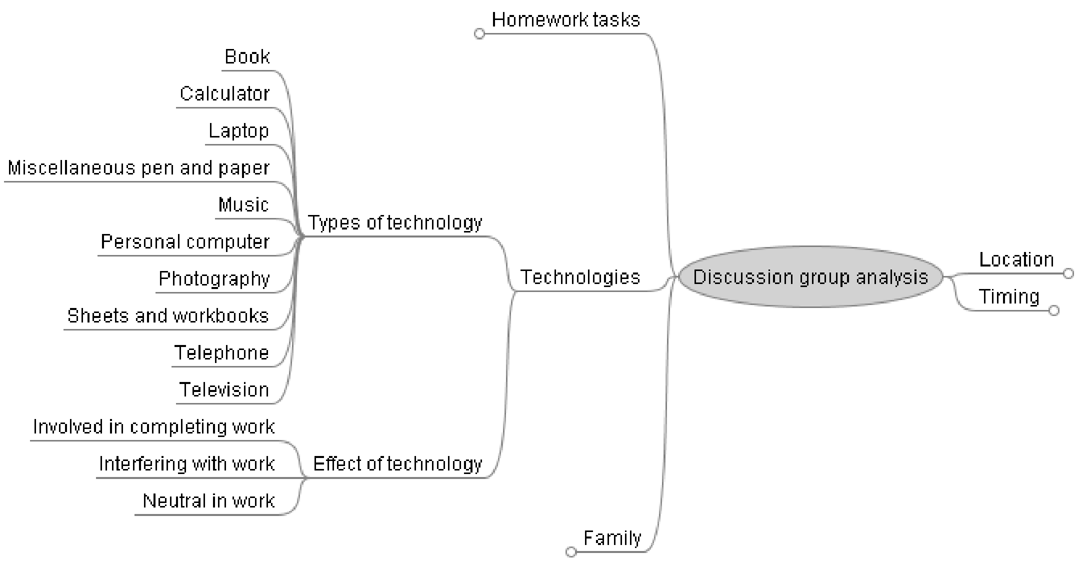
Secondary schools seemed to set homework which spanned the home and school more fully. However, both levels of schooling seemed to include some complex and integrated tasks, and reflected tasks which might benefit from both parental involvement and independent study. These results confirmed the importance of studying home-school networks. The most common types of task overall were finishing off work, practical tasks and research, all of which seem likely candidates for benefiting from increased access to resources and information through networks.

There was a difference between types of homework across school years, and particularly in terms of a split between primary and secondary schools. Chapter 3 assumed that secondary school pupils would have the most, and more complicated homework types. However, Chapter 5 will contain some data drawn from the homework tasks of children at primary school. The data from the discussion groups suggested that these two samples of children are likely to be participating in similar types of task.

4.4 Technologies: "you can talk to your friends on MSN while you're waiting"

The different technology types and effects mentioned by children in the discussion groups are presented in Figure 4.4a below.

Figure 4.4a. Showing technology types and effects mentioned in interviews



Coding notes

- A technology is any resource which is used while a child is completing their homework: either in or around the homework task. The code can be applied to specific information on when, where, how frequently, or how the children use a technology, and the benefits of using it. Each mention of a technology is coded for type and effect.

- Technology type is a flexible code: new categories should be added as new technologies are mentioned.
- Technology effect is a fixed code: technologies should only be coded as being (i) involved in completing work (including technologies used for cheating), (ii) interfering with work, or (iii) neutral if unclear if they fit into either of these categories.

Table 4.4a shows the technologies children mentioned using in and around homework. The most commonly mentioned technologies were the television, computers, and music. Specific questions were asked about these forms of technology, and children agreed they were common to their homework tasks. Also commonly mentioned were 'traditional' homework technologies such as the book, pen and paper and sheets and workbooks.

Table 4.4a. Showing types of technology used in homework

Technology	% of groups mentioning
Television	92
Personal computer	89
Music	82
Book	64
Miscellaneous pen and paper	50
Sheets and workbooks	42
Laptop	8
Telephone	5
Calculator	3
Photography	3

As well as being coded for technology type, references to each technology were also coded for technological effect. As seen in Table 4.4b, 97% of groups mentioned technologies used to complete their homework, and 71% of groups mentioned technologies which had interfered with their work in some way. A further 87% of groups mentioned technologies in which it was unclear if their use had been conducive to or problematic in the homework task. The spread of technologies across these themes was evidence for a mixed effect of technologies on homework.

Table 4.4b. Showing effects of technology used in homework

Effect of technology	% of groups mentioning
Involved in completing work	97
Interfering with work	71
Neutral in work	87

Chapter 1 has already discussed that introducing new forms of technology into homework is likely to change homework activities. This data on the type and effects of technology shows the mixed effect of different technologies on the homework activity.

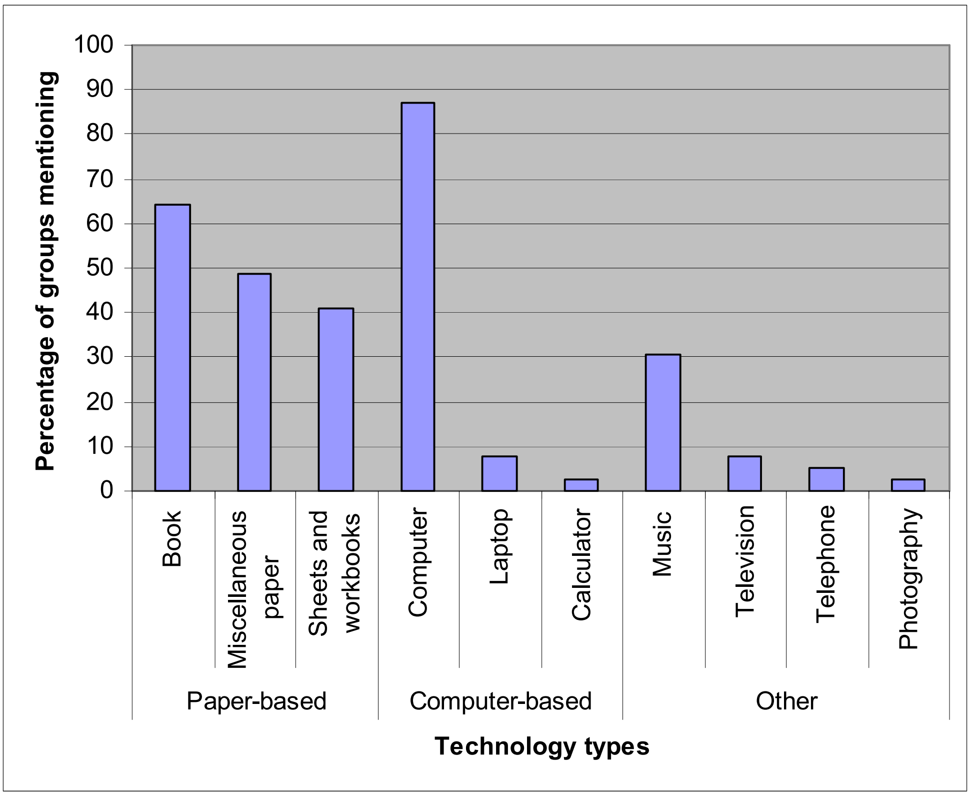
Table 4.4c. Showing the percentage of mentions of technologies involved in completing work at group level

Technology	% of groups mentioning
Personal computer	89
Book	66
Miscellaneous pen and paper	50
Sheets and workbooks	42
Music	32
Laptop	8
Television	8
Telephone	5
Calculator	3
Photography	3

Table 4.4c shows the percentage of groups mentioning each individual technology in completing work. It can be seen here that the most popular technology used was the personal computer: 89% of groups contained at least one child who used a PC to complete their work. However, as seen in Figure 4.4b, which is split into paper-based, computer-based and other types of technology, it was traditional, paper-based technologies (the book, pen and paper, and sheets and workbooks) which were

mentioned most consistently overall, despite these technologies not being specifically referenced within the interview questions.

Figure 4.4b. Showing the percentage of mentions of technologies involved in completing work at group level



The most common and third most common technology types used overall, music and television were hardly ever used to complete homework. Table 4.4d shows that these technologies were most commonly mentioned as being either interfering or neutral in effect. On top of this, echoing teachers' comments in Chapter 3 about the difficulty of technologies used in the home for both entertainment and schoolwork, the personal computer, the main technology used to complete homework, was mentioned by 8% of groups as a potentially distracting technology.

Table 4.4d. Showing the percentage of mentions of neutral and interfering technologies at group level

Effect of technology	Type of technology	% of groups mentioning
Neutral in work	Television	57
	Music	42
	Personal computer	5
Interfering with work	Television	84
	Music	57
	Personal computer	8

The level of interfering technologies in homework showed children often chose to do their homework around potentially distracting technologies. Several groups of children explained that they actively chose to control this:

> *"I don't think this one's very realistic because if you're listening to music and reading a book you can't really concentrate on everything in one go…"*
>
> *"So would you not listen to music while you're doing your homework then?"*
>
> *"No."*
>
> *"I have done before but you can't concentrate."*
>
> *"Sometimes. If you have, if I'm on the computer and things, then I might have media player on while I'm typing it up. It depends what type of homework it is."*
>
> ***Interviewer, Child 1, Child 2 & Child 3, Year 6, Primary School 2.***

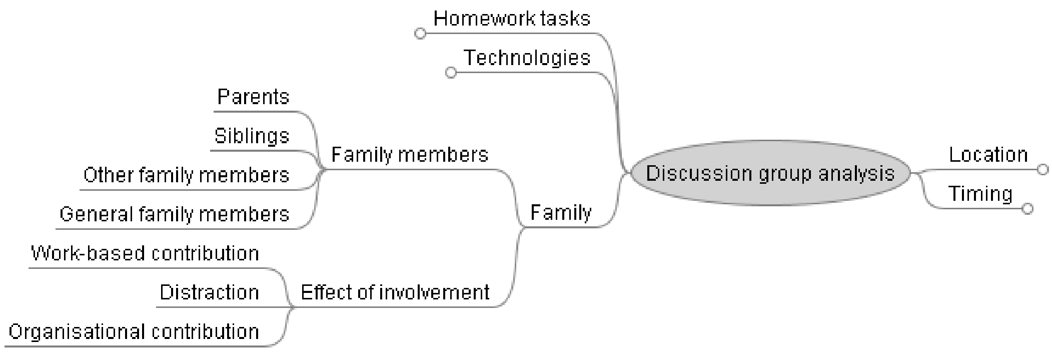
Both music and television could distract the child. Computers offered a mixed work and play environment, where children could be tempted to explore more playful options while doing their homework. There were several possible reasons why children might want to use these distracting technologies: perhaps to make homework less boring, or to entertain themselves during homework which requires little concentration.

The context of homework therefore involved any of a wide range of technologies, and Chapter 5 will look at the specific effects of some of these technology types on children's homework activities. A particularly interesting aspect of the technologies used in homework however, was that children persist in doing their homework around technologies which distract them. When taken in conjunction with further findings in this chapter, completing homework in an area where many distractions are available seems like a common occurrence. However, places – locations and times – where distraction is present can be associated with alternative benefits in the ecology of the home, as will be seen.

4.5 Family: "My Granddad, he gets it wrong"

The family members involved in homework, and the effects of their involvement are presented in Figure 4.5a below.

Figure 4.5a. Showing family members involved in homework and their effect mentioned in interviews



Coding notes

- Any mention of the family being involved in homework should be coded[4]. The family includes parents, stepparents and other guardians, siblings, and wider family members reported by children such as grandparents and cousins. Each mention of a family member is coded for the family member and the effect of involvement.
- Family member is a flexible code: new categories should be added as new family members are mentioned.
- Effect of involvement is a fixed code: family members should only be coded as making (i) a work-based contribution, (ii) a distraction, or (iii) an organisational contribution (organising the time or circumstance of the homework) to the homework task.

[4] Additional notes: Direct 'yes' or 'no' answers to the question 'Now, some researchers like me – a Dr. Cooper and the people who worked with him, asked a lot of parents and most of them said that they give their children help with their work. Would you say that's true for you?' are not to be coded, as these were ambiguous e.g. 'yes' could mean 'yes, they help' or 'yes, they help too much'.

Table 4.5a shows that the family members most commonly involved in homework were parents: mentioned by 89% of groups, followed by siblings, mentioned by 50% of groups. 24% of groups mentioned that their family in general were involved with homework, and 16% of groups specifically mentioned grandparents or cousins who were involved in their homework activities.

Table 4.5a. Showing the percentage of mentions of each family member in homework at group level

Family member	**% of groups mentioning**
Parent	89
Sibling	50
General family members	24
Other specific family members *(Grandparents and cousins)*	16

Table 4.5b shows the different contributions family members could make towards the homework. The most commonly mentioned contribution was help with the work, mentioned by 89% of groups, and 37% of groups said that family members contributed towards the organisation of their homework activities. However, 42% of groups felt that family members had distracted them from their homework in some way.

Table 4.5b. Showing the percentage of mentions of each type of family involvement at group level

Family involvement	% of groups mentioning
Work-based contribution	89
Distraction	42
Organisational contribution	37

As with technologies, it is interesting to see how help and distraction were distributed. Table 4.5c shows the utterances which referred to each family member, and the relative pattern of contributions of each.

Table 4.5c. Showing the percentage of total utterances referring to work-based or organisational contributions or distraction by different family members

Family members	Total number of utterances	Contribution	% of total utterances
Parents	225	Work-based	78
		Organisational	16
		Distraction	6
Siblings	40	Work-based	68
		Distraction	32
General family members	26	Work-based	62
		Distraction	38
Other specific family members	6	Work-based	67
		Distraction	33

Parents were the most involved family member, and they generally contributed work-based help – 78% of utterances relating to parents – and organisational strategies – 16% of utterances. However, 6% of utterances referring to parents mentioned that they could be distracting: a total of fourteen references to parents distracting children from homework were found across seven different groups. These patterns were similar to Cooper et al.'s (2000) previous findings which reported three core axes – helping complete an assignment (work-based), eliminating distractions from the homework environment (organisational) and 'helping' regardless of need (which might be seen as distraction). Siblings, family members in general, and other specific family members all gave work-based help around two thirds of the time, and acted as a distraction around a third of the time.

Reflecting the findings around technologies, it seemed that children were completing their homework around family members who were distracting them: the following group suggests that mixed benefits and downsides might be behind such choices:

> *"Yeah, sometimes when they're doing it you say 'can I do something' and they say 'well, if you don't want my help, then I'll go'...*
>
> *"They either don't help you or they do it all."*
>
> *"Does that annoy you then?"*
>
> *"Yes!"*
>
> *"Yes!"*
>
> *"Yes!"*
>
> *"Sometimes it's ok: sometimes they can pick out stuff, like they give you a = x and stuff like that and you're like…and they work it out and we haven't even done it in class."*

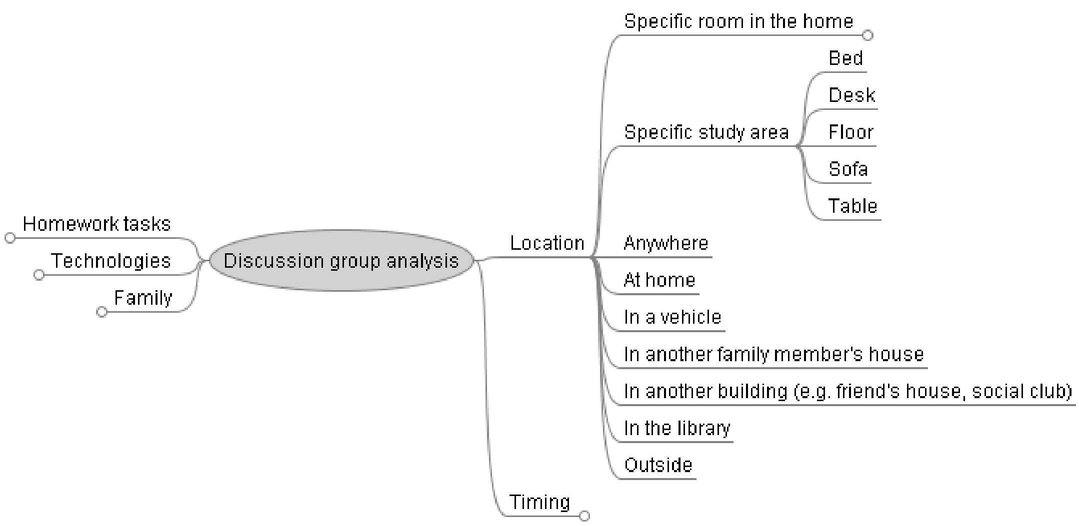
Interviewer, Child 1, Child 2 and Child 3, Year 7, Secondary School 2.

Parents were the most involved family members in homework. However, a variety of family members were involved, and the effects of involvement were not consistent for any family members. The benefits of help – perhaps in conjunction with a preference for company – meant that children chose to do their homework around other family members, even though they might be inconsistently helpful. A major contribution of this thesis will be looking at how children manage this inconsistency, which will be followed up in Chapter 5.

4.6 Location: "In my bedroom or on the computer"

The different locations mentioned by children in the discussion groups are presented in Figure 4.6a below.

Figure 4.6a. Showing locations mentioned in interviews



Coding notes

- Any location mentioned as the setting of homework, either specifically for one piece of work, or generally as a typical location counts here. The location can be at a general level, such as 'anywhere' or quite specific, such as a room in the home.

- This is a flexible code: new categories should be added as new locations are mentioned.

As can be seen in Table 4.6a, the majority of children referred to specific rooms or areas in the home as the location of their homework: a total of 87% of the groups for each. More detail of these will be given below.

Table 4.6a. Showing the percentage of mentions of each location at group level

Location	**% of groups mentioning**
Specific room in the home *(e.g. bedroom, kitchen)*	87
Specific study area in the home *(e.g. table, desk)*	87
In the library	50
In a vehicle	26
Generally at home	18
Outside	18
In another family member's house	8
In another building	8
Anywhere	5

A large proportion of groups indicated that homework was sometimes completed outside the home. However, the cue pictures used in the second interview showed both a library-based scenario and a vehicle-based scenario, which might explain the high proportion of groups mentioning these locations.

This research is, however, particularly focused on the home elements of homework, and these were the most commonly mentioned locations of homework overall. Table 4.6b presents the rooms in the home used as locations for homework.

Table 4.6b. Showing the percentage of mentions of rooms at group level

Location	% of groups mentioning
Bedroom	63
Kitchen	58
Dining room	39
Living room *(including mentions of sitting room, lounge etc.)*	32
Bathroom	11
Computer room	11
Sibling's room	8
Study *(including mentions of office etc.)*	8
Spare room	3

As can be seen in Figure 4.6b, there were four particularly commonly used rooms for homework: the bedroom, kitchen, dining room and living room. These reflected the locations found in Hughes' (2001) work, where he contrasted bedrooms with 'public family rooms'. However, unlike Hughes, the discussion groups suggested that doing homework in public family rooms was just as common as doing it in the bedroom. The bedroom was the most common room mentioned, by 63% of groups, but the kitchen, dining room and living room were mentioned by 76% of groups altogether.

The choice of public family rooms might be expected to be distracting for children. Children tended to refer to distraction in terms of the technologies and family members that provided it, but public family rooms seem likely to be the location for technologies such as the television and other family members. This is the third element of context in which an advantageous trade off against distraction was needed to explain children's choices.

Figure 4.6b. Showing the percentage of groups mentioning each room

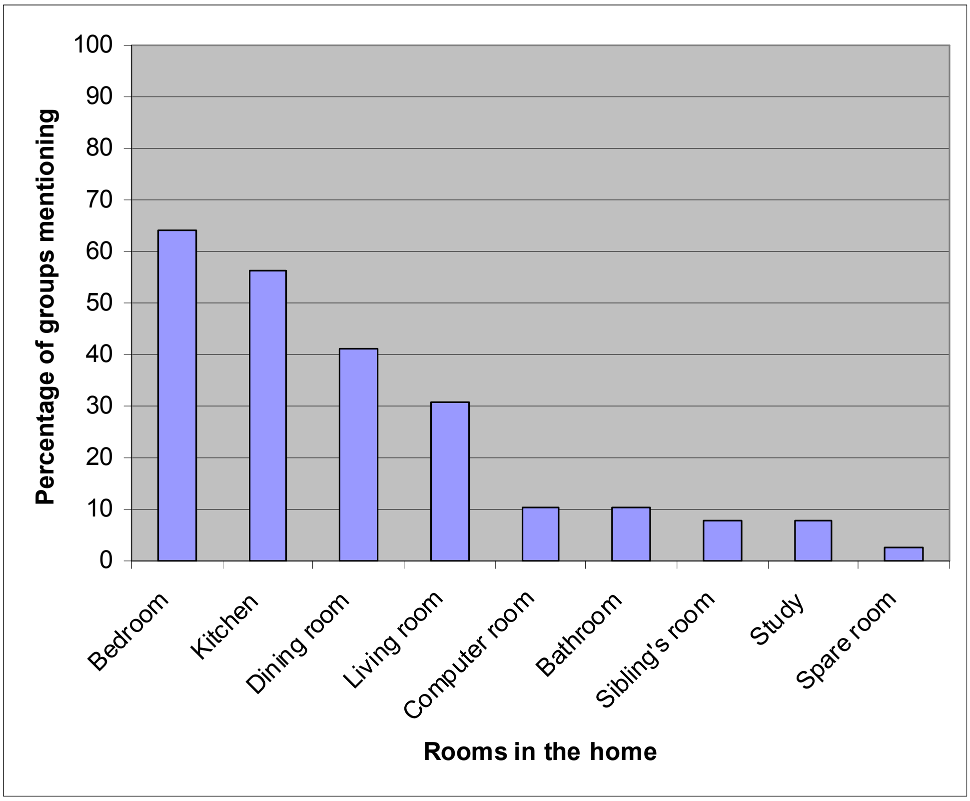


Table 4.6c shows the percentage of utterances mentioning each study area that referred specifically to rooms. The high association between tables and the dining room and kitchen suggested that one major appeal of these areas was a dining room table or a kitchen table for work to take place. The spread of these study areas also suggested that homework differed greatly in terms of its formality: with children mentioning casual locations such as the floor, bed and sofa alongside the more expected and common formal surfaces like tables and desks.

Table 4.6c. Showing the percentage of total utterances referring to study areas in particular rooms of the home

Study area	Total number of utterances	Room in home	% of total utterances
Table	52	Dining room	38
		Not specified	31
		Kitchen	29
		Living room	2
Desk	19	Not specified	63
		Bedroom	37
Floor	26	Not specified	92
		Living room	4
		Bedroom	4
Bed	15	Not specified *(presumably bedroom!)*	100
Sofa	8	Not specified *(presumably living room)*	100

As with use of technologies and family involvement there seemed to be some strategic use of location to create a particular homework scenario. The following extract is typical of children's discussion of location, and shows how these factors interact in the ecology:

"Where in the house do you do it?"

"In my bedroom or in the living room"

"The conservatory or in the bedroom, or if I go round to my Grandma's and Granddad's sometimes I do it there."

"Sometimes I get a magazine and lean on the floor and do it, 'cos then I can watch telly at the same time, sometimes, but sometimes it like distracts me, so I go in my bedroom."

"So does it depend on the kind of homework you've got then?"

"Yeah."

"Yeah."

"If I get hard homework I just go somewhere where no-one's there, and I'm on my own."

"I go in my bedroom, but if it's easy like colouring in or something, you just tend to watch the telly while you're doing it."

Interviewer, Child 1, Child 2, Child 3 and Child 4, Year 6, Primary School 2.

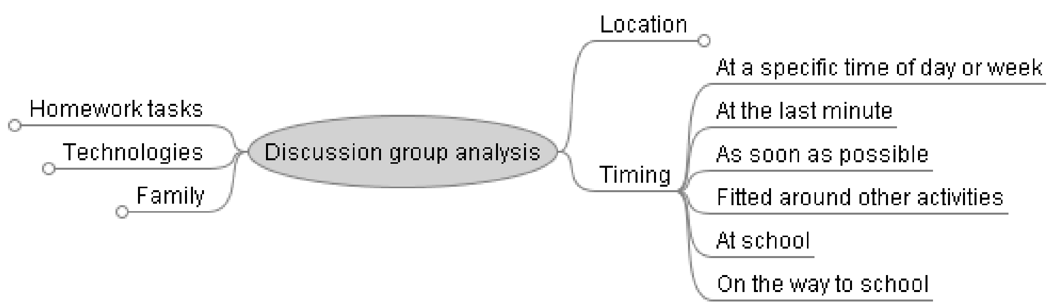
Choice between locations seemed to be made on the grounds of appropriateness for purpose. This quote shows that children were tailoring their choice of location to avoid distraction from technologies. However, there were also examples of children tailoring location to avoid exposure to other family members. This extract was unusual in the depth to which this was discussed, but many of the children gave a range of locations and suggested there were strategic choices being made in their selection.

There are easy links to be made between location and the other elements of context mentioned before. When children appeared to be choosing to work around other family members and technologies, they were also choosing locations where other family members and technologies were present. Therefore a choice of location was interconnected with these other factors. Previous research identified the contrast between family rooms and the bedrooms, and these two locations apparently offer very different kinds of opportunity for homework. Chapter 5 will show how locations were associated with different styles of homework, and how central the different elements of location discussed within the home were to these opportunities.

4.7 Timing: "Just after the Simpsons"

The different times children mentioned doing homework in the discussion groups are presented in Figure 4.7a below.

Figure 4.7a. Showing timing mentioned in interviews



Coding notes

- Timing should be coded as the time that children do their homework, and things that drive that choice of time. It should not include when the homework is due but rather when it is done, unless the time it is due is used to explain when they do it. Expression of a timing preference is code-able as an instance of that timing.

- This is a flexible code: new categories should be added as times are mentioned.

Table 4.7a shows the six different types of homework timing identified by the discussion groups. What stands out in these categories is how timing fit into the routines of family life. Homework was characterised as dictating routine: 47% of groups said that homework was handled at a particular time in the schedule; or responding to it: 37% to 45% of groups attempted to fit it around other activities, or avoid it clashing with other activities with immediacy or delay. Least common were reports of doing homework at or on the way to school.

Table 4.7a. Showing the percentage of mentions of each homework time at group level

Timing	% of groups mentioning
At a specific time of the day or week	47
At the last minute	45
As soon as possible	37
Fitted around other activities	37
At school	11
On the way to school	8

Timing had not been identified from the literature review as a key element of the homework activity, but these interviews showed that children saw timing as a key element of their homework activities. As with the previous sections on technologies, family involvement and location, the time homework was done was used to make active choices about the circumstances of any activity. In some cases this was to fit in with the routine of the home. In others it was interwoven with the ability to choose an overall context for the homework activity, as shown by these children from Primary School 2 who were coordinating distraction and help available from other family members:

"Right then, what about timing, when do you tend to do your homework?"

"At night."

"When I've been given it, I usually go home and do it, then it's over and out."

"That's what I try and do, but I've got two brothers who are always [difficult]. And I do it later when it's about half five."

"Yeah, I have to do it late at night otherwise it can't really be done."

"We normally get homework for like the weekend, so I do it like, Sunday morning or something. "

"It's very rare that we get homework in the week or like on Wednesday and say it has got to be in for Thursday. But if we do get it like that I normally do it at about seven o'clock."

"I do it when my mum gets home from work because she's a teacher so she doesn't get in till later and I have to wait for her so she can make sure I'm doing it right."

Interviewer, Child 1, Child 2, Child 3 and Child 4, Year 6, Primary School 2.

Again, this paints a picture of children and family members actively managing the homework situation to their advantage, and suggests that there were clear strategies used by families to optimise the homework situation.

The discussion of timing relates to two different themes that will be taken up in the following chapters. Firstly, timing was an additional way in which children indicated that they could manage their homework activities for certain effects. Chapter 5 will show how the times children chose complimented homework styles in more detail. Secondly, Chapters 6 and 7 will consider how the routines of family members could be an important element affecting the design of technologies to support family involvement, as these different strategies require different approaches to be taken to involving family members.

4.8 Conclusions

The main contribution of this chapter has been in mapping out a path for future research. It identified some key elements of context in homework, and started to answer some questions about the homework ecology that have so far gone unanswered.

A major theme in this chapter was that the ecology into which homework technologies will be introduced is complex at best. Supporting the diversity of tasks, families, locations and times in which homework is completed is obviously a challenge for technology designers. This diversity illustrates the importance of this thesis in providing a description of how the ecology affects and interacts with networked technologies. However, there are also other findings which give more specific contributions to taking this research forward, which are presented below.

Focusing on secondary schools

The first point to be taken away from this chapter is the spread of homework tasks across school years. There were some differences in the type of task that children were participating in between years 5 and 8, but overall all year groups seemed to participate in a large number of tasks which would benefit from shared home and school links. This indicates that the mixed sample of primary and secondary school children to be studied in Chapter 5 – due to restrictions in the kind of families which could be recruited – should not cause an inaccurate picture of the kinds of activities which need to be supported by homework technologies.

Secondary school homework in particular seemed to involve a large proportion of complex tasks which would benefit from the use of home-school networks and other types of home-school link. Again, this supported the usefulness of concentrating of this thesis on the application of home-school networks in secondary schools, as seen in Chapters 5, 6 and 7.

Families actively managing homework

The quotes taken from the interview focus on the ecology of the home, and homework's place within it, painting the picture of children actively managing their homework: working with and around technologies, family members, locations and routines to allow homework to be completed in the most expedient or fruitful manner.

There was evidence from technologies, family and location that children balanced positive and negative elements within homework. However, as homework is managed it is necessary to ask why apparently negative elements of homework are allowed to intrude at all. There are some situations where an explanation of children's tolerance of distraction into homework is easy to understand: the example in the family section above shows that distraction from parents can be tolerated as they also provide help. However, the discussion groups showed that siblings interrupted homework more than they helped with it, and so the benefit of doing homework when siblings were around was questionable.

Some interpretations of these findings are less than positive. For example, it is possible to interpret children's use of distracting homework areas as an attempt to make homework seem more enjoyable by doing homework in locations where entertainment technologies and other family members are available. Another suggestion, recently featured in the press ("Students 'lacking homework space'", 2006), is that children lack the space in the home to choose more appropriate locations. However, neither option fits well with the picture of children and families actively and competently managing their homework that has been presented here.

Chapter 5 will therefore focus on understanding in more detail why children choose potentially distracting homework situations, arguing that distraction and help are available in the same niches within the ecology of the home, and that supporting children in negotiating access to their homework in these potentially distracting circumstances is a key aspect of the homework design space.

Children managing their homework

Many of the findings in this chapter refer to themes that will prove important in Chapters 5 to 7. However, those chapters will discuss in-depth work conducted with a small group of families: eight in the case of Chapter 5, and three in the case of

Chapters 6 and 7. This chapter provides evidence that many of the decisions that these families make – primarily about when and where to involve other family members – are common to a wider sample.

Choice of location seemed interlinked with distraction and involvement in this chapter, and the particular role of ecological niches within the home will be investigated further in the next chapter. However, this chapter has shown that it is more than the physical aspect of a niche – the space in which homework takes place – but its social properties as well, such as its place in the routine of the household, which are important to children in defining the context of their homework activities. Chapter 5 will unpack this idea further. It will investigate exactly how homework is coordinated at ground level. Together Chapters 6 and 7 will go on to present evidence that the process of actively including or excluding family members could be significantly changed by the introduction of home-school networks.

5 Opening up and closing down homework: A video ethnography of the everyday practice of homework

This chapter will present video diaries conducted with seven families, looking at their current homework practices using video diaries. It will consist of three major parts. It will look at ways in which technologies used in homework support collaborative work – opening up homework to family members – and independent learning – closing down homework from family members so children can work alone. Further, it will consider how technologies mediate the opening up and closing down of homework throughout an activity. Finally, it will look at some specific examples of this process in action, and consider the differing ability of children to open up and close down homework when using paper and computer technologies to mediate work.

5.1 Video ethnography of the home

Having established that a wide range of types of homework tasks, locations and family involvement were seen in homework in the discussion groups in Chapter 4, this chapter will investigate how these factors interact within the ecology. A video diary approach situated homework practices within the wider context of the household with families recruited to make diaries of day-to-day activities.

5.1.1 Design

A video diary study was chosen to record the participants' activities. As with the mail studies used in the Equator project (Crabtree et al., 2001) participants were given direct control over the cameras, and what was filmed. Family members appeared more comfortable with the idea that not all their interactions would be filmed, and this method allowed recording in some areas where a permanent camera would have been ethically inappropriate – such as children's bedrooms. It also reduced the filming of excess footage.

Eight families were recruited to take part in the research. Mindful of the challenges involved in conducting research in the domestic (Birnbaum, 1985; Forester, 1989; Hindus, 1999; Mateas et al., 1996; O'Brien & Rodden, 1997; Venkatesh, 1985, 1987), the decision was made to recruit families with a contact member known to the lead researcher: either the mother or father. It was hoped that this would make the families more willing to take part, and increase their buy-in into the project. Each participant was equipped with a small handheld video camera, an instruction booklet, and three mini DV camera tapes to record their diaries.

The researcher arranged a meeting for the handover of the video camera. In two families this took place at the participants' home, however, where the families were less well acquainted with the researcher, the handover took place at the contact parent's place of work. Where the homes were visited, presentation effects towards the researcher were apparent to some extent (although this might be expected at the start of any ethnographic study). Within the video diaries, once the intrusion of switching the camera on was over, parents frequently reported that they or their children ignored the camera, or even that they were surprised at how their interactions appeared when looking back at the tapes. However, one family in the main section produced no homework clips, and mostly brief shots of technology use, making their data impossible to fit within a universal analytic scheme. They were therefore removed from analysis and only seven families were full participants in the study, as described in the participants section.

5.1.2 Ethics

As mentioned in Chapter 2, collecting video data of families, and particularly children, in their own homes, is a sensitive activity. In order to ensure that family members were willing to take part in the study, the contact parent from each family was asked to fill in a consent form for this study, all adults (over 18) were asked to sign to agree to their participation in the study, and the contact parent was encouraged to ask children if they were comfortable with their involvement in the video diary. The consent form can be found in Appendix 5.A: Consent form.

It was also acknowledged that consent to participate in the study did not necessarily mean that family members were willing to have every aspect of their lives on tape. As a consequence, families had full editorial power over the tapes they gave in, and were encouraged to rewind and record over sections that went wrong, or which they were uncomfortable sharing. It is possible that such a procedure might introduce bias into the diaries, with the families only keeping clips which portrayed ‘good’ homework practices. However, few families reported erasing any data, and said they did so only when they felt the clips had not captured anything interesting or relevant. This suggested that the strategy was mainly beneficial, giving the families an increased sense of privacy without loss of data.

Standard privacy and feedback were provided, as discussed in Chapter 2. As demonstrated in the pictures used to illustrate this chapter, children’s faces were digitally obscured in all publications and other deliverables arising from the study to preserve their privacy. Finally, the names used in this chapter were randomly assigned to preserve anonymity.

5.1.3 Participants

The demographics of the seven families producing video diaries analysed in this chapter are given in Table 5.1a.

Table 5.1a. Showing the participants in the study

Family	Parents	Occupation of contact parent	Children	Age of child	School attended
Beech	Mother and Father	Mother: primary school teacher	Emma	8	Primary
			Gary	7	Primary
Eddison	Father and Mother	Father: primary school teacher	Gail	12	Secondary
Forth	Mother and Father	Mother: postgraduate student	Luke	14	Secondary
Parker	Father and Mother	Father: university lecturer	Rob	10	Primary
			Isabel	8	Primary
Randall	Mother	Mother: secondary school teacher	William	11	Secondary
Simpson	Mother and Father	Mother: primary school teacher	Ben	10	Primary
			Paul	9	Primary
Waterbeck	Father and Mother	Father: university lecturer	Chris	14	Secondary
			Abi	16	Secondary

As can be seen, a mix of families was represented in the participant set: two- and one-parent families, and one to two children of different genders. However, all were from reasonably homogenous socio-economic backgrounds, all the contact parents were involved in education, either as a teacher or a University lecturer, and all families had at least one home computer. This was a downside of the sampling method used in recruitment. However, there were no obvious differences between the activities captured in the video diaries and those described by the wider population sampled in the discussion groups in Chapter 4.

5.1.4 Video Diaries

The video diaries were filmed in two groups. The first was the pilot, where two families were asked to make diaries in order to identify issues in gathering the data. The main study was then completed with the remaining six families. The slight differences in these two stages are outlined below.

The Pilot

The Parkers and the Waterbecks were included in the pilot. Pilot work began with an open brief to families to film video diaries surrounding their life at home. Cue questions suggested families record meals, work (school and general), television, computers, and key events (arriving home and last-minute activities):

- Does everyone in the house eat meals at the same time?
- Where do people watch TV in your house?
- What gets done at the last minute?
- Can you follow a piece of work (office or school) through your home?
- How do you leave the house in the morning?
- Which activities do you tend to do on the computer?

A filmed house tour and a map of main rooms and technologies were requested to orientate the researchers.

The pilot families kept the video camera for one and two months, due to differences in the amount to which each family felt they had completed the brief. However, most filming was concentrated within a two-week period for each family, indicating that families became less motivated after this period of time. The main study was therefore shortened to two weeks accordingly.

Feedback suggested that the openness of the brief in the pilot meant families were often left unsure what to film and what not to film, with participants generally deciding not to film when unable to make a decision. A more closed brief was developed for the main study. Therefore the only difference between the pilot and main studies was the timescale and the specificity of the instructions.

The Main Study

The remaining six families' diaries (five usable diaries) were streamlined to two weeks. The brief of the main study was to film pieces of at least five to ten minutes' length for each diary section. Each family was asked to film two examples of seven different activities, one per week, although it was emphasised that they could replace activities with equivalent ones if necessary, or film more examples if it seemed appropriate in order to describe their home life accurately. The seven activities were:

- Use of the computer
- Use of the television
- Use of a technology of their choice
- The life story of a piece of homework and a piece of work
- The family coming home from work and / or school
- The organisation of a meal

One of the families in the main study (and also the family whose data was discarded) was reluctant to provide tours of the house, seeing this as a security risk. In this case the map was used as the main orientation device.

The Data

The data from the video diaries collected was transferred onto a video editing programme, and then split into individual ‘clips’, the boundaries of which were established by a family member switching on and switching off the video camera. As can be seen in Table 5.1b, there was some spread in the amount of data captured, with families recording between 20 and 130 minutes of data, and 10 to 30 clips overall. However, as will be seen in the later analysis, all families produced at least one clip of a child doing their homework, and longer videos tended to focus on a wider range of household activities, i.e. reflecting families who seemed to have responded to the instruction to “film more examples if it seemed appropriate in order to describe their home life accurately”. Appendix 5.B: Data produced by the Eddison family and Appendix 5.C: Data produced by the Simpson family contain timelines showing the length of time (in minutes and seconds) of the clips making up the whole Eddison family and Simpson family diaries, for an idea of the typical spread of activities seen.

Table 5.1b. Showing the clips produced by each family

Family	Length of video (hr: mins: secs)	No. of clips produced	Mean length of clip (mins: secs)
Beech	1:30:53	15	6:04
Eddison	0:25:54	10	2:35
Forth	1:58:51	30	3:58
Parker	1:09:47	22	3:10
Randall	1:18:33	13	6:03
Simpson	2:10:03	19	6:51
Waterbeck	0:20:31	13	1.35

5.1.5 Analysis

Analysis began with an initial sweep of the video diaries, from which homework and related work activities were picked. Related activities were clips showing family members doing their homework, or conducting an activity which could have been realistically set as homework.

Chapter 4 presented children as actively managing their homework activities and family involvement seemed to be a major part of their shaping of the activity. In addition it highlighted that children often seemed to be around their family members at times when this might be distracting. Therefore, the analysis of this chapter will concentrate on the contrast between involved and uninvolved family members in homework, to see exactly what benefits children seemed to obtain through this choice. Chapter 2 highlighted the importance of considering all aspects of an ecology to be socially meaningful, therefore children conducting homework alone cannot be thought to be outside of the social influence of the family: the choice to do homework away from the family is as much a socially meaningful choice as doing it together. Therefore understanding the motivation and mediation of independent study is just as important as understanding that of collaborative study.

No piece of homework completely embodied collaborative or independent work, a fact the findings will consider in more detail. However, there was good evidence for 6 clips showing primarily independent learning, and 6 clips showing constant family involvement, out of 22 total clips. These 12 clips were analysed to see how elements of context potentially supported the aims.

For simplicity's sake the elements of context analysed in this section were reduced to two:

- The ecological niche, or place in which the homework was completed: this combined the elements of location and timing of homework from Chapter 4 with the social factors behind that choice. Given the in-depth information available in the video diaries, each clip could be contextualised in terms of a place defined by time and location together.
- Aspects of the technology the homework was completed with: this was a direct reflection of the technologies involved in completing work in Chapter 4, and an examination of how the technologies mediated each activity.

The homework tasks were set by the teachers in the children's schools and family involvement is the focus of this study. These elements of context from Chapter 4 were therefore studied separately. The focus of analysis was how independent or collaborative study was supported by or undermined by properties of the home ecology. In independent work, the focus was on how place and technology closed down the homework situation from family involvement. In collaborative work, the focus was on how place and technology opened up the homework situation to family involvement.

Intermediate homework styles

The remaining 10 clips consisted of a mixture of independent and collaborative work, either involving clips where children experienced both, or where they were involved in independent work but the situation was such that they could easily consult with other family members.

Although the discussion groups in Chapter 4 presented evidence that children make active choices about the way to handle their homework, children were not necessarily free to pick place and technology for every homework activity. In the video diaries, family members were not asked to provide rationales for their choice of place, and it was not clear whether family members actively chose a place and technology to complete their homework based on their intent to conduct the homework in one style or another, or whether their homework style was driven by the places and technologies that were available to them. There is, in fact, reason to believe both to be true. Children's reports in Chapter 4 that they actively chose their homework location gave some evidence that homework style drove choice of place. However, children may have been restricted in their choice of place: they might have no private unshared bedroom, or be out of the house on a particular night. They could also be restricted in their choice of technology: whether they possessed a particular piece of software, or whether the teacher had set a technology-specific homework, such as filling in a worksheet.

However, these examples will show that, intended or not, there is a beneficial association between homework style, homework place and the design of homework technologies. This implies that as long as both independent learning and family involvement are to be preserved – as long as there are benefits to children attempting work on their own and in conjunction with family members – it is important to preserve or to mimic the factors allowing children to 'close down' or 'open up' work successfully.

Supportive factors and affordances of technologies

In order to understand how technologies support the opening up and closing down of homework this chapter will look at the aspects of technological design currently shaping homework. This will be done by looking at three aspects of the technologies, their general properties, affordances and body moves. The early illustrations of opening up and closing down homework presented in Sections 5.2 to 5.4 will focus on general properties and affordances of technologies. Body moves will be considered in Section 5.5.

The properties of technologies are those aspects of technology which restrict or encourage certain kinds of use. One example, featured later in the chapter, is that technologies which are visible from a distance are better at opening up homework, as family members can see what children are doing and become more easily involved. The property of visibility allows or encourages this process to happen. A more specific variety of property is an affordance. The original definition of affordance was proposed as an element of perception by Gibson (1979), and was first used in design by Norman (1988). Gibsonian affordances refer to the actions that physical properties of an object make possible for an actor. Paper, for example, is light and thin, which gives it the affordances of mobility and fold-ability for an average human being. The properties of homework technologies – general properties and affordances – used by the children in this chapter in opening up or closing down homework will be considered to identify properties which could be replicated or mimicked for similar effect.

5.1.6 Presenting the results

The clips which represented examples of work being opened up or closed down will be presented in the next two sections. Analysis will concentrate on how properties of the place in which homework was completed, and properties of the technology – described as 'supportive factors' for the way they support the style of homework used – close down or open up homework. Section 5.4 will look at activities where work could be closed down and opened up throughout the activity, and will show how a process of closing down work called 'huddling' was used to achieve this.

5.2 Findings: Opening up work

'Open' work represented work where sharing of the activity was high. The next two sub-sections will present examples of 'open' work from the Parker family, involving making a sandwich, and the Simpson family, involving use of the computer. The third will then present the remaining four examples of 'open' work seen in the diaries.

5.2.1 'Open' work example: The Parkers

Figure 5.2a shows a typical open piece of work from the diaries. Rob was making a sandwich as a school project. He was standing in the kitchen at the start of the day, and his parents were around getting ready to go to work. The activity involved making a 'healthy' sandwich, which Rob was putting together to take to school that day.

Figure 5.2a. Rob making his sandwich

On the table next to him was a letter from the school, filled in by Rob from a template, informing the parents of what was needed in the activity – a school-driven attempt to create a shared activity. Parents were politely asked to provide the materials necessary for the sandwich, and the letter ended *"thank you for helping me"*. As well as the father filming the activity, Rob's mother was also involved in its completion, helping cut and wrap the sandwich. What is more, she was involved in a good deal of educational talk around the activity, asking questions such as *"Is the idea that you had to make a healthy sandwich?"* and *"What about white bread, is that healthy?"*

Place

The activity had to take place in the kitchen, which automatically put it into a room where interaction was commonly high. The kitchen table afforded supporting and laying out the technologies, increasing their visibility and accessibility.

Supportive factors

The materials used to make the sandwich were highly visible, and this made them easy to see and hence easy to share.

The parents' involvement in making children aware of the learning point behind the activity – what makes a healthy sandwich? – and their involvement in activity – providing the food and preparing it – were partly shared because the letter explicitly asked the parents to be involved.

5.2.2 'Open' work example: The Simpsons

The Simpson family also recorded examples of 'open' work where family involvement was high. In this particular example Ben was searching for information on the computer, and his mother, father and brother were standing watching – his father was actively helping, and his mother was filming and occasionally commenting. Ben asked for his father's help in finding websites on the computer *"because it takes me ages to write in, and then I write it in wrong, and forget to put dot com on the end"*. He went through several sites, including the service provider's site where they started, the CBBC (child specific BBC site) and Newsround site after that, and then eventually a football-related site. Paul was standing to one side of the computer, interested in the activity, and asking questions.

The computer in the Simpson house was placed in an upstairs study / spare bedroom, which seemed to be used by all the family, although the video diaries only showed the children using this computer – the mother had a laptop which she used to do her own work at different times. From other clips it was clear that this room could be used either as a private room to study alone in, or as a joint entertainment / information centre, as it functioned in this example.

Figure 5.2b. Ben at the computer, his father leaning over, and Paul to one side

The family shared the screen. At several times Paul looked over and asked questions about Ben's search, *"why does it, why do you have to do that, why does it say user over there?"* and his father leant over to help access various sites, even typing in the URL when necessary, as seen in Figure 5.2b.

Place

This room was not often used as a communal family area, and the fact that all the family were gathered in it suggested that they had all chosen to be involved in the homework, rather than being coincidentally present.

Supportive factors

The fact that a large screen was involved meant it was easy for the family to share elements of the homework together: mainly due to its size and its orientation against the wall. Then meant that even the mother, standing at the back of the room, was able to join in with suggestions.

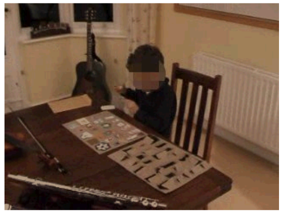
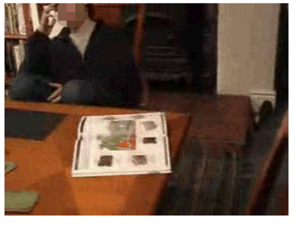
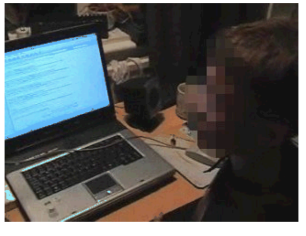
Exceptions

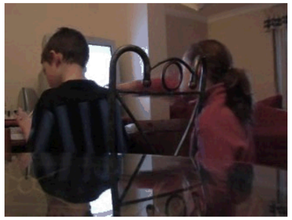
The keyboard input was difficult to share, and even though the family was drawn into the homework through the easy-to-view screen, the keyboard and mouse interface offered poor Gibsonian affordances for anyone not sat directly in front of the computer, making it difficult for the parents to participate in controlling the computer.

5.2.3 Other 'open' work examples

Similar approaches to homework assignments were seen in multiple families across the homework diaries, as shown in Table 5.2a.

Table 5.2a. Showing other examples of 'open' work from the video diaries

Scenario	Still	Place	Design	Exceptions
Rob at the living room table		Rob uses the living room, a communal space, and his father helps him construct the advent calendar. The table lays out the calendar so it is visible and accessible to all.	The advent calendar is visually appealing, and the work visible, so that it is easy for the father to become involved.	
Chris at the kitchen table		Chris chooses the kitchen as he has arranged for his father to test him on his revision. As they choose a communal area for this, other family members are also around.	The textbook is colourful and clearly laid out: there is no particular need to draw the father into the activity, but this allows him to quickly assess the material and test Chris.	The textbook has to be turned to each person so they can read the text. The closes down use, but does support the activities, as it helps in hiding the answers from Chris.
William at laptop		This is a communal family area, which William and his mother both frequently use.	The laptop screen allows visibility of the activity from behind the chair, where William's mother is standing. The bright colours of the webpage are visually appealing.	The space to view the laptop is somewhat constricted and the mother has difficulty inputting information on the keyboard.

Scenario	Still	Place	Design	Exceptions
Emma and Gary at the computer		Emma and Gary are sat in the living room, with their father and mother in the corner, so there is lots of family interaction. The computer faces into the room so it is visible to those passing by.	The screen makes their activities highly visible, and the webpages are brightly coloured and visually appealing.	Emma and Gary have difficulty sharing the keyboard.

5.2.4 General ‘open’ work

The examples of open work shared several properties, which are summarised below in terms of place and supportive factors.

Place

The places children completed work with family involvement included the kitchen, the study and the living room. These were all either communal areas, where family members were constantly passing through, or, in the case of the study, an area where family members had joint rights to use the space. All the rooms were being used simultaneously by other family members. In some cases – Chris revising in the kitchen for example – the two family members had chosen to meet each other to work on the homework together.

The study areas chosen in these examples were tables; these seemed to function as efficient workspaces to manage and display work or as the location of a computer or laptop.

Supportive factors: visual properties and mobility

Table 5.2b shows the properties which were useful in drawing family members into homework, or the properties which supported a fully involved set of activities with the child and other family members.

Table 5.2b. Showing properties allowing work to be opened up

Scenario	Technology	Properties allowing work to be opened up	
		General properties	**Affordance**
Rob makes a sandwich	Sandwich ingredients	Visible, so parents can easily see what is happening.	
	Instructions on paper		Mobile at a macro level, so can be carried home and shown to parents.
The Simpsons use their PC	Computer screen	Visible, so family can easily see what is happening.	
Rob at the living room table	Advent calendar	Visible, so father can easily see what is happening.	
Chris at the kitchen table	Textbook	Well laid out, so father can quickly access the contents.	Mobile at a micro level, so can be picked up and rotated away from Chris.
William at the laptop	Laptop screen	Visible, so mother can easily see what is happening. Visually appealing, so the mother becomes interested in involvement.	
Emma and Gary at the computer	Computer screen	Visible, so family can easily see what is happening. Visually appealing, so the family become interested in involvement.	

There were two overall properties which supported family involvement. The first was visual properties; when technologies were visible other family members could see what the activity involved, and when well laid-out family members were able and tempted to join in. The second was mobility, either over a distance – macro-mobility – or within the physical boundaries of those involved in the activity – mobility at a micro level. This allowed flexibility of involvement, and supported opening up of homework to other family members.

5.3 Findings: Closing down work

Closed work represented work where little sharing of information took place. These following sections will present examples from the Eddison family, showing mostly ‘closed’ work taking place in a bedroom and the Forth family, showing mostly ‘closed’ work taking place at the computer. The remaining examples of closed down work will then be discussed.

5.3.1 ‘Closed’ work example: The Eddisons

Gail was working on her homework in her bedroom, at a desk, with the book in front of her, as seen in Figure 5.3a. Although the door to her room was open in the diary, Gail’s room was away from the main area of the house. In an earlier clip from the diary Gail prepared to go upstairs to start this work. There, in the public space, talk around her homework was reasonably free. The entire family was around in the living room where her bag was kept, but remained there when she went – her father commenting, “off she goes upstairs to do the homework”. The video diary then continued with commentary on technologies downstairs, suggesting that the parents were happy to leave Gail completing the homework on her own.

Figure 5.3a. Gail working in her bedroom

In the next clip her father was seen climbing the stairs to come and film her completing her homework. Her room was therefore separated from the rest of the family, unless particular effort was made to make contact. The father attempted to talk about the homework, saying *"Fractions, hey? Lucky you"* but Gail only muttered in return. Information sharing was therefore limited. Gail had already completed a large quantity of her workbook, which she referred to as she completed the activity, and was making her way through the exercises.

Place

Gail was doing her homework in her bedroom, which she did not share with anyone else. Her choice of room complemented the work she had been set, as she had privacy for concentration on the questions, a desk allowing individual access to the workbook, and a lack of distraction from either the family or media. She had chosen to use the bedroom at a time when the rest of the family were downstairs, although the fact that she did not share the room suggested that it would be an ideal location to close down work at most times of the day.

She had also chosen to use a desk which faced the wall, meaning she was unlikely to be distracted from her activity by events happening around her, as shown by her persistence in studying while filmed by her father.

Supportive factors

The fact that the workbook provided all the knowledge that Gail needed to do the activity supported independent learning well and helped close the homework down. Although this was not a property of the technology itself, the use of a paper workbook meant that multiple types of information could be bound together, something that is not possible with some types of technology, such as the tangible materials used in the sandwich making task described in Section 5.2.1. The relevant property of the technology was its self-contained nature, as one technology contained all the information that was necessary to complete a piece of work.

The workbook was clearly laid out, but the text was small, and as the video shows, the father and daughter did not find a lot to talk about in the activity. The father could see that there were sums, but the workbook was not designed to be appealing to observers.

Exceptions

Although this was a ‘closed’ example, a certain degree of family involvement was possible. Gail left her door open, and was happy for her father to film this brief segment of homework, even though she did not appear to wish to talk to him for long.

5.3.2 ‘Closed’ work example: The Forths

Figure 5.3b shows Luke talking about the homework he was about to do on the computer. This was the editing of an essay he had previously completed based on feedback from his teacher. He had this on the sheet from the previous draft, which was folded up inside his homework diary.

He was sat in the study, which was a narrow room, mainly furnished with the computer and other equipment. It was immediately on the left when entering the house, and backed onto the dining room, meaning other family members passed by fairly regularly during the time when they were returning home. On the other hand they were usually occupied elsewhere in the evenings, when this piece of work was taking place.

Figure 5.3b. Luke sits with the corrected essay and his original file

His mother was videoing the clip, but at the end Luke turned towards the screen and the camera was switched off, so it appeared that he would be working on the activity alone.

Place

The study represented a slightly different space to the bedroom described in Gail's example: it was a location which was used by the entire family at different times of the day. However, the room appeared cramped for more than one family member, and Luke completed his work at a time when the rest of the family was elsewhere.

The study area around the computer was quite limited in space, suggesting that it was rarely used by more than one person, and the screen was difficult to view from the side. This meant that Luke was unlikely to be distracted by other people, and they were unlikely to view and become interested in his work.

Supportive factors

Luke had to manage multiple resources to complete the activity – the paper-based homework diary, the piece of paper with his teacher's feedback, and the original word document. However, as with Gail's example above, the activity was very self-contained – it did not require him to seek out additional sources of information.

The affordances of the paper included fold-ability used to fold up the paper inside the homework diary, meaning it reminded Luke to complete his work. The paper was also light and its micro-mobility allowed it to be viewed from a variety of angles, making it easy to use multiple sheets together. However, both paper and word processing software were text-based, so even if a family member did enter the cramped space around the computer, it would be difficult to quickly grasp the content of the activity. The computer screen could also not be seen from the angles available to another family member entering the room.

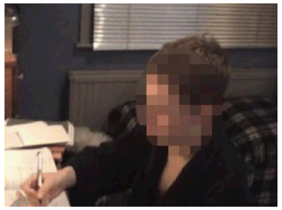
Exceptions

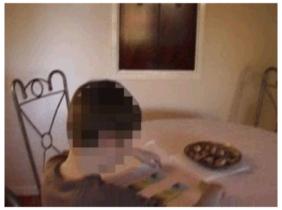
The macro-mobility of the paper would allow Luke to carry the details of his activity to other rooms and ask his parents questions if he wished.

5.3.3 Other 'closed' work examples

Similar approaches to homework assignments were seen in multiple families across the homework diaries, as shown in Table 5.3a.

Table 5.3a. Showing other examples of 'closed' work from the video diaries

Scenario	Still	Place	Design	Exceptions
Emma at the kitchen counter		The work is taking place during a time when the kitchen is not being used, even though this is an area used by the rest of the family.	Emma only uses the exercise book, and seems to be writing a piece based on her opinion / imagination. The text is small and it is difficult to grasp content from a distance.	
Luke in his bedroom		The bedroom is not shared, and the rest of the family is downstairs while he is using it, creating a private area.	He is answering sums in his exercise book with the paper allowing different representations of sums and questions. The text is small and it is difficult to grasp the content of the activity from a distance.	
William's bedroom		The bedroom is upstairs, where there is only one other small bedroom for his mother, which she rarely uses except to sleep. There is therefore good privacy.	The materials around William's desk include papers and pens, suggesting that he uses this area for work on essays and the like. These small text activities are unlikely to be visible to others.	

Scenario	Still	Place	Design	Exceptions
Gary in the living room		Gary uses the living room table, but at a time when the rest of the family are not around, and entertainment media are not switched on.	Gary seems to have all the information he needs to work on the activity on his own.	Gary continues with this activity later, as seen in Sections 5.4 and 5.5, and the visually appealing, simple materials encourage involvement.

5.3.4 General 'closed' work

As with open work, the examples given in these sections shared several qualities in common, which are summarised below in terms of place and supportive factors.

Place

Completely independent learning seemed to take place in areas where children either chose to avoid distraction, as indicated in Chapter 4, or ended up avoiding distraction as other family members were not around. The examples above all show children working in places which were private, i.e. the bedroom, or places where they could rely on family members not to be present, such as communal rooms during times of the day when other family members were usually not present.

Study areas involved desks, and computers or tables used as a solo work station. Children tended to be completely engaged with their work, i.e. sat completely facing the activity at hand.

Supportive factors: visual properties and combining information

Table 5.3b shows the supportive factors which were shown to be complementary with closing down homework in the homework clips presented in this section.

Table 5.3b. Showing properties allowing work to be closed down

Scenario	Technology	Properties allowing work to be closed down.	
		General properties	**Affordance**
Gail in her bedroom	Workbook	Necessary representations for activity available in one technology, no additional information or help needed.	
Luke at the computer	Computer screen	The angle of the screen means the activity is not visible.	
	Computer and papers together	Necessary representations for activity available in one technology, no additional information or help needed. Small text is unlikely to be visible or appealing to others.	
Emma at the kitchen counter	Exercise book	Small text is unlikely to be visible or appealing to others.	
Luke in his bedroom	Exercise book	Necessary representations for activity available in one technology, no additional information or help needed. Small text is unlikely to be visible or appealing to others.	
William's bedroom	Pen and paper	Small text is unlikely to be visible or appealing to others.	
Gary in the living room	Papers	Necessary representations for activity available in one technology, no additional information or help needed.	

There were two properties which complemented closed down work in these clips. These were the self-contained nature of technologies, so no additional sources of information were needed to complete work, and, again, visual properties, or a lack of visibility and visual appeal: the use of small text meaning that other family members would not be drawn to discuss the work, and angles meaning that work was not visible for others to see.

It is possible that these properties stopped work from being opened up to other family members, or just that in independent work it did not matter that these elements were present. However, the following sections will show how methods for reducing visibility seemed to be useful for negotiating the closing down of work when transitions between independent work and family involvement were seen.

5.4 Findings: Huddled work

Outside of the ‘open’ and ‘closed’ work styles, a third kind of clips was also seen. In this third style, transitions between independent learning and family involvement were seen, with children working in places similar to those seen in situations with ‘open’ work, but with the technologies mediating the closing down of the homework. Many of these examples showed evidence of children actively managing the involvement of others in homework. The ten examples seen in the following subsections involved a process that was labelled ‘huddling’. This involved actively closing off work while in a communal area, or a place where others were present, by shielding the work.

5.4.1 Huddled work example: The Waterbecks

Figure 5.4a shows a typical example of a huddled approach occurring within the diaries. Abi was working on an A4 pad of paper – apparently making notes, or writing an essay of some kind. She was sat on the sofa in the living room in the evening – a time when the rest of the family had often been seen watching television together in other clips. The living room led off the main hallway, and seemed to act as both entertainment and main seating area for the Waterbecks. Although the majority of clips in this family’s diary showed multiple users in the living room at once, only Abi and her father were present on this occasion – with her father having entered the room to record her activity on the diary.

Figure 5.4a. ***"Oh! Homework?"*** **Abi working on the sofa**

Papers were placed around Abi, taking up the entire sofa, and thus preventing other family members from sitting down, should they wish to join her. The paper was not only used as a technology to complete the homework, but was arranged around her, making it difficult to sit nearby. Abi and her father talked briefly – he seemed surprised to find her doing work, saying "Oh! Homework?" when he found her there, and the clip was short, suggesting that he did not feel comfortable interrupting her work for long. The closed nature of the activity could be seen by the signals that Abi was sending by her use of her immediate surroundings. On the other hand, the television was on, suggesting that Abi was not removing distraction from her surroundings entirely.

Place

Abi was working in the living room, during a time of day when her family frequently used this area, and she had the television on, suggesting she was not concentrating very hard on her work. She was sat on the sofa, a relaxed use of space, but had papers spread all over it, stopping other family members from sitting with her.

Supportive factors

The Gibsonian affordances of the papers' lightness allowed sheets to be arranged around Abi, creating a kind of barrier around her. This could be either an explicit signal that she did not wish other family members to intrude on her, or an unintended consequence of arranging her papers for ease of access. In either case, her use of papers was closing off the space around her.

Huddled elements

Abi had chosen a place where family involvement was possible, opening up the homework, but was using elements of the technology to indicate that she did not want to share the activity at this particular moment, closing down or 'huddling' over the homework.

5.4.2 Huddled work example: The Simpsons

In this second example, Ben used a digital music player to create the huddled work. Ben was working on a homework sheet at the kitchen table, highlighting formal vocabulary used in a letter as a homework activity. He was listening to the radio on a digital music player while he worked. His mother was busy in the background, stacking or washing plates, and then putting the kettle on to boil.

They were sat in the kitchen, where the Simpson children often seemed to do their homework while the mother carried on with household chores in the background. Most of the time they ignored each other, even while she cleaned around him, but when he asked a question, she came over to help, and he took his headphones out of one ear.

Figure 5.4b. ***"Is abrupt in formal vocabulary?"*** **Ben working at the kitchen table and getting his mother's assistance**

Ben interrupted his mother in her activities in order to get his homework help, and included her in his activities by removing the earpiece of his digital music player, so that he could interact with her more successfully:

[working on sheet with headphones in one ear]

<u>*[clattering of pans and kettle boiling]*</u>

"Mum! Is abrupt in formal vocabulary?"

<u>*"You what?" [starts to come over]*</u>

[reaches to take earpiece out] "Is abrupt in formal vocabulary?"

<u>*[mother is leaning over him at this point]*</u>

[finds word and points with highlighter] "There."

"Yeah."

[Ben puts earpiece back in]

Ben and Mother, Simpson Family.

Place

The kitchen was a communal space, and the mother was walking around it at the same time as Ben was completing his homework. Although the near presence of his mother opened up the homework place, Ben had closed down the homework by listening to a radio while he worked. However, Ben had the opportunity to involve his mother if he wished due to her proximity, and at one stage opened up the work by taking out his earpiece and asking her a question.

Supportive factors

The text on the paper used to complete the activity was only visible from close up, and the fact that Ben was huddled over the paper closed down the activity. The table's Gibsonian affordance of a large, supportive space allowed the papers to be laid out so they were slightly visible to his mother when she stood beside him, but also allowed the spreading of the papers around Ben in the same barrier-like fashion seen with Abi in the previous example.

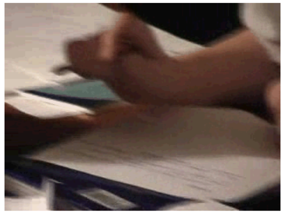
Huddled elements

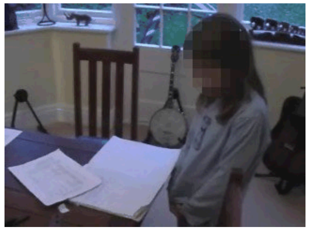
The work was closed down to the extent that the mother needed to come up and lean across Ben, as visible in Figure 5.4b. However, Ben actively drew attention to himself by asking a question. The fact that he was working in a communal area, during a time when his mother was also using the area, meant that he was able to open up the activity when necessary.

5.4.3 Other huddled work examples

Similar approaches to homework assignments were seen in multiple families across the homework diaries, as shown in Table 5.4a.

Table 5.4a. Showing other examples of huddled work from the video diaries

Scenario	Still	Place	Design	Exceptions
Chris at the kitchen table		Chris works at the kitchen table, when his family are moving around the kitchen, but the table allows him to spread papers out around him suggesting he is busy.	The papers allow Chris to form a barrier around himself suggesting that he is busy.	
Emma and Gary in the living room		Emma and Gary are working in the living room, but can call their mother in the kitchen for assistance through a hatch that leads between the kitchen and living room areas.		
Chris at the kitchen computer		Chris is sat at the kitchen computer, while the rest of the family is working around him. Using the computer means he has to face towards the wall, so he is unlikely to become involved with others.	The screen allows Chris to face away, and avoid being distracted by the other family members.	

Scenario	Still	Place	Design	Exceptions
Isabel at the living room table		Isabel is sitting in the living room, which is a communal and frequently used area, but has used the table to spread papers out around her, suggesting she is busy.	The papers allow Isabel to form a barrier around herself, and give the impression of busy work that is not to be interrupted.	Isabel gets up from her chair to talk to her father who is filming the diary: this gesture seems to suggest she is willing to stop the homework for the purposes of the video diary.
Ben and Paul at the kitchen table		Ben and Paul use the kitchen table while their mother is in the room preparing a meal. The table is used to spread out their papers, but each is huddled over his work.	The papers allow Ben and Paul to each mark out a section of the table for their own use.	
William on the living room floor		William is using the living room while the television is on, and the small table he uses is orientated towards the screen, allowing him to work with his back to his mother, shielding his work.	The papers and exercise books used to complete his homework can be hidden by his body or picked up and shown to his mother.	

Scenario	Still	Place	Design	Exceptions
Emma and Gary at the living room table		Emma and Gary are in the communal area of the living room, but both have papers spread out around them on the table, particularly in the case of Emma, marking out a work area.	The papers spread around Emma in particular create a barrier suggesting that she is busy.	Gary's activity here is much more open than Emma's, as will be shown in Section 5.5.
Ben at the computer		Ben is working on the computer, situated in the study upstairs. His mother comes into the room to hurry him up, reminded of him by the flushing toilet.	Ben is sat directly in front of the computer, so when his mother first enters she cannot see the screen. He has to invite her to look and share the activity, moving to one side to provide access.	

5.4.4 General huddled work

This mixture of opportunity for collaborative and independent work was managed, as described above, by supportive factors which allowed the closing down of work in areas where family members might otherwise be included. This formed the process of huddling.

Place

As described in the rest of this section, huddled work involved the use of communal areas. In this way the rooms seen in these examples were very similar to those discussed in the section illustrating open work.

The study areas, however, varied more, between the use of open tables, such as seen in more open work, and individual study areas, such as those seen in more closed work.

Supportive factors: visual properties and micro-mobility

Table 5.4b shows the properties which supported the huddling of children within these areas, closing down the activities.

Table 5.4b. Showing properties allowing work to be huddled

Scenario	Technology	Properties allowing work to be huddled	
		General properties	**Affordances**
Abi in the living room	Paper	Small text is unlikely to be visible or appealing to others.	Micro-mobility, the papers can be arranged as a barrier around Abi, discouraging involvement.
Simpsons in the kitchen	Paper	Small text is unlikely to be visible or appealing to others.	
Chris at the kitchen table	Paper		Micro-mobility, the papers can be arranged as a barrier around Chris, discouraging involvement.
Emma and Gary in the living room	Unknown		
Chris at the kitchen computer	Computer screen	Poor visibility, unidirectional screen means Chris is placed between screen and family.	
Isabel at the living room table	Papers		Micro-mobility, the papers can be arranged as a barrier around Isabel, discouraging involvement.
Ben and Paul at the kitchen table	Papers		Micro-mobility, the papers can be arranged as a barrier around Ben and Paul, discouraging involvement.
William on the living room floor	Papers		Micro-mobility, the papers can be placed so William is aligned away from his mother, or picked up and shown to her.
Emma and Gary at the living room table			Micro-mobility, the papers can be arranged as a barrier around Emma, discouraging involvement.
Ben at the computer		Poor visibility, unidirectional screen means Ben is placed between screen and family.	

The main properties which appeared to be of use in closing down homework in these more communal areas were similar to those seen in closing down homework. Again, small text made it difficult for other family members to become involved, and viewing a computer screen from an angle or directly behind a child meant poor visibility for other family members. On top of this, the micro-mobility of paper was used, intentionally or otherwise, to create a barrier around children working, which might discourage involvement. This micro-mobility meant that children could tweak the visibility of technologies to other family members.

5.5 Findings: Mediating huddled work

This final stage of the analysis will investigate the ability of different technologies to support this huddling process, and show how well the concept of huddling is mediated by computer-based as opposed to traditional paper-based homework technologies. This follows Sellen and Harper (1997, 2001), who compared these two types of technology in the office, to suggest why paper-based technologies were still so popular in this context.

The previous sections of this chapter have shown how the properties and affordances of technologies potentially support children in opening up and closing down homework. This section will look at some specific actions which were used to negotiate the opening up and closing down of huddled work, and how the affordances of two kinds of technology, traditional paper-based technology and the home PC, support these actions differently. The concept of 'body moves' will be used to describe these actions-with-technologies.

Body moves

Alongside the concept of properties and affordances, this section will use the idea that cooperative work is facilitated by both dialogue and 'body moves' (Gill, 2004; Gill et al., 2000). Body moves describe the bodily gestures that accompany speech in collaborations. Rather than just echoing speech, as with generic hand gestures, body moves replace, precede or enhance speech. Body moves are focused on the object of collaboration – the technologies in these examples.

Three body moves are relevant here, as they specifically attempt to change the dialogue partner (or prospective dialogue partner)'s focus. These are important as negotiation of a helper's involvement in homework is a fluid process in huddled work:

- The attempt-contact body move involves one participant in the dialogue drawing attention to an entire activity by moving into the bodily field of engagement of the other, enabled with eye contact or a bodily gesture. Varieties of the attempt-contact happen constantly in huddled work – with gestures such as the display of a certain piece of work and eye contact being essential for drawing in a helper.
- The demonstrative reference body move, which happens once attention is caught, directs attention at a micro level, focusing by pointing at the technology.
- The focus body move involves a similar focusing of attention which is achieved by one participant leaning in towards a point of interest, and taking the focus of the other with them.

A technology which is easy to gesture around – supportive of body moves and other actions – makes sharing of activities a lot easier and can demand less coordinating dialogue between collaborators (Gill, 2004).

This section will continue with two sets of vignettes, one using paper, and the other using computers, to demonstrate how interactions between family members seemed to differ depending on how the affordances of the technologies supported these actions and body moves.

The activities presented are not directly comparable; in both computer scenarios, the degree of interaction might be expected to be higher than in the paper examples, as the computer activities involved the internet, a complex resource to navigate. This was reflected in the placing of both paper-based examples in the 'huddled' examples section, and the placing of both computer-based examples in the 'open' examples section. However, it is the level and quality of negotiation rather than its frequency is of interest here.

5.5.1 Paper example: The Randalls

In this example, William was asked to draw a version of his family tree in Spanish for his homework. His mother was involved in the activity as he needed her to put together an English version of the family tree for him to translate into Spanish. Both large scale huddling moves and smaller body moves were used to negotiate her involvement in the activity, and the technologies supported this.

The Randalls were sat in their living room, and William had a small table put in front of him so he could do his homework on the floor in the evening. His mother was sat at the side of the room, watching television as William completed closed elements of the activity. William stayed at his homework table during the course of the homework, and his mother was brought into the activity through body moves.

Physical signals

The summary of the place and supportive factors involved in this homework can be found in Section 5.4.3 on 'other huddled work'.

1) Opening action

William and his mother were discussing the ordering of his homework activities:

> *"Which one?"*
>
> *"Let's do the family tree now that we, we're there. So. Pass me a pen and I'll put it on the back of here… I'll write it in English and then…"*
>
> *"[William hands over pencil] That's my… [he points at the piece of paper she is about to use] my homework!"*
>
> *"You need it for school?"*
>
> ***William and Mother, Randall Family.***

William's mother agreed to take part in the activity, and he provided and negotiated the resources which she needed to take part – using the large-scale action of handing over the pencil to cue her involvement. The pencil doubled as both a technology to complete the activity, and a symbolic action; William was figuratively handing over control of the activity to his mother with the pencil.

2) Opening body move

William then clarified his message about which piece of paper to use by using the demonstrative reference body move to make sure that his mother was using resources appropriately, pointing at the relevant piece of paper.

Figure 5.5a. ***"That's my homework!"*** **William hands the pencil to his mother (off-screen) and protests at her choice of paper**

Figure 5.5a shows that William was turned towards his mother, off-screen on the left of the picture.

3) Huddling gesture

As soon as his mother provided the relevant information – in this case, the family tree, William turned back towards the table and carried on with his work. With both William and mother facing the television, this meant William's back was to his mother while working on the closed part of the homework, as shown in Figure 5.5b. William was using huddling, closing off the work from his helper at a point where she was not needed.

Figure 5.5b. William completes his family tree in a huddled manner

Huddling acted as the opposite of the attempt contact body move, using a disengagement of eye contact to close down the homework, indicating the mother was no longer needed in the activity, and allowing William to work. The small table William had chosen to use, and the fact that they were both facing the television while working, allowed him to face away from her in a style that would appear either unnatural or impolite should they both be sharing a work surface.

4) Verbal negotiation and a huddling gesture

Later in the clip the television programme came to an end, apparently alerting William' mother to the time, and the mother made an effort to become involved with the activity, asking him to complete it faster:

"See if you can get on a little bit faster with that…"

"I'm done – I only need to write one more word."

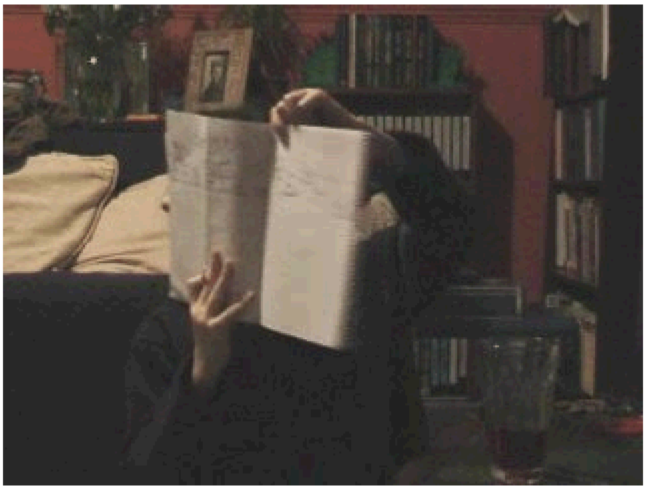
"Oh, well done!"

[turns back to the table, working quietly for a minute. He then picks up his exercise book and turns to show it is finished, while speaking] "It's a bit further along than it is down, isn't it?"

William and Mother, Randall Family.

In this case, the mother was also able to open up the homework activity, but used a more explicit verbal signal to do so.

Figure 5.5c. *"It's a bit further along than it is down."* William shows his mother the completed tree



In response to his mother's inquiry, William broke eye contact and returned to his solo attempt at the homework for a while.

5) Opening body move

Lastly, William used an attempt contact body move of turning to his mother and displaying the book, as seen in Figure 5.5c, to show that the activity was finished. The ability to perform this movement also relied on the variability of expression of paper, allowing her to gauge the completion of the tree at a distance without seeing the exact words.

This entire sequence of negotiation was achieved without William's mother having to move from her position. The fact that the television was on gave her something to focus her attention on when not taking an active content-supporting role, and allowed William to close down the activity while he was completing elements for which he had the information.

5.5.2 Paper example: The Beeches

The second example will focus on Gary's homework, making a flicker book out of materials provided by his teacher at school. A flicker book is a set of drawings changing slightly on each page, which can be flicked through in order to generate an animation. Such an activity uses paper, but in a highly visible and visually appealing form, reflecting the qualities seen opening up work.

Gary and Emma were sitting at the main table in the family living room, which also functioned as a dining area for the family. Emma had previously completed this assignment when she was in Gary's school year, making her well-qualified to help Gary.

Physical signals

The summary of the place and supportive factors involved in this homework can be found in Section 5.4.3 on 'other huddled work'.

1) Opening body move

Emma made an attempt-contact body move in coming over to the table to work next to Gary. She was immediately drawn in by the visibility and visual appeal of the homework, recalling her own attempt at the activity:

> <u>*"Oh, I remember doing that one when I was in your class"*</u>
>
> *"I'm on number 10, when I've finished number 10 [turns sheet over] I have to go on the back [turns sheet back] and I can cut out those lines [draws around picture with his finger], and stick them, stick them, staple them together – not the dotted lines the, erm, [traces lines with pencil] bold lines, and it'll make it just right for that one [turns over picture and traces with pencil] so I can do it flicking there, [turns sheet over again] or flicking on that row. It's a flicker book – make a flicker book."*
>
> <u>*"I think I remember actually doing that when I was in that class."*</u>
>
> ***<u>Emma</u> and Gary, Beech Family.***

As seen in Figure 5.5d, Gary's materials were clearly visible to Emma from where she chose to sit. He used the micro-mobility of paper alongside demonstrative reference and focus body moves to draw attention to relevant parts of the paper while he demonstrated the activity.

Figure 5.5d. ***"Just right for that one."*** **Gary points out the corresponding picture on the back of the flicker book sheet**

2) Huddling gesture

After this, Emma sat down at the table, and gathered the papers around her, as seen in Figure 5.5e. The papers created a barrier around Emma, and her book was orientated away from Gary. This gesture closed down the activity, and the two children worked in silence on their homework.

Figure 5.5e. Emma's work is far less easy to share than Gary's work

3) Verbal negotiation and an opening body move

Later in the activity, Gary became stuck, and their co-location made it easy for him to ask Emma for help:

> *"You said you did this before – do you have to fold on them bits?" [holds out two similar pictures he has cut out of his sheet]*
>
> *"I don't know… I've got it somewhere…"*
>
> *"I think you do…" [swaps the pictures around and makes as if to fold them]*
>
> *"No… that's just a holding picture."*

Emma and Gary, Beech Family.

Gary's demonstration of what he intended to do with the sheet acted as a focus move, drawing Emma's attention to the specific area he intended to fold. The tangible and visible qualities of the paper, and therefore the visibility of the gestures that Gary was making, meant that Emma could work out where Gary had made an error in interpreting the instructions – the sheet did not need to be folded – and allowed her to correct this.

4) Continuing the openness with a body move

The exchange was continued with Emma easily completing a demonstrative reference body move without having to come and stand near Gary.

> *"you have to staple them, there [points with pencil to the line] you don't fold anything"*

Emma, Beech Family.

The materials Gary was using were clearly visible from Emma's seat, and she could easily point out the correct stapling point to him, as seen in Figure 5.5f.

Figure 5.5f. ***"You have to staple."*** **Emma shows Gary the correct spot for stapling the pictures**

Again, paper was useful here as it provided good variability of expression – Emma could see all the information she needed from a distance, and could thus help from her current seat without becoming too distanced from her own activity.

5.5.3 General paper work

The previous two examples showed that body moves were easy around paper technologies. Paper was mobile at a macro level; it could be carried to a variety of locations, allowing co-location with other family members. It was also mobile at a micro level; it could be orientated towards helpers, allowing easy attempt contact body moves to be made, and orientated away from them, allowing huddling. In the case of the Randall family, quick switches were made between the two orientations. The visibility of elements on the paper meant that demonstrative reference body moves could easily be made, and that focus body moves could be easily seen once a helper's attention had been gained. The micro-mobility of both the paper and supporting technologies such as the pencil also meant that larger actions and gestures were supported, such as pointing.

Contrasting examples taken from the same families below, however, suggested that the computer was less good at supporting these actions and body moves, and also, as a consequence, it was less good at supporting transitions between open and closed work.

5.5.4 Computer example: The Randalls

In this example, William and his mother were working on a Google search together, with William choosing the search topic – this time a recreational search for information about the film Star Wars. His mother was contributing knowledge and instructions about navigating the Internet in general, and the search engine in particular.

They were sat in the dining room, where the mother generally used her laptop to prepare her own lessons. Based on the layout of the space, a small table, with a single chair facing it, and the fact that the mother mentioned this was primarily her work machine, rather than the family's shared computer; it seemed that this space was most frequently used for single-person interaction with the computer.

Physical signals

The summary of the place and supportive factors involved in this homework can be found in Section 5.2.3 on 'other open work'.

1) A lack of opening body move

William and his mother discussed a pop up that he encountered, which had presented him with a false 'close' button, and had taken him to an unwanted website. They also discussed elements of navigation:

"I had to start to shut it down because I clicked the 'x' and it said 'you have won the hourly prize'"

"You don't touch them, if you leave them and just ignore them"

"Oh, right, I thought, I thought if you clicked the 'x' then it went off"

"Well, it's meant to, but not always"

"Right. Well. What did you type in?"

"I didn't know where to go… well, go to the top of the Google screen… Come on!"

William and Mother, Randall Family.

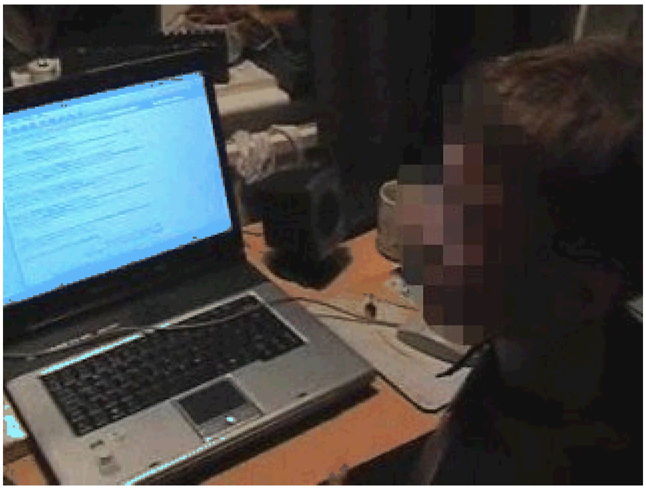
The conversation showed some awkwardness introduced into the collaboration by the restriction of the keyboard, designed for single person input. The mother was hovering behind William while talking to him, and while she could easily see the screen, and provide instructions, she could not help him navigate on the page. There was an element of frustration in the mother's voice when she said *"Come on!"*, suggesting she was finding her inability to help William navigate limiting, and the camera was switched off straight after this, presumably to allow full concentration on the activity.

What signals were being blocked here? If William and his mother were collaborating on a tablet PC, and able to work together to navigate the screen, creating a more shared activity, this would allow demonstrative reference or focus body moves to draw attention to the relevant part of the screen, here this was achieved by dialogue alone. It was not the space which constrained their ability to interact; the dining room was quite large. However, the way the interface of the laptop constrained the space in which movement could be made and the number of people who could act directly on the computer itself restricted potentially useful body moves.

2) Unintentional huddling

The computer also restricted the ability of the child to open up and close down the homework. The mother had to stand in the dining room with William to support his activity, and all her focus was on her son and the computer. She had to stand directly behind William, and so her view of the laptop screen was not ideal, as seen in Figure 5.5g. This created a huddling gesture of William protecting the laptop, even when he did not want to shield the screen.

Figure 5.5g. The Randalls using their laptop



The computer could not be passed to William's mother, or shown to her from a distance, in as effective a way as was achieved with the paper-based family tree. The variability of expression that paper offered was not achievable here, and the laptop was not as mobile as the paper technologies. Because of this, in order to help William out with the activity, his mother had to constantly stay beside him. Using the laptop meant that the activity must stay open constantly in order to allow interaction, and yet prevented the mother from being completely involved, making it ideal for neither open nor closed work.

5.5.5 Computer example: The Beeches

This second example from the Beech family involved Emma helping Gary search for information on the internet. He was looking for a flying dinosaur to research for his homework. This clip took place in the same living room as the previous paper-based Beech example, but this time they were sitting at the computer, on one side, rather than at the living room table.

As with the Randall family example, the contribution of the helper, Emma in this case, was very much focused on navigation.

Physical signals

The summary of the place and supportive factors involved in this homework can be found in Section 5.2.3 on 'other open examples'.

1) Opening body move

Emma was sat alongside Gary and helping him to search on the internet for information. This required constant negotiation:

> <u>*"Put 'flying dinosaurs'"*</u>
>
> *[wiggles fingers, thinking about typing]*
>
> <u>*[reaches across to keyboard, then pulls hand away] "'a'… 'w'…"*</u>
>
> *"Is it 'u'? Isn't it 'u'?"*
>
> <u>*"Could be. Let me just…"*</u>

[both get up to check book in far lounge and then return]

"Yeah, yes it is. 'u' 'r' 's'"

[types] "'u' 'r' 's' zoom in dinosaurs…"

[points at on-screen link] "I'd go on that one, yeah… definitely"

Emma and Gary, Beech Family.

Emma appeared to be making demonstrative reference moves to help Gary navigate. However, there was a difference between her gesture when she pointed towards the screen and her gesture when she moved towards the keyboard. In a screen point there was a smooth gesture, whereas when she moved towards the keyboard, as seen in Figure 5.5h, she snatched her hand back. It appeared that her natural move was towards the keyboard to help type, but as with the previous computer example, the interface did not allow her to become involved. This process can be compared with the easy handing over of control which took place with the paper-based family tree for the Randall family. The fixed position of the computer failed to support such smooth actions.

Figure 5.5h. *"Put flying dinosaurs."* The Beech children together at the computer

2) Opening body move

Some general searching took place, and then there was a second example of what seemed to be a similar phenomenon, with Emma and Gary searching for the 'Yahooligans' website, a child-friendly site provided by Yahoo!:

> *"Yar"*
>
> <u>*"No, 'ya'" [reaches across to keyboard again]*</u>
>
> *"'h' is it?" [typing] "'h' 'o' 'o'"*
>
> <u>*"'l' 'l' 'i' 'g' 'a' 'n''s'"*</u>
>
> *[typing] "'g' 'a' 'n''s'. And then it's dot com? Dot com…"*

<u>Emma</u> and Gary, Beech Family.

Emma again reached for the keyboard, as seen in Figure 5.5i. In both extracts of dialogue we could see that Emma had to follow her instinctive gesture with instructions for Gary's input, rather than inputting the information herself, as her gesture indicated she wished to do.

Figure 5.5i. *"No, 'ya'."* Emma reaches across again

3) No support for huddling

As with the Randall family, the homework was almost completely opened up, with Emma maintaining complete involvement in the homework throughout. As the computer examples involved more complex activities it is unsurprising that there was more involvement of the helper. However, it is difficult to imagine how a helper would constantly engage and disengage from the activity and hand over control in a similar way to that seen in the paper-based examples.

5.5.6 General paper and computer work

Both computer-based activities were opened up, with a lot of family involvement, and both paper-based activities were huddled. From these different homework styles, it is tempting to conclude that the computers were good at involving family members. In some ways this is true, computers seemed to demand a lot of engagement from helpers, and accounted for half the 'open' work examples in the video diaries, compared to a sixth of the closed and a fifth of the huddled work examples. However, the micro-mobility of paper, its ability to offer variability of expression and its visibility were more able to support transitions between opening up and closing down work, and paper was thus more flexible.

This section has shown how the visual properties and micro-mobility of technologies such as paper were used to negotiate family involvement. It suggests that making children work at a computer could severely limit their ability to negotiate the involvement of those around them. Therefore, a home-school network accessed by a computer would be likely to significantly change the face of family involvement in homework when other family members are co-present. Parents and siblings would be more likely to act in the role of a guide, which might be useful in some activities, but problematic if they were ignorant of the content of the activity, and potentially restrictive of the child's autonomy. A way of avoiding this, using ubiquitous technologies is presented in the conclusions, alongside a consideration of how networked technologies will not only require a management of family involvement around a technology, but also through one, across a network.

5.6 Conclusions

The focus of this chapter has been the mediation of activity through technologies, and how a combination of completing homework in a particular ecological niche, mediated by a certain type of technology, can help children to negotiate the involvement of their family in their homework.

Properties of place versus networked technologies

There were two types of place presented in this chapter, the places where 'open' work was conducted – or where huddled styles of work were necessary to close down work from family members – and the places where 'closed' work was conducted. It was not clear-cut whether places where completely independent study took place were chosen because children wished to avoid distractions, or presented children with the opportunity to do independent study because they had no input from other family members available. However, the technological factors which supported independent work in these places were also used to manage the closing down process in places where family members were present, indicating that children's tool choice helped them sustain independent work by discouraging joint activity.

Family rooms seemed to be a good place to do homework at least some of time, as they offered opportunities for children to engage in both independent learning and to benefit from family involvement. Some reports (e.g. "Students 'lacking homework space'", 2006) have suggested that doing homework in a family area is a problem for 'serious' work, and that the use of family rooms indicates that children lack appropriate spaces for their homework. However, it is equally possible that children studying in family rooms are making use of the ecological resources available to them, and gaining the opportunity to involve their family, as associated with several homework outcomes. Understanding the ecology as a whole, therefore, helps understand the benefits of children working in distracting areas: completing the activity in a family area conveys to the family that support may be needed, and the mediation of activity through flexible technologies allows children to control access to their homework at a more fine-grained level.

Design solutions

This chapter has identified the need for homework technologies to support opening up and closing down of work, when both collaborative and independent work could benefit an activity. There were several specific properties of the homework technologies examined in this chapter which mediated activity in a manner which allowed this fine-tuning.

Visual properties

Visual properties supported both opening up and closing down of homework as follows:

- Visibility of a technology meant that family members could see opportunities to become involved and where involvement was necessary, or allowed children to negotiate involvement in their homework by manually altering its visibility.
- Visual appeal meant family members were encouraged to join in an activity, as it looked interesting and engaging.
- Lack of visibility / visual appeal meant it was difficult for family members to see what children were doing and that they were less interested in content.
- Variability of expression meant paper offered different types of information at different distances, allowing the gist of well laid out work to be gathered without involving family members in content, or progress updates to be gathered at a distance.

It appears that certain visual properties of technologies convey to family members that they are open to sharing, and others that they are closed to sharing. It is not just homework technologies which use these signals within the ecology of the home. Take, for example, the television: as engineers have developed the technology to support for size increases of its monitor, screens have grown bigger and bigger. This not only allows better vision, but also draws in family members as the picture grows more visible and more visually appealing. Even in traditional technologies like books, such signals are common: for example, picture books for children may be designed to be read by their parents, but the pictures make the books visually appealing even for children with no reading skills, and draw them into the activity.

Mobility

Mobility supported the opening up and closing down of homework as follows:

- Micro-mobility meant technologies could be rotated to provide variability of access, either negotiating family members' access to the homework, or, in one case, allowing the Waterbeck father to test his child while hiding the results from him.
- Macro-mobility allowed technologies to be moved between rooms or between home and school, allowing children to take information to family members for help seeking.

Again, the mobility of technologies can be seen in other contexts indicating when sharing and is not appropriate. A good example could be seen in studies of the negotiation process in medical consultations between doctors and patients conducted by Luff and Heath (1998; Luff et al, 1992). The card with the patient's information supported macro-mobility: it could be passed around between departments and professionals as a signal that they needed to deal with a particular aspect of the patient's treatment. However, it also supported micro-mobility: it could be propped up on the desk as a focus for remarks, shared with the patient to help explain a previous diagnosis, or brought into the foreground of the doctor's activity to indicate that the doctor was making notes independently on the condition, without a need for the patient's input.

Self-containment

The ability to combine multiple representations – data, activity information, questions and answers – present in paper meant that paper acted as a self-contained homework resource providing all the information necessary to support a piece of independent learning without outside output. In addition to this, the micro-mobility of paper meant that several pieces of paper could be gathered together to allow children to combine representations in this way.

The self-containment property is perhaps most often seen in use in the school ecology: perhaps appropriately, given that independent work seems to be the area where homework involves the most ‘school-like’ activity in the ecology of the home. The majority of class-based lessons involve self-contained technologies in work, for example textbooks in schools, which act as a single source of academic thought on an area, and exercise books which act as a single source for children to record their work to encourage independent and silent work. This is not to say that collaborative work from multiple sources does not take place in schools, but it tends to involve a deviation from the classwork model, usually signalled by taking the class to another place, such as the school library, or rearranging the space, for example by pushing desks together.

Collaborative work and the PC

The finding that open work is encouraged at the computer, but is mostly focused upon navigation and negotiation rather than learning activity, echoes findings that the home computer is not the best interface for home networks (Crabree & Rodden, 2002, 2003; Frohlich et al., 2001; Norman, 1998). In the examples considered at the end of this chapter, the inflexibility of the PC interfered with children’s ability to subtly open up and close down work, and while this did not appear to preclude ‘open’ activities, it made their selection an ‘all or nothing’ choice. This suggests that making the home PC the point at which networks are accessed may compromise face-to-face family involvement.

Many of the cited beneficial properties of networked homework technologies in Chapter 1 can be understood in terms of their opening up of homework. Educationalists hope that networked technologies can open up homework across time and space, to new homework partners, and to a greater quantity and quality of information from a variety of sources. However, this chapter has presented evidence that involvement is not always appropriate, and that traditional homework technologies offer properties and affordances which allow involvement to be fine-tuned. This chapter showed that the home PC is not as successful in supporting this fine-tuning. Currently home-school networks have only been discussed in terms of their opening up of homework, not in terms of their ability to close homework down and this needs to be considered further. This discussion will be taken forward into Chapter 6, which will also look at extending the concept of closing down homework into the movement of information between home and school ecologies.

This chapter therefore identified two potential areas in which children might have difficulty negotiating involvement in homework when networked technologies are used. The first is across a network: children may be denied the opportunity to work independently should constant access be available to their work from family members, teachers or peers. The second is around their use of the network in the home: children may have difficulty negotiating involvement to their work if they are constantly conducting homework through the home PC, which is not as flexible as traditional homework technologies in supporting their negotiation of involvement.

Difficulties in negotiating involvement in work in face-to-face homework situations using networked technologies might be avoided by using networked devices other than the home PC. Ubicomp technologies (Tolmie et al., 2002) are one way this might be achieved; such systems integrate functionality into the home allowing information to be accessed in subtle ways. For example, ubicomp technologies could be used to move information between screens in the home, making work highly visibly by displaying it to family members on a large screen, and then closing down the task by moving it to a personal device. Mobile computing technologies offer micro- and macro-mobility in ways similar to paper and could also be used for such systems.

Chapter 6 will look at how ubicomp technologies might be used in homework in the future, using highly networked and pervasive systems to investigate how huddling of work might take place across networks. It will be followed up by Chapter 7, looking at the design solutions produced in this chapter and Chapter 6, and how these might integrate into the ecology of the home.

6 Envisioning future alternatives: Technology lab tours to explore future ubiquitous computing arrangements

This chapter will look more explicitly at the relationships within the community of homework, and how the roles parents and teachers take can support certain types of information sharing and discourage others. The study deliberately used provocative technologies which collected and used a wide range of information types in depth to assess how families might react to these technologies. It complemented the home-based studies in the preceding and following chapters by asking families for their views on speculative ideas and technologies, rather than focusing on specific applications, and by investigating reactions to increased information sharing both within the home ecology and between home and school ecologies.

6.1 Method

This study took three families from a school where use of home-school networking was high and offered them some ubiquitous computing technologies which could be used to make managing homework easier, to obtain feedback on their reactions to these technologies. This final group of participants were involved in three stages of research. The first was an interview study, involving ten families, which is briefly reported below. The second was the major focus of this chapter: the technology lab tours. The last, technology trials within the microsystem of the home, will be reported upon in Chapter 7.

6.1.1 Ethics

For these three studies, common ethical considerations had to be taken into account. All involved the same group of families, and, for the three families who participated in all three stages, common procedures and materials were provided.

All ten families were presented with a recruitment pack, which covered the entire study. The consent form can be seen in Appendix 6.C: Consent form. In all three studies, the parents were present for the studies and interviews, and the whole family was encouraged to give the researcher feedback on the process at all times. As with the discussion group study, ethical approval for this procedure was obtained through the University of Nottingham School of Psychology Ethics Committee. Standard privacy and feedback were provided, as discussed in Chapter 2.

The only major difference between stages was that the two probe studies contained incentives for taking part, with the lab-based section rewarded by cinema vouchers to take the family to see a film (although families were not made aware of this reward in advance) and the home section rewarded by a cheque sent with the instruction to 'take the family out for a meal on us as a thank you'. However, all the families identified their own reasons for taking part, as discussed within the chapter, and these seemed to be their primary motivation.

6.1.2 Recruitment interviews

Participants were recruited from School E, the independently funded boys' school with high use of technology and a current home-school network introduced in Chapter 3. This school was chosen as they already used a home-school network, and thus the families would be familiar with the experience of and limitations of using such a system.

In order to recruit an initial pool of participants, a letter (included in Appendix 6.A: Letter to parents at School E) was sent to all the parents of children aged 11 to 14. The letters were sent through School E, using their database of family addresses. Families were asked to contact the primary researcher with their email, telephone number or postal address if they were interested in taking part in the study.

A total of ten families agreed to take part in interviews in their homes. These families were invited to discuss what they thought of the home-school network and homework practices currently used in School E.

Ethnographic interviews

Ethnographic interviews were conducted with each of the participant families. A visit to the home took place, which was split into two stages. The researcher arrived, and then sat with the whole family and asked questions in a semi-structured interview format, as follows:

- What are your reactions to the way <School E> uses ICT in homework?
- Do you like ICT-based homework?
- What proportion of homework do you have to use the computer for?

- What kinds of ICT homework do you get?
- What kinds of non-ICT homework do you get?
- Where do you do your homework?
- How well does homework fit into your family routine?
- Have you ever had a fun homework? Name one.
- How would you improve homework?

Then the family were asked to give a tour of their house, especially concentrating on their PC and the places in the home in which homework was completed.

These interviews were ethnographic in three senses:

- The location of the study, with the family agreeing to have the researcher present in their home.
- In format, with the researcher attempting to make the visit as relaxed as possible. The interview was always described as 'a chat' rather than 'an interview' and every effort was made to position the family rather than the interviewer as the expert in the situation. Families seemed comfortable with this, and were keen to offer refreshments and generally act as hosts.
- In terms of the kinds of information which could be gathered. The visit included a tour of the family's house, which was conducted by the family members, and they showed the researcher both technologies and places throughout the home which they associated with homework.

However, the limitations of the home context meant that the researcher was a long way from the participant observation of classical ethnography. On top of this, the visit represented the first or only contact with the researcher for these families, meaning relationships were still reasonably formal.

Gathering background on the families of school E

An in-depth analysis of the interviews will not be presented here as these interviews primarily acted as a recruitment and introduction strategy for the three families who followed through from this stage to the main studies of Chapters 6 and 7. However, a small amount of background information was gathered which was used in choosing the demo technologies described later in this chapter. This was as follows:

- All the interviewed families used the Internet as a major information resource in homework, however three of the families independently stated that they had trouble in assessing the quality of information they found on the Internet.
- A home-school network was available to all family members, and nine of the ten families had broadband connections at home allowing files to be transferred between home and school at a reasonable speed. However, of those nine families, four seemed unaware of or confused about the network's existence, one had tried to use it but found it too confusing, two had used it but found it unreliable, and only two families used the network frequently and were pleased with it.
- None of the families lived within walking distance from the school, meaning that lifts from parents or public transport were used for the journey between home and school. All of the families who used public transport for travel coordinated their activities with mobile phones.

The ways in which these findings were used as inspiration for the demonstrator technologies will be outlined in the section on these below.

6.1.3 The three focal families

After the ten families had participated in the interviews, three of the families were recruited to continue with the study. Three families were chosen as this allowed the researcher to get to know each family in depth; allowing interpretation of their responses to the technologies to be based on a rich understanding of the home ecology. A follow up letter was sent inviting them to take part in a further study, included in Appendix 6.B: Follow up letter to parents.

The three families were chosen based on their willingness to continue with the study, and the extent to which their routines fitted with the proposed schedule of the research, so partial self-selection was involved in recruitment. As with the video diaries in Chapter 5 the constraints of recruitment meant that the families formed a reasonably homogenous group in terms of socio-economic status. However, the families did still represent a range of family arrangements and children in different stages of their high school education.

The families will be presented below, with details about their general backgrounds and use of technology. These three families also participated in the study that will be presented in Chapter 7, where further details on the families will be included.

Family A

Family A consisted of a mother, father and only son, aged 12. The father worked full-time as a policeman and the mother part-time in retail. They owned a single personal computer, placed in a peripheral conservatory, which was used mainly to access the Internet and play games. Technology did not appear to play a central role in the family's life, and television and mobile phones were the only other technologies that were used as routine. The PC was assembled by a close family member, and the father stated it was purchased for the son's education. However, both father and son used the computer regularly for work and leisure, and the mother also used it occasionally.

Family B

Family B consisted of a mother and father, a son, aged 14, and a daughter, aged 12. Both parents worked full-time, the father in the health service and the mother in teaching. Family B had integrated technology more fully into their everyday lives than Family A. The main family PC was set up in a central position in the lounge. The son had an extensive study and entertainment centre in his bedroom, with PC, digital television and Playstation2 games console, and the daughter also had her own PC and Nintendo DS handheld console. The son had been particularly encouraged by his parents to use technologies to overcome difficulties in his writing stemming from dyslexia. Again, family members all had mobile phones.

Family C

Family C was a single mother, a son, aged 14, and a daughter, aged 16. The mother worked full-time for a pharmaceutical company. The family had a television, and a PC, which was well equipped with printer and scanner, but shared within the family, and slow to load. The PC was used extensively and creatively by all the family members, for a variety of home and school projects. It was set up in a corner of the mother's bedroom, and used individually. Each family member also had his or her own mobile phone.

6.1.4 Demonstrator Technologies

Three broad applications of ubicomp technologies were identified from the ten ethnographic interviews carried out with the wider group. Each demonstrator was chosen to fulfil three criteria:

- Openness: every demonstrator included one or more ubicomp technologies which allowed information to be shared between child and parent or home and school to a greater degree than systems currently available through the home PC. In other words, they allowed homework to be 'opened up' as described in Chapter 5.
- Relevance: every demonstrator was relevant to the families' lives. This was achieved by drawing on the background information gathered in the ethnographic interviews for inspiration.
- Educational application: every demonstrator had some educational application, and there was a genuine argument for using some version of each demonstrator in the homework context.

These applications were therefore chosen as potential solutions to identified problems. However, they were also designed to be as provocative as possible, emphasising the range and degree of information which could be gathered about families' lives, to discover where their concerns lay, and to encourage families to consider what steps would be necessary for them to control the sharing of information. This allowed interviews to focus on the social as well as pragmatic problems of negotiating access to homework.

Demonstrator 1: Situated information access

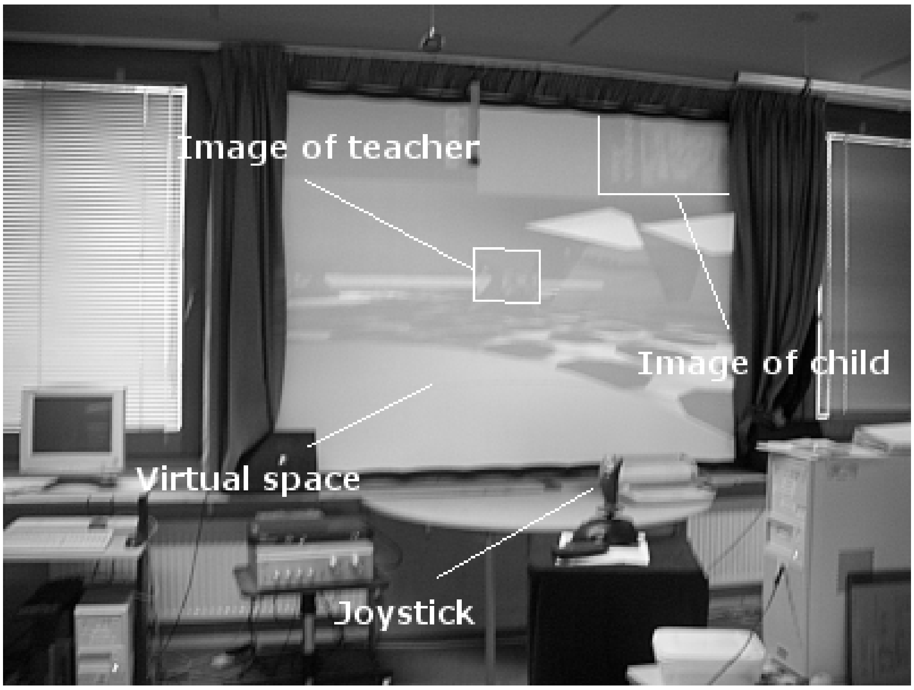
The interviews with the families showed that their primary use of digital technology in homework was to access information, mostly through search engines, but that they were unable to efficiently judge the quality of this information. One major benefit of networked technologies mentioned by educationalists, as seen in Chapter 1, is their ability to connect users to a variety of specialists. Improving situated information use through specialist knowledge was therefore taken as the theme for the first demo.

Mixed Reality Boundary

A situated display allows children to navigate around a bazaar of teachers, each offering subject specialties, and clustered together so that the answer of Geography teacher 1 can be compared to that of Geography teacher 2.

As seen in Figure 6a, the Mixed Reality Boundary is a display screen which can be placed on any wall of the home. In the demonstrator it allowed the child (pictured top right on their own display screen) to chat face-to-face with teachers through a video conferencing system. However, each teacher was placed within a virtual reality space, and children could navigate through this space using a joystick, finding groups of teachers by subject specialty, and consulting and comparing teachers' views and opinions on homework subjects.

Figure 6a. The Mixed Reality Boundary. This video conferencing system could be placed on the wall of a home, to select and communicate with experts



The Mixed Reality Boundary presented an 'always on' communication future that allowed exploration of families' reactions to a two-way exchange of information between home and school, and highlighted how new technologies could open up homework significantly. The motivations for using this technology are considered in Table 6a.

Table 6a. Showing the motivations behind the situated information access demonstrator

Demonstrator	**Openness**	**Relevance**	**Educational application**	**Ubicomp technology**
Mixed Reality Boundary	Through networking with new homework partners at a distance	Gave families a more reliable form of information, and encouraged children to consider and compare multiple viewpoints	Could be used in almost any homework situation to research or evaluate pieces of work	Situated display technologies with video conferencing links

Demonstrator 2: Embedded information capture and access

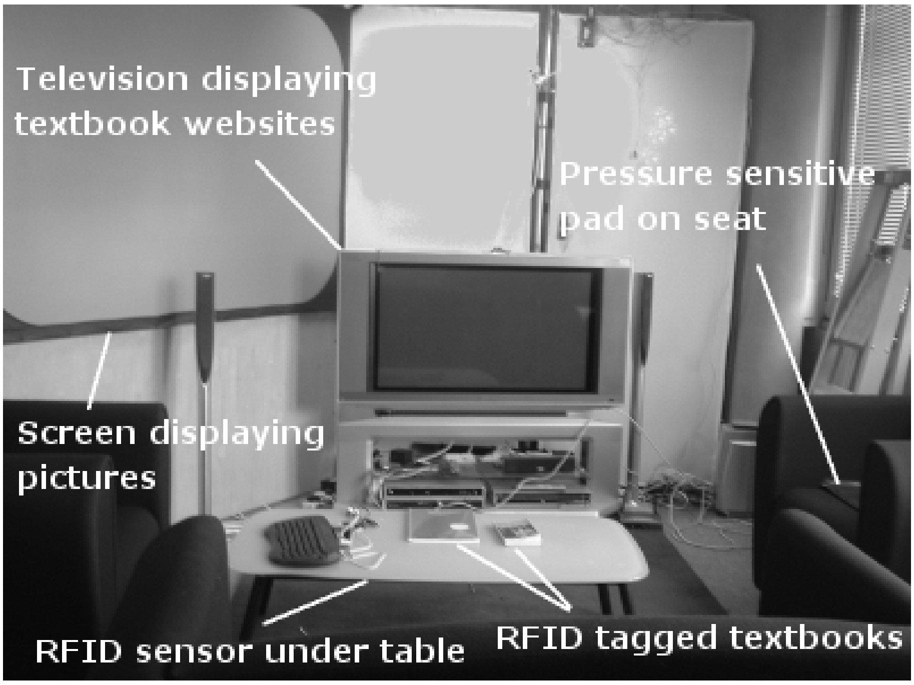
The interviews also identified families' discontent with current attempts to link home and school through technology. All had access to the school's networked homework system, which could be set up to provide online homework information, file sharing for the child between home and school, and the ability to upload files to a teacher's web space. However, the majority of families were confused by the system as a whole, or expressed dissatisfaction with its reliability or ease of use. The second demo therefore attempted to introduce them to more situated ubicomp technologies which might fit more easily into their everyday lives. A mock 'lounge' within the Mixed Reality Laboratory was equipped with embedded environmental sensors and a variety of output screens to demonstrate these functions.

Intelligent text books

A child opens his schoolbag and places a copy of Macbeth on the table. This opens a webpage on his television displaying additional study resources, which end in a quiz for the teacher to assess.

Figure 6b shows the lounge area with textbooks set up to display webpages on the television when placed on the RFID-enabled sensor table. Each textbook was tagged to display an appropriate website: a mathematics textbook triggered a webpage with mathematical questions, and Shakespeare's Macbeth script triggered a webpage discussing the use of themes in Macbeth.

Figure 6b. The lounge area with screens, pressure sensor, and tagged textbooks on table



Seat photo capture

A child sits down to do their homework, and a camera records the information. The picture is sent to the teacher with details of when and where the homework task began, so she can check work is being completed promptly.

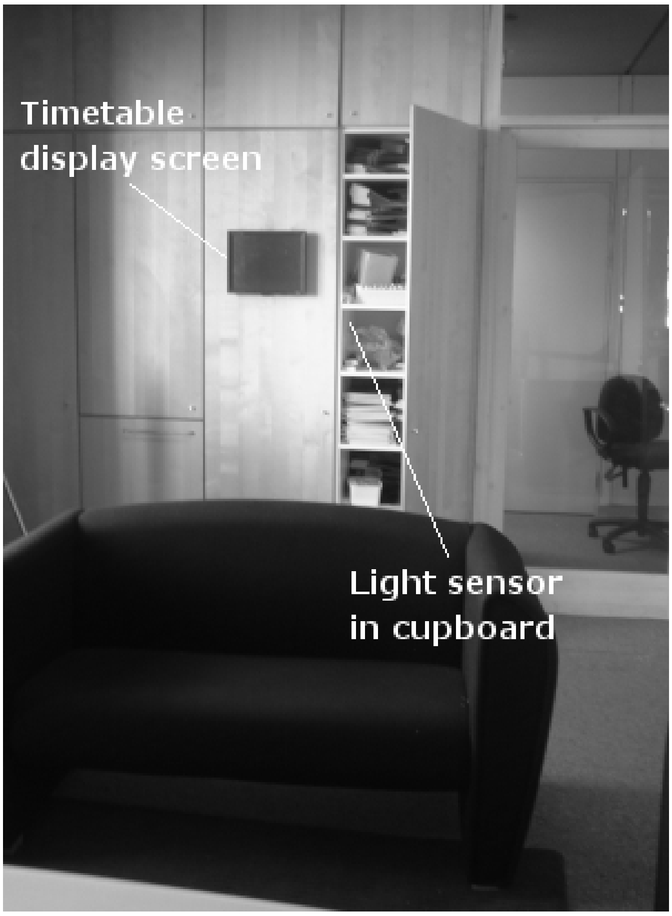
Figure 6b shows a pressure sensitive pad placed on a seat in the lounge area chair, so when a family member sat on the chair, a webcam (not visible in Figure 6b, to the top left) photographed the family member.

The homework cupboard

A child comes home after a day at school, and opens the cupboard where her textbooks are stored. The display screen on the adjacent cupboard lights up with her homework task.

Figure 6c shows the ‘homework cupboard’ which was filled with various homework resources. When the cupboard was opened to access the homework resources this triggered a light sensor, and an electronic version of a child’s homework diary was displayed on the front-of-cupboard display to the left.

Figure 6c. The lounge area with homework cupboard and front-of-cupboard display



These demonstrators allowed investigation of how children and parents felt about essentially ‘negotiation-free’ transfer of information built into their domestic environments: again opening up of homework with no options to ‘huddle’ the homework area. This encouraged family members to consider what, if any, information was deemed suitable for handling automatically in this way, and what constraints they would require upon such a system. Table 6b summarises the motivation for presenting these three technologies.

Table 6b. Showing the motivations behind the embedded sensor technologies

Demonstrator	Openness	Relevance	Educational application	Ubicomp technology
Intelligent text books	Through networking with greater access to information across time and space Through face-to-face mobility (of information and devices), and increased visibility of information	Presenting a different mode of information transfer to a PC-based system	Transferring homework tasks easily, increasing access to resources, sending reminders or recording progress	RFID tags and sensors embedded within physical artefacts to trigger digital information
Seat photo capture			Monitoring children's progress and their choice of place for homework	Pressure sensor and cameras used to support activity-based triggering
Homework cupboard			Monitoring progress and sending reminders	Light sensor used to track and record activity
Output screens			Using children's actions as a cue to send information, such as reminders or homework tasks	Appropriation of screens in domestic settings

Demonstrator 3: Locational Information Capture through Mobile Devices

The final demo took inspiration from the families' use of mobile phones to communicate and coordinate the journey home from school. It linked together the parental wish to track information with the educational literature's ideas on the use of mobile devices for learning, which included tracking devices which alerted the child (or teacher) to educational opportunities around them.

Locational tracking

A child carries their mobile phone with him, and a tracking system sends reminders and alerts dependent on his location. His parent notices he is on his way home early, which will allow a change of plans for the evening, making it possible for the child to get his homework done and visit his aunt. The child sees a piece of litter which needs to be recorded for a project, and takes a photograph, with the locational information available to map litter locations at school.

This demonstrator showed systems for tracking children and recording information about their location through a mobile network.

Two forms of representation of location were considered, a map-based system provided by the Childlocate (2006) mobile tracking system, and a locational clock. Inspiration for the locational clock was taken from the 'Harry Potter clock' co-opted by a number of researchers as a novel way to track family members' positions (at home, at work etc.) on a large clock face (e.g. Jones & Grandhi, 2005).

This demo highlighted the new kinds of information which networked technologies allowed families and schools to share, and encouraged family members to think about how technologies could open up homework across time and space. The motivations for choosing this demonstrator are given in Table 6c. Unusually in this demonstrator its relevance to families and its educational application were quite different. However, this allowed the acceptability of within home and home-school uses to be contrasted.

Table 6c. Showing the motivations behind the locational capture demonstrator

Demonstrator	Openness	Relevance	Educational application	Ubicomp technology
Mobile phone tracking	Through networking with access to new partners and new information across time and space Through face-to-face mobility	Families attending the schools were highly distributed, making tracking technologies likely to be particularly relevant and families were already using phones to track journeys	Monitoring children's activities, allowing location-specific tasks to be sent to children, or information about the location of their activities to be captured for projects	Mobile tracking devices

6.1.5 The procedure

The three demos were set up in different areas of the Mixed Reality Laboratory. The families started with one demo each, and then rotated between them. After each family had seen all three demos, they attended a debriefing with an interviewer. This consisted of a semi-structured interview encouraging them to discuss how they could see these technologies being used generally within the home, and specifically within homework. An example transcript can be seen in Appendix 6.D: Example demonstrator probe session transcript. In order to contrast how these information types were seen within the microsystem and across the mesosystem families were asked to discuss how both parents and teachers might benefit from sharing through them. The interviews were analysed for core themes, which are presented below. As mentioned above, it was the overriding commonalities and differences across families that were picked out, making this analysis a more inductive one than the content analyses used in Chapters 3 and 4.

6.2 Findings

Reactions to the technologies themselves were positive. Initially all families welcomed the use of new technologies. Families A and B were particularly keen on the educational applications of sensor technologies:

> *"Good, because the book's there and then you don't get in detentions or whatever, because you know that you've brought the right books in and everything."*

Son, Family A.

> *"I liked the idea of, like, a cupboard that, you know what's in that cupboard before you open it, so you don't waste time looking through different cupboards."*
>
> *"And you also liked the idea of a bag that could tell you what books were in there, so you knew what books were in your bag, whether you'd got the right books and things like that, from a school point of view. If you've put the right homework back in, or, you know, some sort of system that could tell you, that, for that next day, you have got the correct books in that bag."*

Son and Mother, Family B.

They were also both impressed by the ability of the demonstrator technologies to provide particularly relevant educational information:

"Sometimes you can search for something like that and the information that you get back is aimed at a PhD student, which is fine, but…"

"Not really interested."

"They're not really interesting, or you've got to trim it down and put it in a language that is relevant."

Interviewer and Father, Family A.

"I find the idea behind it is excellent, because search engines, yeah, I find aren't specific enough."

Mother, Family B.

The mobile locational technologies were received with slightly more scepticism, but Families A and B still acknowledged their practicality

"It's good, but they can turn the phone off, so then you can't find where they are, so if they go somewhere where they're not meant to be then they can just turn the phone off and then it won't be finding them."

"Yeah, so you can trick your parents into not finding you."

"You wouldn't do that, would you? No, we thought it was a good idea, didn't we?"

Son, Interviewer and Father, Family A.

"To me, it's quite nice to know that they're in the place where they're supposed to be… I wouldn't want to be using it to keep track of where they've gone when they've gone out on a Saturday afternoon with their friends. But as a specific 'have they got to that point that they're supposed

to be at' then yes, it's nice, it's a good way of doing it without having to keep phoning."

Mother, Family B.

Family C was less keen on the educational applications of these technologies, but, alongside families A and B, saw how all the technologies could be used in some aspect of their lives, as with this response to the sensor technologies:

"Again I can think more sort of, perhaps office applications than home applications."

"Yeah."

"Okay, okay."

"Okay, I can understand like…"

"Or school applications."

"… like in school, if I know that so many of our teachers would love it if they had a board telling them which books were in the cupboard, and which books weren't and, so they weren't going through half a dozen cupboards looking for the right text book."

Mother, Daughter, Interviewer and Son, Family C.

These initial reactions suggested that these families were interested in new technologies in this area, and the face value of such technologies was clear to them. They also tied in with the educational rhetoric that the practical benefits of networked technologies will make their use acceptable.

Further conversation, however, elicited concerns, suggesting that networked technologies might impact on the social flow of the families' everyday lives. The analysis drew out three main areas in which families felt the opening up of not only homework information, but potentially parallel information about homework practices and the home in general could be problematic. The first two areas examine relationships within the family, looking at how these affected the type of information that family members were willing to share. The last looks at relationships between the family and the outside world of education, and considers how these might affect technological design.

6.2.1 Trust in the developing parent-child relationship

One way in which networked technologies opened up homework was through the sharing of information about homework between parent and child. This potentially allowed information to be shared across time and space. This could be at a local level throughout the home, for example through the sensor technologies, or on a greater scale, for example through the locational technologies.

One property of the demonstrators selected, and ubicomp technologies in general, was that information capture was situated, often seamless and un-negotiated. The families saw this as acceptable within the context of some domestic relationships. Ubicomp devices could monitor the 'vulnerable', in the context of relationships established to ensure safety. In keeping with previous applications of ubicomp technologies, the very old or the very young were seen as candidates for this kind of care by all the families involved (Dalsgaard et al., 2006; Mynatt et al., 2000; Mynatt et al., 2001; Vetere et al., 2005):

"any person that you feel might be vulnerable, you know, living on your own, or whatever."

Father, Family A.

"I'm not sure it would be much use in like our situation, because we're old now, it'd be more for young children."

"Yeah, that's what I mean by sort of vulnerable people."

Son and Mother, Family C.

For the age group studied here the acceptability of opening up information about day-to-day life, particularly within homework, changed in line with the emerging roles of children as independent adults. The interviews saw acceptance, then resistance, and finally rejection of parental access to children's lives, across the families. The only son in Family A, at age 12, seemed to be quite accepting of information capture in his day-to-day life:

"I think it's getting used to doing that instead of just picking up the phone and dialling, punching his number in."

"Mm, would you take long to get used to it? How would you find it?"

"I wouldn't feel like I was being tracked on really."

Father, Interviewer and Son, Family A.

In Family B the elder son, aged 14, expressed a higher degree of concern about schools and parents having access to information about him, and talked about resisting information capture:

“they’ll not be able to say to you ‘well, no, I did loads’ when they didn’t.”

“And how would you feel about that kind of thing then?”

“I like being able to lie about it!”

***Mother*, Interviewer and *Son*, Family B.**

In Family C, where the eldest child was a 16-year-old daughter, both daughter and mother rejected the capture of information about her life, suggesting that ubicomp technologies would be both useless and inappropriate:

“you know if she was out on a Saturday night, it probably is better that I don’t know actually!”

***Mother*, Family C.**

The families suggested that these changes were due to the evolution of the parent-child dynamic as time went by. Both the parent of the youngest child and the oldest child in the group indicated that rejection of parental control was a natural stage of development:

“obviously when he gets older, when he’s out with his girlfriend and stuff, he doesn’t want dad, ‘where are you?’ you know.”

***Father*, Family A.**

“you know… I think it’s, it’s just part of growing up that you don’t, you don’t do it.”

***Daughter*, Family C.**

This suggested a stage existed where children felt unable to stop monitoring of their activities, but where they wished to assert some degree of independence.

The carer relationship

The definition of personal or private information differed according to relationships, as has been shown in other research into social networks, where adults showed strong differences in the type of information they were willing to share with friends, relatives and workmates (Davis & Gutwin, 2005; Iachello et al., 2005). These interviews found that carers had the strongest right to capture information, whether caring for the generally vulnerable, or for their own children. This suggested that the parent-child relationship, where parents were seen as the ultimate 'carer', should support the automatic transmission, or negotiation-free transmission, of information more readily than the teacher-child relationship. Trust was the key factor for this equation: the caring relationship between parent and child was built on trust, which facilitated information sharing. In design terms, this level of trust was particularly useful, as it suggested that homework could be opened up by networked technologies when parents were still in the role of the child's carer.

Supporting a changing relationship

As discussed in Chapter 3, however, home-school networks are likely to be of particular benefit in secondary schools. The children in this study appeared to moving towards an age where monitoring was not universally supported. As children became older, the role of a parent as carer became more blurred and more information was viewed as personal, private, or generally inappropriate for capture.

Parents and children in the interviews stated that as children aged they started to demand privacy, and a new role of independent adult began to emerge. Therefore using technologies which undermine the child's negotiation of their own autonomy would seem inadvisable. This general increase in autonomy and independence, well-documented in the adolescence literature (e.g. Coleman & Hendry, 1999), is unsurprising in a context like the management of homework, which has been notorious as a site of tension between parents and children (Solomon et al., 2002). Technologies therefore need to be adaptable to changes in this relationship as time goes by. Strategies for achieving this will be discussed below.

6.2.2 Family roles and responsibilities

Trust between parent and child facilitated the sharing of information. For example, families saw the potential of tracking, as with current mobile use, for coordination – two-way sharing of locational data, rather than one-way monitoring:

> *"I think it would be more useful for parents, adults than children…"*
>
> *"I think you might use it to find out, you know, am I on the way home yet, and even reflect it back on me, if I'm not back from work yet."*
>
> ***Son and Mother, Family C.***
>
> *"it would probably minimise the phone calls of 'where are you? how long are you gonna be?' them sort of things… to know when we've left work, or I'm still at work."*
>
> ***Mother, Family B.***

However, these were non-homework examples. Within homework itself, all the parents and children were concerned that use of captured data might violate the rights of children:

> *"you'd have to be careful that you weren't sort of like, feeling, make an individual feel a bit you're spying on them all the time, wouldn't you?"*
>
> ***Father, Family A***

but in other ways, opinions on rights and responsibilities differed wildly from family to family. As seen before, the 14-year-old boy in Family B liked to maintain his right to mislead parents about his activities. However, in Family C, the other 14-year-old boy in the interviews focused on the child's responsibility to complete the work.

> *"I'm the same for homework. I think it's really mostly the child's responsibility, that they have to take responsibility really, and it shouldn't always be up to the parents to make them do it, and they should accept the consequences… I think a parent could use it to find out if they are doing their homework, but they wouldn't necessarily need to step in."*
>
> ***Son, Family C.***

Lastly, the daughter in Family C suggested there was a middle ground:

> *"If you could see if your child was doing their homework, isn't it breaking a bond of trust, if you can't trust them to do that… I think it's just part of growing up that you don't, you don't do it, and I just hate the fact that it would be completely controlled."*
>
> ***Daughter, Family C.***

She felt that the child had a right not to be monitored, that this was part of the bond of trust between parent and child, but also felt the child was likely to sometimes not do homework. This indicated that even when the child was shown to be shirking their responsibilities, they might be forgiven, and that the relationship was more like training for adulthood than an immediate switchover.

Trust works in mysterious ways

In these examples it became clear that trust sometimes meant not sharing information. As children got older they developed the right not to be monitored and not to have homework opened up without their consent. Families focused on the rights of children to have their privacy, and recording their homework activities (through either sensor or locational technology) was seen as undermining rights and responsibilities. Similarly, the adoption of responsibility by the child could be threatened by implying a lack of trust, undermining the child's development. The interviews suggested that information capture and disclosure between parent and child decreased in the home ecology as time went by, and mobile and personalised technologies certainly offer the ability to configure information capture and disclosure. However, the different reactions of the two identically aged sons in Family B and C showed age acted as an imperfect guideline for information disclosure. This gave a complexity which made it impossible to model these changes through design.

Converting relationships into technological rules

The apparent reason that children were worried about the invasion of their privacy was not that they were concerned about opening up homework content to their parents, but that they were concerned about the additional information that was carried alongside content: such as information about whether they had done their homework. This is a documented difficulty with networked technologies. For example, Palen and Dourish (2003) noted that networked technologies often recorded and transmitted additional information, unsuitable for sharing, with the target information.

The complexities of disclosure in the adolescent relationship were not only dealt with daily within the family, but were presented to the interviewers as unproblematic facts of everyday life. This goes beyond suggesting that trust was negotiated in a highly complex and situated manner within the family. Rights and responsibilities were not just individual, but also heavily embedded in the intimate relationships of the family, and in some cases the negotiation of disclosure seemed to be instinctive rather than explicitly negotiated.

However, introducing configurable tools to manage information sharing requires explicit rules, so here designers face a large challenge. Suchman (1987, 1994) has argued that technological attempts to make socially-based interactions explicit – accepting or denying access to information being such an example – can highlight both the tool and the inexplicit social process, causing breakdowns. Potentially, configurability of systems is as much of an issue as a solution here. However, the transmission of homework information within the family could be addressed by allowing space within the design for social solutions to disclosure, allowing signals sent through technology to be ambiguous and the user the space to create socially acceptable stories around these signals (Aoki & Woodruff, 2005; Boehner & Hancock, 2006; Iachello et al., 2005).

6.2.3 Home-school relationships

It is also important to consider the exchange of information with additional partners that was proposed as a benefit of networked technologies. When families considered the flow of information between their own group and the outside world trust was lower than information sharing within the family. In general, families were sceptical that information gathered by environmental sensors or mobile devices would remain under their control, even though the demos were mostly configured to transfer information into rather than out from the home. Families felt that the storage of information was inevitably vulnerable to outside access:

“The actual data you use for reminders and help from that point of view is good, but, as I say, the cameras, I can see them being used if there’s a burglar alarm tool, not as a, yeah… not really as a within-the-house tool.”

***Mother*, Family B.**

“you’ve got a database so people can watch what you’re doing.”

***Son*, Family B.**

However, it was not just the dangers of unnamed malicious parties families had privacy concerns about. Reactions of all the families to the Mixed Reality Boundary (MRB) showed that, even when teachers were involved, allowing access to the home put a completely different slant on the acceptability of technology:

“Erm, it didn’t feel intrusive, because it was just… if it was in homes or something, I think it would.”

“Yeah, so we’re talking about this TV screen being able to do the same sort of thing, so we could actually go…”

“In your home?!”

“In your home, or, or in your classroom, or…”

“I think it’s a fun concept.”

“Right.”

“But I wouldn’t like it in my own home!”

“It could be more useful in like, public places.”

***Daughter*, Interviewer and *Son*, Family C.**

Families B and C felt that the only way in which domestic information would be shared was with strong family control of disclosure, as with these responses to sharing homework tasks:

> *"I think it's got to be more family-based really rather than in a specific one-on-one area, especially with teenagers."*

Mother, Family B.

> *"I think the essential thing is switching it on and off."*

Mother, Family C.

Lastly, from the families' discussion of sensors it seemed that opening up homework to schools was only acceptable when the family could see strong rewards for this investment, such as diagnosing meaningful difficulties with their child's education:

> *"The exams are getting progressively more important as he goes… if he failed them all, it wouldn't be very nice, but it's not the end of the world, but if you could use something like this to demonstrate that, yeah, he used the maths, in that sort of situation, if you got 89% in maths, and you could show a record of amount of revision time."*

Father, Family A.

"if there's a record of what textbooks have you looked at, and how frequently for things like tests, if you've then got a poor mark in a test then you've got proof that you've really revised hard for, then you know that there's some underlying problem there. Rather than…."

"Yeah."

"And also the flipside that as a parent you know they've failed that test because they haven't picked the textbooks up. I'm not sure how keen they'd be on that aspect of it, but from a parent's point of view, I can see that it would be beneficial to be able to say, well, look, you've failed it because… and they'll not be able to say to you 'well, no, I did loads' when they didn't."

Mother and Son, Family B.

The contrast between views on information sharing within and outside the family was particularly strong with mobile devices. As discussed before, families saw coordination as important for parents and children's social interactions, but were reluctant to draw this into the more serious activity of homework. What is more, no family was open to sharing this information with schools, despite media coverage of technologies being used to do exactly this ("Student ID badges raise privacy issues", 2005).

Controlling domestic information

Generally, a database was seen as a dangerous record, with fear about the ability to control captured information high. As in within-family sharing of information, children were worried about disclosure, but families in general were not comfortable with sharing information about their activities in an uncontrolled manner. Even strong educational scenarios in the sensor and information finding demos, while acknowledged as useful, did not overcome these concerns.

When it came to controlling the sharing of homework information through these technologies, only the family was trusted to control disclosure of domestically situated information. Technologically-based solutions to disclosure which were discussed with families such as security filters were rejected as solutions to the problem of controlling information. Simple controls were demanded, and seemed to be the best ways to assure families of safety. To achieve this, designers need to ensure visibility of processes – for example, using awareness tools to show families how the information gathered in their home is transmitted and to allow them to manipulate a good working model of the network and the devices it uses. This approach to privacy acknowledges previous assertions that design should not just be about protection, but also about empowering users to understand and act with systems. The need to provide this control without lengthy configuration tasks has already been addressed by other authors (Lederer, 2004).

6.3 Conclusions

This study explored the attitudes of a group of families towards the introduction of networked ubicomp technologies in their home ecology to open up homework. It thereby came up with an additional aspect of the design space to consider in developing networked, rather than stand-alone homework technologies, and some design solutions which might be used in this area. What is more, it drew attention to several aspects of the relationships involved in homework, both within and outside the home.

Awareness systems closed down through ambiguity and control

The chapter demonstrated that ubicomp technologies, while they solve the problems of tying study to the inflexible home computer and bring many of the benefits of networking espoused in Chapter 1 into the home, also create new difficulties. While mobility and tailored visibility were available with such technologies, supporting huddled work face-to-face, the use of networked technologies meant a new type of huddling is needed for children to socially negotiate access of family members to technology.

One of the proposed benefits of ubicomp technologies was that they would preserve children's ability to use homework technologies at a variety of locations, and the demonstrator technologies presented examples of how this could be achieved, through mobile systems or multiple screens.

Networked technologies replace face-to-face interactions with two types of mediated interaction presented in the demonstrators. The first is communication, as seen in consultation through the Mixed Reality Boundary, where networking allows an 'open' style of interaction between participants. The second is awareness, as seen in an always-on MRB, and the sensor and location demonstrators, where the network allows increased awareness of the activities of others, without directly requiring participants to communicate.

Awareness across a network acted like visibility of technologies in face-to-face negotiation, allowing prospective helpers to see information about what was happening, and so was a major candidate for a system allowing children to manage the involvement of others across a network. However, as seen in Chapter 5, additional design elements were needed to huddle over technologies and close down homework in face-to-face situations. This chapter showed that in networked situations, activities needed to be closed down to protect privacy as well as allow children the opportunity for independent learning.

This chapter identified two possible ways in which home-school networks could be closed down, through ambiguity of information sent, allowing children variability of expression through such systems, and controls, allowing them to switch off such systems altogether. This was particularly important when home-school networks potentially included information which might be sensitive to the home ecology.

Parent-child versus teacher-child

Trust and coordination seemed to be the basis on which family members shared information, but sharing information between home and school was more complicated. As seen in Chapter 3, the sharing of information between home and school involved in new homework technologies was an emerging issue for ICT Heads, and the difficulty of sharing information between teacher and child was particularly important in this chapter.

However, many proponents of the use of networked technologies in homework held that one potential reason for the use of these technologies was to change the relationship between home and school, or in particular, child and teacher. These proponents held that personalisation of learning agendas would be possible through such devices, and this could reposition the child in education as a user in charge of their own learning (August et al., 2007; Department for Education and Skills, 2005;

Green et al., 2005, Sharples, 2000). The repositioning of the child in their own education would also change the design challenge presented here. If the relationship between teachers and children was more partner-like, then information might be shared more easily. By framing ubicomp technologies as coordinating between teacher and child, trust might be established on a more equal footing, and the acceptability of such devices in home-school relations increased. This could be increased over time, mirroring the home ecology's development of the child's autonomy.

Using awareness technologies could allow children to open up and close down homework across a network. However, such systems need design solutions such as ambiguity and control to allow them to preserve the privacy of both the child as an individual and the family as a whole across the network. The final study, presented in Chapter 7, will therefore look at some of the key design ideas that have been gathered throughout Chapters 5 and 6 and apply them through probe technologies sent into the homes of the three families involved in this chapter. It will draw together the concerns raised in Chapters 3 through 6 about the introduction of technologies into the home context.

7 Technological probes in the home

So far, this thesis has understood homework in a journey moving from the school towards the home, and this last study chapter will show some of the effects of placing technologies into the ecology of the home. In doing so, it will draw from the methods discussed for design in the home in Chapter 2, in particular the ethnographic studies of technologies in-situ, and technological probes used to gather data about how new technologies actually mediate activity in the home.

One set of conventions for describing the uses of technology in the home proved particularly useful. Crabtree and Rodden (2003) identified two meaningful types of place in the home – the 'ecological habitats' where the technologies that support activities are based, and the 'activity centres' where technologies are used. In this study, the focus is less on the selection of these places as design inspiration, and more on their position as ecological niches in which technologies will be introduced. However, identifying the places in which technologies lived, and the places in which technologies were used, was a meaningful and useful distinction in understanding their integration into the home.

In additional to this fine-grained study of space, analysis of the home will also consider the coarse-grained unit of the room as a meaningful ecological niche for activity. There was a visible effect of the meaning family members assigned to a room on the placement and use of technologies, and clues as to these meanings could be found in the ecological habitats, activity centres and approaches to work. These places formed the ecology of the home, and its overall aesthetic – as Harrison and Dourish (1996, p.69) put it "a space which is invested with understandings of behavioural appropriateness, cultural expectations, and so forth."

7.1 Probing the homes

This study was designed as a week-long trial of three technological probes in the home. Three key questions were identified for study, two based on the findings of Chapters 5 and 6, and one based on the domestic design research literature.

- What more can be learnt about the open-closed continuum by studying the use of technologies in the home?
- What more can be learnt about the effect of family relationships on technology use by studying the use of technology in the home?
- What additional issues arise in implementing homework technologies that are specific to the domestic environment?

This study acted as a balance to the one conducted in Chapter 6 in two ways. Firstly, the technologies in Chapter 6 were designed to be controversial, whereas the technological probes in this study were primarily designed to investigate the effect of introducing different types of technology offering new but genuine functions for use during their homework. Secondly, although the study in Chapter 6 was focused on the home using real families, these trials were based in the home ecology, allowing families the opportunity to try out technologies in situ.

The ethical considerations for this study are discussed in Chapter 6, Section 6.1.1, in the context of general research within the home.

7.1.1 The technology probes

As discussed in Chapter 2, the concept of a technological probe was not to present participants with a finished design of a product, or even a prototype, but rather to explore their uses of and attitudes towards a set of open-ended and flexible devices. However, the technology probes used here were specifically chosen to encourage reflection on three major concepts, based on themes arising in previous chapters, and reflecting on findings from previous research. These were:

- Ease of transitions between open and closed homework
    - Mobility: Chapter 5 introduced the idea that mobile technologies might be particularly good at supporting transitions between open and closed work.
    - Awareness: Chapter 5 discussed how providing awareness of activities the child was involved in might aid appropriate parental involvement in homework.

- Supporting privacy and trust in homework
    - Ambiguity: Chapter 6 suggested that ambiguity of signals between children and parents might leave the social space for the family to learn about each other's activities without feeling like privacy or trust were breached.
    - Control: Chapter 6 also discussed that concerns about technologies invading privacy could be alleviated by allowing children or families to control the information which was sent about them.

Together these were investigated to see which, and in which combination, were useful to the family – although it was expected that ambiguity would be more useful the home, and control for sharing of information between home and school.

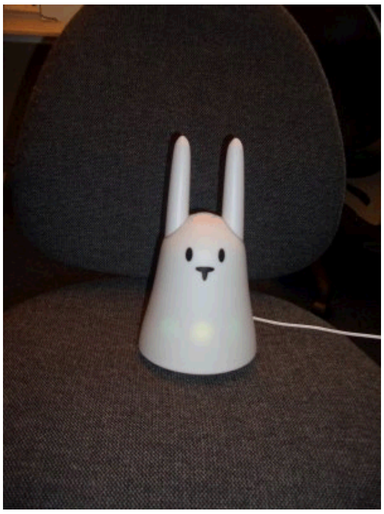
- Aiding the domestic integration of devices
    - Appearance: Lastly, research into domestic technologies for entertainment had investigated how reflecting ludic – playful rather than work-related – values might increase the integration of these technologies into the home (Gaver et al., 1999). Therefore appearance was also studied.

These elements of the technologies will be revisited in the findings sections, and their apparent effects on use discussed. The probes will be introduced below in terms of their appearance and main functions, and how they reflected these concerns.

Probe 1: The Nabaztag rabbit

The Nabaztag is a commercially available communicative device, sold as a 'smart object'. It can be connected to a wireless network and sends and receives information input through a proprietary server hosted by the manufacturers, Violet. It has one additional mode of input – the ears can be rotated and a sensor records their orientation – and three modes of output – four multicoloured lights (three on the stomach, and one on the muzzle, as seen in Figure 7.1a) an internal speaker, and an internal motor which can also rotate the ears.

Figure 7.1a. The Nabaztag rabbit



The Nabaztag server can be set up to communicate a variety of information through the Nabaztag. Violet provides services such as information about the weather, podcasts, the ability to 'marry' any two Nabaztags so that ear movements made on one copy the other, and a speech synthesis system so users can email messages for the Nabaztags to read out. Nabaztag owners are also welcome to program their own services, using any of the outputs, to create new functionality for the device. Each family was provided with two Nabaztags as part of the probe package.

The Nabaztag was chosen to address issues across all three concerns. The two Nabaztags were ‘married’ so that when the ears were moved on one, this was reflected on the other. This provided an opportunity to support awareness of what was happening in the area of one Nabaztag to the other. The ear signals were both ambiguous and user-controlled, allowing privacy to be respected. Alongside this, the families could send messages to the Nabaztags, which would be synthesised and read out loud, creating a less ambiguous, but still user-controlled messaging system. Lastly, the Nabaztags themselves were playful in appearance, in the shape of a rabbit.

Probe 2: The messaging laptop

A laptop was also provided, to be used as an always-on screen in the lounge. The laptop was set up with an email programme always open, an email address to send and receive information, and a screensaver which meant the status of the screen could always be viewed. The laptop used in the study is seen in Figure 7.1b.

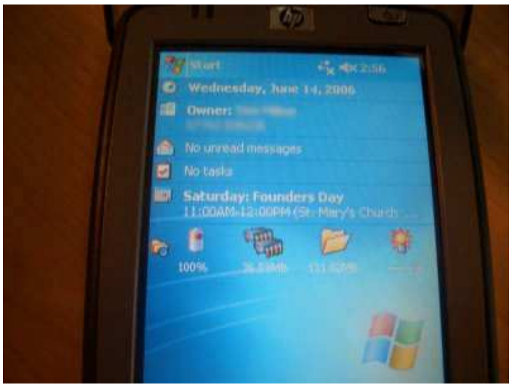
Figure 7.1b. The messaging laptop

The messaging laptop was a contrast probe to the Nabaztag. Unlike the Nabaztag it appeared serious. It could be used to send user-controlled messages, but ambiguity could only be introduced by a conscious attempt to include ambiguity in the message, and the messages could be used for both social and educational functions. The laptop also made it possible to send messages to the Nabaztag.

Probe 3: The Personal Digital Assistant (PDA)

Lastly a PDA was provided, with a wide range of software, including a calendar system, Office package, email and Internet access. The PDA used in the study can be seen in Figure 7.1c.

Figure 7.1c. The PDA



The PDA was the mobile technology of the package. It could be used to send messages to either Nabaztag or the laptop, and in addition featured a diary, and Internet and Office options which could be used for both social and educational purposes. Lastly, an arrangement was made with School E to allow children to take the PDA to school and use it as a homework diary during the probe week, meaning it could truly be used across the home and school. Unlike the work station of the laptop, this device was part-fun, part-serious in appearance.

Connecting the probe package

The three devices were linked together on a wireless network to form a single 'homework network' within the home. Two of the three families who were involved in the study had broadband connections, but no wireless network. In those cases, a USB wireless access point was connected to their family PC to create a wireless network for the course of the study. The use of a wireless network meant that all the technologies could connect to the Internet, and via the Internet, each other.

7.1.2 Engaging with the families

The participants were the three families who had participated in the study in Chapter 6. All had enjoyed finding out about the technologies in the lab visit, and were looking forward to using some in the home.

The probe package consisted of the three technologies (four devices), instructions for their use, contained in full in Appendix 7.A: Nabaztag instructions, Appendix 7.B: Messaging laptop instructions and Appendix 7.C: PDA instructions and wallet-sized cards containing the URL for the form through which messages could be sent to the Nabaztags.

A major part of introducing the technologies to the homes was the placement of the technologies. Guidelines were created so that they were in an area where they would support the appropriate style of work:

- Nabaztag 1 was to be placed in an area where each son did homework on his own – a typical closed work location. Nabaztag 2 was to be placed in an area which the whole family used socially – a typical location for supporting open work. Linking these two areas was intended to support transitions between closed and open work.

- There was no need to keep the laptop in one place; however, as it was to be used for communication it was initially set up, plugged in, in an area similar to that of Nabaztag 2. The messages, which could be sent to the laptop or the Nabaztags from any PC, allowed the child to update their family on their work from any PC, or the PDA, or the parents to send updates to the child while they worked from any PC.

- Lastly, the PDA was used to support either closed or open work across a variety of locations. No particular location was needed for the PDA, although families did have to find a plug socket for its charger.

Over the course of the studies in this and the preceding chapter the three families developed a relationship with the researcher, who conducted the original chat with them about the types of technologies they used (as discussed at the start of Chapter 6) and organised the lab visit in Chapter 6. The same researcher visited the families' homes at the start of the study to set up the wireless homework network with functioning technologies and briefed them as to the use of the technologies. Lastly, the researcher returned after a week of using the technologies in-situ to conduct further ethnographic interviews with the families. By this stage, the families and researcher were comfortable with each other, and the families seemed keen to discuss how the technologies were used. Every effort was made to maintain a conversational tone throughout the interview, but the main points below were all discussed, with the sub-questions used where families did not discuss a particular aspect of use. A semi-structured interview format was used, following the structure below:

- Tell me what you thought
    - Which was your favourite of the technologies?
- Tell me what you first made of the device
    - Has that view changed?
- Explain how you used the technology
    - What was it used for?
    - What didn't really work?
    - What did you want to do?
    - What will you miss?
    - Why didn't you use it?
- Talk me through where the technology was placed
    - Where was it kept?
    - Would it have worked better somewhere else?
- Tell me how you felt about sharing information through it
    - Was sharing information comfortable?
    - Was there anything not shared and why?
    - Tell me what you thought of the rabbit versus the laptop
- Tell me a little bit about your computer set up and network

An example transcript can be seen in Appendix 7.D: Example in-home trial transcript. In addition to these interview-based findings, the researcher also chatted with the families in the initial ethnographic interviews referred to in Chapter 6, the study of Chapter 6, and the study presented here, including involvement in a tour around their homes during the set up of the technologies. The researcher's field notes from all these encounters were used to inform understandings of the families. Photographs of the technologies in-situ were also taken. Information from all these areas will be presented as an introduction to these families in the next section, and used in the presentation of the findings.

7.2 The ecology

In the researcher's engagement with the families over the course of several months, an in-depth understanding of the three families and their home lives was built up. This information is presented here.

7.2.1 The families

As mentioned above, these were the same families that participated in Chapter 6. To briefly recap:

Family A

Family A was the father and son who attended the MRL visit, and the mother, who did not attend. The son was the only child and his father saw him as young, still finding his own independence. However, he was expected to take on responsibilities – for example, he coordinated his own journey to school, and took on the role of host when the parents were a little late arriving to meet the researcher.

Family B

Family B was the mother, father, son and younger sister who attended the MRL visit. As noted in the details of the MRL visit, the son appeared to be in the stage of challenging his parents' authority in a light-hearted manner – their relationship was quite open and friendly. The sister was slightly younger, and there was less evidence of her teasing her parents in this manner. There was a degree of friendly rivalry and teasing between brother and sister.

Family C

Family C was the mother, son and elder sister who attended the MRL visit. The son in this family was the same age as the son in Family B, but had an elder rather than younger sister. The children seemed to have quite an egalitarian relationship with the mother. The daughter was starting to learn how to drive by the time this study started, and generally both children seemed independent – the son also talked about how he travelled into town on his own when necessary. The mother's job involved some travel abroad, and she was absent from the home during the middle section of the probe use, indicating that all the family members were comfortable with the children supporting themselves over short time spans.

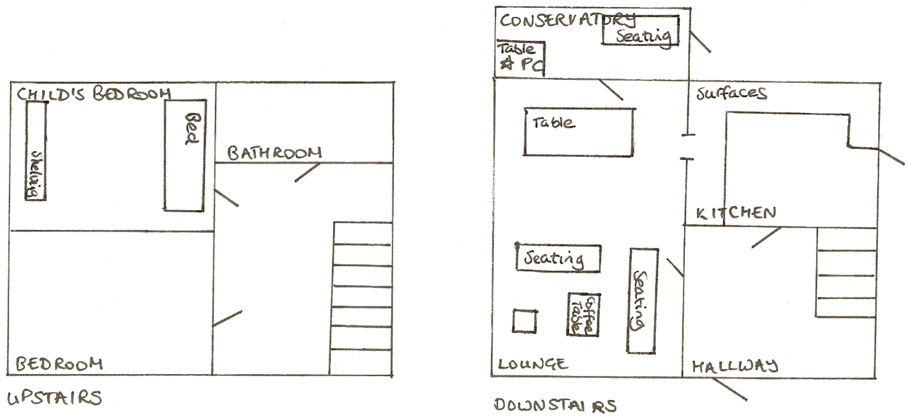
7.2.2 The homes

Field notes, including sketches of the home layouts of each family (not to scale) were used to establish an understanding of the domestic lives of the families involved in the study. These will be presented here, in particular focusing on the layout of the home, and the areas in which the probes were placed. The following observations were written up from the researcher's field notes:

Family A

Figure 7.2a shows the layout of Family A's house. There are three main entrances into the house, at the front into the main hallway, at the side into the kitchen, and at the back into the conservatory.

Figure 7.2a. Family A's house layout



The kitchen is the main entrance room into the home. The conservatory and the lounge are also used heavily, with the PC based in the conservatory, and the television a focal point in the lounge. Upstairs is the son's bedroom.

- The son's bedroom
  - Furniture in this room consists solely of a shelving system on which books, a television, and other items are arranged.
  - The room is decorated to indicate that this is his territory – it is personalised with wallpaper and bedding of his favourite football team.
  - The television is smaller than the one in the main lounge area, but the father mentioned in the interviews that the son would watch the television alone while his parents were downstairs.

- The lounge
  - The main section of the lounge is used by the whole family for shared and individual leisure pursuits, and general entertaining: it was used for the final interviews with the family.

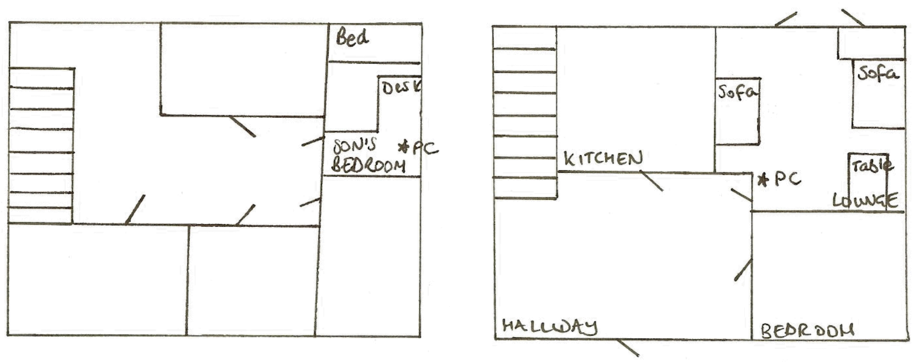
- The majority of the son's homework takes place at a table at the end of the lounge when his parents are not yet home, and he leaves his books out on the table the rest of the time.

- The kitchen
  - The side door into the kitchen was where the family members chose to enter and exit the house. I initially called at the house at the front door, and was let in there, however, this was locked the majority of the time, and on later visits the kitchen door was used.
  - The kitchen also acts as a more general social space – the family often listen to the radio, and fetch refreshments from there.

Family B

The entry to the house is through the front door. There is a bedroom directly to the right of the front door, but the family seem to pass straight through into the lounge area when arriving into the house, or sharing activities.

Figure 7.2b. Family B's house layout



The lounge curves around a corner, as can be seen in Figure 7.2b. There is a large dining table immediately visible on entering the room, and the main family PC is to the left. There are two sofas creating a seating area further into the lounge, and patio doors lead out to the back garden. This seemed to receive a lot of use – there was a swimming pool and trampoline set up in the garden on different visits to the home.

- The son's bedroom
    - Technologies are spread out, but at focal points in the room – for example, the PC screen is in the corner, in the middle of the room – and it is personalised, with small figurines and posters.
    - The son refers to his room as island-like – he often referred to his mother shouting to get his attention while he was in his room.
    - The son does his homework as well relaxing in this room, making it the main centre for all his activities.

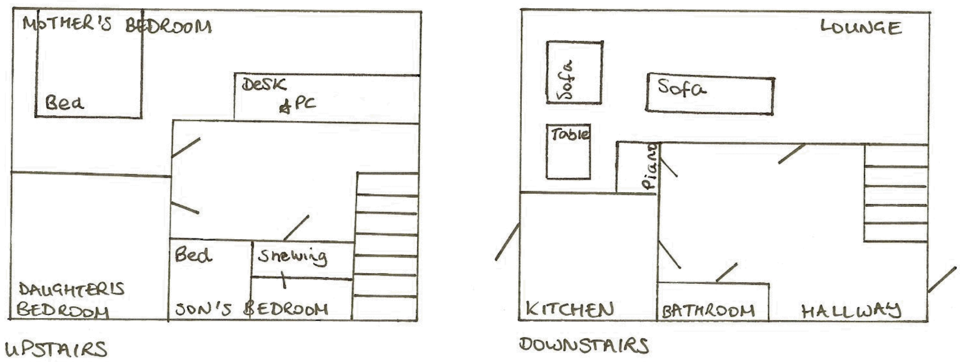
- The lounge
    - The lounge is set up in two sections: a formal entrance-way with dining table and chairs where the final interview took place and a relaxed area for leisure and entertaining.
    - There is a main family PC, which is often used by the family – for example, used to look up train times for the researcher.
    - Two sofas are the only seating in the back of the lounge, one orientated directly at the television in the corner, suggesting that television watching is one of the main uses of the room.

Family C

The entry to the house is through the front door – marked on the right of the downstairs section in Figure 7.2c. The kitchen is straight ahead from the door, and there is a door out through the kitchen onto the patio beyond, where there is seating –

this is where the initial interview with the family took place. At the other end of the house is a large lounge area, comprised of a main section, with sofas orientated towards the television, and an alcove with a dining table, chairs, and a piano.

Figure 7.2c. Family C's house layout



Immediately at the top of the stairs is the mother's bedroom, where there is a large double bed, and around the corner, the family PC. The son and daughter both have individual bedrooms upstairs.

- The lounge
  - The lounge is set out as an entertainment area, with sofas orientated towards the television, and a stereo in the corner, but the furniture is more formal, and the area seems geared towards entertaining as much as media use
  - Technologies are placed in the corners of the room, out of the line of sight, with a stereo and telephone in the corner, except for the television, which was again a focal point for the sofas.
  - A large coffee table is placed in the middle of the room, with magazines on it, and coasters, again suggesting this area is geared

towards entertaining. This is where the final interview of the study took place.

- The mother's bedroom
    - The mother's bedroom has two functions: it is the room where she sleeps, and the home of the family PC.
    - The children seem quite happy to go into the mother's room, and even sit on the bed while I am setting up the computer.
    - The bedroom is upstairs towards one end of the house, and appears quite private, family members indicated they often worked alone here, although they interrupt each other to negotiate use of the PC.
    - The mother still maintains overall control over the room: for example, she indicated she had to throw the children off the computer when she needed to go to bed some nights.

7.2.3 Routines

In the course of interviewing the families, several elements of the family routines which potentially reflected on the integration of the technologies were uncovered.

Family A

The son attended the high school daily, and travelled to and from school on the local tram system. The father was the second to arrive home from work, and by the time he came home, the son had been alone for a while, completing his homework and watching television. The mother worked both in retail and for a youth group. She returned home later in the evening. The son participated in sports quite a lot in addition to his schooling – football and Tae Kwando classes were both regular pastimes, and he played football every Saturday.

Family B

The mother worked as a teacher and the father in the health service in the city centre, although they lived some way outside it. They had one car, and arranged travel into town either through car sharing, or by the father cycling when necessary. Both son and daughter attended schools in town, and travelled into town by tram – they were dropped at the tram stop by their mother in the morning, and picked up in the evening.

Family C

The mother worked for an international pharmaceutical company, and travelled to work every day by car. The son and daughter used a mixture of lifts and public transport – either the tram system or the bus – to get into school every day. At the time of this study, the son was revising for exams, and was not travelling into school every day. The mother also travelled for business intermittently, and was away for a couple of days during the course of the trial.

Elements of these routines, whether part of the day-to-day running of the house or unusual circumstances during the trial, all impacted on the use of the technologies.

7.3 The integration of the technologies

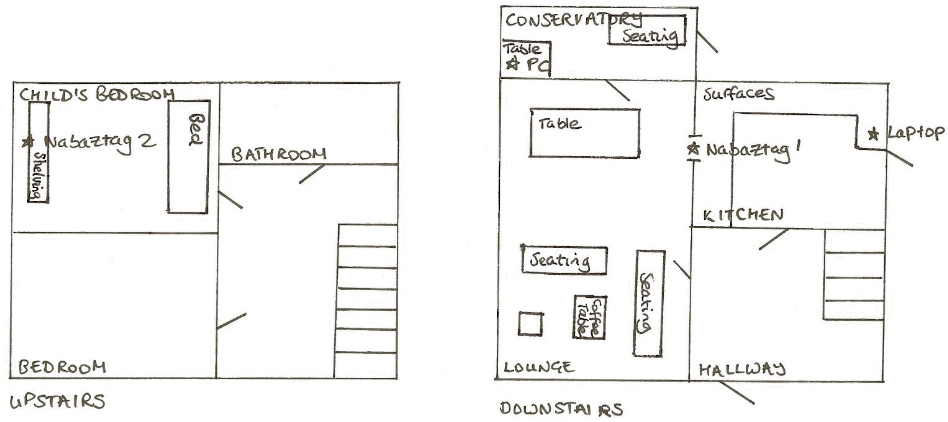
This section will concentrate on the impact of the physical structure of the home on the family's integration of the technologies.

7.3.1 Placing the technologies

Family A

In Family A the father and son were both active in installing the technologies, but the mother did not arrive home until they had been set up. The general positions of the technologies can be seen in Figure 7.3a.

Figure 7.3a. Family A: Layout of the house, with Nabaztag and Laptop locations



The researcher asked for Nabaztag 1 to be placed in a shared area, for which the father selected the kitchen and the son suggested the lounge. The researcher pointed out the hatch between the two rooms, as a compromise, and as it would also allow the family to send messages to the Nabaztag while the son was doing his homework if they wished. Placing this Nabaztag forced the movement of the cookie jars that sat in the hatch. It was still facing the same direction as left when picked up, which was towards the lounge, as can be seen in Figure 7.3b, suggesting that the family had had minimal interaction with it.

Figure 7.3b. Family A: Position of Nabaztag 1 from the lounge

The hatch bridged the gap between the kitchen, where family members entered the house, and the lounge, a social area. The father again asked for the messaging laptop to be placed in the kitchen. He felt that it would be good to receive messages as the family came home – which was in keeping with the idea of the laptop as a messaging screen in the instructions. The child agreed with this reasoning. The laptop was therefore placed opposite Nabaztag 1, on the surface next to the main door, and next to the other free power socket, as seen in Figure 7.3c.

Figure 7.3c. Family A: Position of the Laptop

Nabaztag 2 was the most difficult technology to place in this home. The son in Family A tended to do his homework while the house was empty, at the table in the lounge. The Nabaztag could not support this activity – the parents would be out of the house while homework was taking place, and if present, it is likely they would be in the lounge too. Either scenario would make the ear signals redundant. The bedroom was identified as the only place where the son would work on his own while the parents were home – often reading books, sometimes for homework – so Nabaztag 2 was placed there.

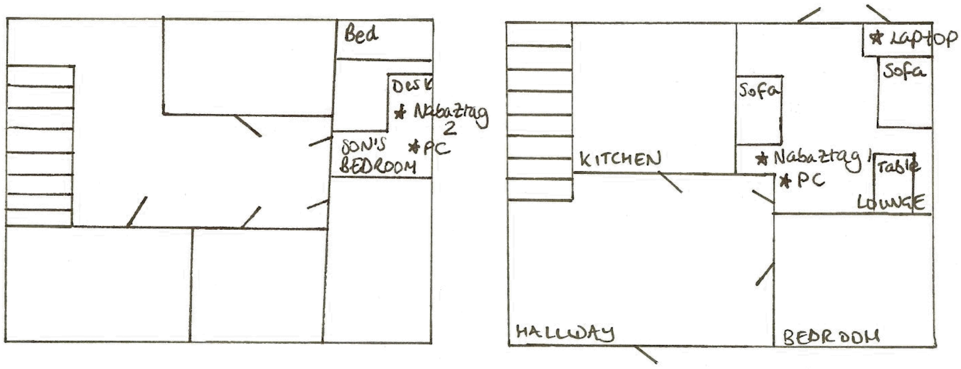
Figure 7.3d. Family A: Position of Nabaztag 2

The significance of this room for the son was discussed above – it was obviously his private and personalised space. Therefore, while the father and son were consulted equally about the positioning of the devices, it was the son who took charge here – the father waited downstairs while the son selected a place for the researcher to place the Nabaztag, next to a spare socket on an extension cord. The son had to displace several of his everyday belongings to fit it in this space but seemed happy to do so, suggesting that the device was welcome. However, as can be seen in Figure 7.3d, when the researcher returned to Family A's house to collect the probes the Nabaztag's back had been turned to the room. The Nabaztag was also unplugged at this time, to make way for the charger for the PDA.

Family B

In Family B, all four family members were present for the placement of the technologies, and interacted in deciding which areas fit the brief the researcher gave them. The final locations are visible in Figure 7.3e.

Figure 7.3e. Family B: Layout of the house, with Nabaztag and Laptop locations



The family identified the best area for Nabaztag 1 as the lounge, and it was placed beside the sofa in the back section. This supported the theory that the back section of the lounge was the more social area. Once this was agreed, the mother selected the position of the Nabaztag. As with Family A, the choice of location was driven by the location of plug sockets. As can be seen in Figure 7.3f, the Nabaztag was placed on the floor.

Figure 7.3f. Family B: Position of Nabaztag 1

The laptop was placed in the opposite corner of the back section of the lounge. As with Family A, the Nabaztag and the laptop were separated. This corner was chosen as it was the other location of free plug sockets, but also because it had a flat surface to put the laptop on and the family did not wish to have the laptop on the floor as it was seen as fragile. The location can be seen in Figure 7.3g.

Figure 7.3g. Family B: Position of the Laptop

The family's converse willingness to have the Nabaztag on the floor suggested that they were willing to see this as an informal piece of technology.

The family, led by the son, then chose his bedroom as the best place for Nabaztag 2. This was where he did his work, and also the place where his mother felt they most needed a way of contacting him. As with Family A, the son alone arranged with the researcher where to place the rabbit, and found the plug socket for it. As can be seen in Figure 7.3h the son placed the Nabaztag quite near to the centre of his work area.

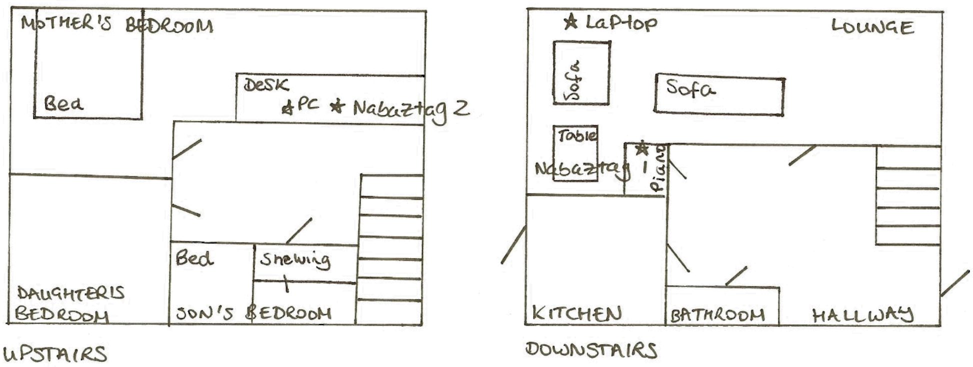
Figure 7.3h. Family B: Position of Nabaztag 2

The second Nabaztag displaced some general electronic and work equipment from the son's desk, and seemed to disappear quite naturally into the ecology of the desk, partly mimicking the figures the son had collected, partly the electronic equipment, and partly the study tools, which seemed to reflect the role of the Nabaztag as both humorous rabbit and information device quite well.

Family C

Only the son and mother were present for the placing of the technologies, as the daughter had a social engagement. The mother and son thus negotiated the placement of the technologies between them, placing a Nabaztag and the laptop in the lounge, and the second Nabaztag initially in the son's room. The locations of the technologies can be seen in Figure 7.3i.

Figure 7.3i. Family C: Layout of the house, with Nabaztag and Laptop locations



As in the previous families, the position of the Nabaztag was driven by the positions of plug points in the room. The mother and son immediately agreed on the lounge as the social area in which both Nabaztag 1 and the laptop should go, but the mother selected where to put both items. The Nabaztag was put in a corner, on top of the piano, in the less used alcove of the lounge, reflecting the idea that the lounge was a space where technologies were not easily welcomed, an issue likely to be heightened with its rabbit shape, which was definitely not in keeping with the formal space.

Figure 7.3j. Family C: Position of Nabaztag 1 (barely visible)

As can be (barely) seen in Figure 7.3j, the space above the piano was in a dark area of the lounge, with the rabbit relegated to a position where it was not visible from the majority of the room, although its messages could be heard. Nabaztag 1 was put in a corner on the piano. As can be seen in Figure 7.3i, this was around the corner from the most-used part of the lounge, where the sofas sat.

Figure 7.3k. Family C: Position of the Laptop

The mother was in charge of finding the space for the laptop. There was another plug point available in this corner, and a shelf was available as a flat surface to put the laptop on, which, as in Family B, was considered important. However, the shelf was in the corner of the room behind the sofa. A picture was displaced in putting the laptop on this shelf, suggesting that this area was for decorative items, rather than ones to be used. The laptop was placed in the corner where technologies were supported in the lounge – a stereo system was on the shelf below, and a telephone beside it, as seen in Figure 7.3l – but this corner was out of the main view of the lounge. This indicated an attempt to make the technology disappear by hiding it, rather than integrating it.

The second Nabaztag was initially placed in the son's bedroom, as with the previous two families. He was in charge of selecting this room, and placing the rabbit. However, the son told the researcher in the final interview that he had almost immediately moved it to the computer area, on realising that all of his work took place there.

Figure 7.3l. Family C: Position of Nabaztag 2

As can be seen in Figure 7.3l, the Nabaztag in the mother's bedroom seemed to sit a lot more comfortably in the PC space than in the lounge, fitting with the variety of technological devices sat on the desk, and at a focal point, in contrast to the Nabaztag placed on the piano.

7.3.2 Using the technologies

The families differed to some extent in their use of technologies:

The son in Family A used the PDA nearly every day to record homework tasks, and also to access the internet. Family A only sent a couple of message with the

Nabaztags to test them at the start of the trial, and they did not use the laptop for messaging, only reporting using it as an additional computer. The PDA was the piece of technology they selected as their favourite.

Family B used both Nabaztags almost every day, particularly using Nabaztag 2 to communicate with the son in his room, and using the ear signals in a variety of scenarios. They barely used the laptop, and used the PDA mainly to communicate with the Nabaztags. The Nabaztags were the piece of technology they selected as their favourite.

Family C used the Nabaztags almost every day, again particularly using Nabaztag 2 to communicate with the mother’s bedroom. The son used the PDA every day for a variety of tasks, including planning his revision, making revision notes, and using the internet. The PDA was the technology they selected as their favourite.

7.3.3 Feedback on the probe method

This study followed the convention of using technology probes to investigate some of the issues and potential of different kinds of homework technology. The advantage of such a study was that it allowed a variety of concepts and ideas to be highlighted in the course of a week’s engagement with the technologies for each of the families. However, the family was aware that these technologies would not be available for their long-term use: that they were not actually integrating the technologies into their homes. There was some attempt to deal with this effect by making sure that all of the probe devices used were available on the market. Families A and C saw the wireless network itself as their most likely purchase from the study, but Family A were keen on the idea of buying a PDA.

One particular challenge faced in this study was the time limit of a week. In each family, the sons chose a particular piece of technology to investigate first when they arrived: the sons in Family A and C went straight for the PDA, and in Family B the son and daughter immediately started playing with the rabbits, although they used the PDA to interact with these. This was perhaps influenced by the relative novelty of the Nabaztags over the PDA in this family, but also reflected how useful the families went on to find the technologies. However, whether immediate appeal would have been influential in the long-term is unknown.

All of the families suggested that given time, they would have had greater opportunity to try the technologies, and that the space of one week was not long enough to get a full picture of how they might have accepted the devices in the long term:

> *"It was quite difficult in a relatively short amount of time, and the fact that it was a bank holiday weekend as well, we really didn't have a real need to… a real need to do anything, I would have used the laptop more probably during the week, if I'd have been here, over the weekend. Perhaps if it had been a more normal weekend, I guess I would have been and used the laptop more… it was bad timing in that respect."*
>
> ***Mother, Family C.***

All the families also indicated that they felt guilty where they had not given one technology their full attention, suggesting that they had intended to use all the technologies, and perhaps even saw the benefits of using all of them, but the time squeeze had prevented them from doing so.

This inability to fully investigate the technologies during the time provided indicated that introducing multiple devices, or even multiple functions of devices, to a family at once is highly ambitious. Hence attempting to revolutionise rather than subtly change household activities may be inadvisable. This has implications for both the study of technologies, and the introduction of homework technologies, suggesting that introducing one new element at a time is more likely to lead to adoption of multiple functions or devices. However, valuable feedback on the design tactics was still gained, and this will be presented below.

7.4 Findings: Easing transitions

As was seen in the placement of Nabaztag 1 in Family A, ambitions to link open and closed work could be impeded by work patterns of parents. Work meant that parents needed to be certain places at certain times and the places they worked could constrain their activities. In the UK the standard full-time working day is longer than the standard school day, leaving a section of time in which children can potentially do homework while parents are not in the home, let alone co-located, even in families not working unusual shifts. For children with parents at work independent study might be the only option. Some parents did manage to maintain communications throughout the day, often using the work computer, but for others it was not an option:

"because at work I don't use a computer, so I'm not sending emails through anyway, and neither are you, are you?"

"No."

"It's just not something that's part of our daily work so you don't use it."

"No. I tend not to use the office when there are staff in."

Mother and Father, Family B.

The mother in Family A and both parents in Family B were restricted in their computer use, which meant that they were unable to use this technology to keep in touch with their children. In fact, the only message sent to the Nabaztag from a PC outside the house in the study was from the mother in Family C, who worked at a computer a lot of the time. There is an opportunity here to support transitions between open and closed work over a distance when parents are at work, but it may be limited by the format of each parent's activity.

7.4.1 Mobility: Overlapping activity centres and ecological habitats

It seems sensible to assume that transitions between open and closed work are best supported when the activity centre of the child doing homework and the activity centre of the helper, who can potentially become involved with homework, overlap. With static technologies, however, technologies were tied to ecological habitats (the place where the technologies lived) rather than activity centres (where the technologies were used). Families were asked to choose one location where closed work and one where open work took place for the technologies. This indicated how common open and closed work were in their everyday lives, and also how closely tied to ecological habitats the homework activity centres were.

The shared area required for placing Nabaztag 1 and the laptop was an area all the families recognised and agreed on quite quickly. The closed workspace necessary for Nabaztag 2 caused more problems. In Family A, the son's main homework area was separated from the families' social activities in time as well as space, and so the location in which he most frequently worked in a closed manner was also a family room. This meant that although Nabaztag 2 could be placed in an appropriate ecological habitat, there would be no support for connecting the activity centre of his homework to the activity centres of his parents. However, he noted that awareness information would be useful if it was practical to share across a network:

> *"And what about kinds of information, so say a record was kept of what you were doing with the rabbit, or when you were using MSN, or when you were using certain textbooks… signals about when you were doing your work...*
>
> *<u>"Yeah, because if they knew when I was using the textbook… my mum and dad would know that I'm doing my homework, and if I was on MSN, then Mum and Dad would know that I've finished my homework, so they ring me…"</u>*
>
> ***Interviewer and <u>Son</u>, Family A.***

In Family C the son did the majority of his work in the shared family computer space. This location was chosen for Nabaztag 2, but was also an area with opportunities for open work where family members often came in and out. This created the opposite problem: there was little need to provide additional transitions between open and closed work: activity centres already overlapped.

The mobile PDA supported closed and open work and transitions between the two more successfully. Both Families A and C, who used the PDA the most, used it to support homework in a number of locations. The following example shows how the PDA supported work in the lounge, where the son in Family A could interact with his family more easily:

> *"I like the PDA – more in the start of the week, the Thursday and Friday I found it quite useful to either do some Biology revision notes on it and then emailed them to myself, and then printed them off. So I got that done, and that was quite useful, being able to sit down here with the TV in the background ..."*
>
> ***Son, Family C.***

The other advantage of mobile technologies was that they were easy to shut out as well as let in. When multiple activities took place in one area the static devices could be resented. This was seen with both of the sons who had Nabaztags in their bedrooms, and experienced problems with the Nabaztag's lights at night:

"Was it Saturday morning when I set it?"

"Ah right, I unplugged it because it was flashing purple and I wanted to sleep so I unplugged it. I got up about 11 and I plugged it in, and it went 'get up now' at eleven!"

"Yeah, so maybe that's the thing, it'd need to be somewhere where it wasn't flashing lights all night, because he obviously unplugged it, which I didn't know."

"Yeah I unplugged it every night, it was kind of a purple glow and it'd go on and on and you'd close your eyes and then it'd rile you."

Son and Mother, Family B.

The makers of the Nabaztag attempted to address some of this problem by including a sleep option, which turns the device off at night between set hours. However, the families all rejected using this option. As the mother from Family B noted, this restricted their ability to send messages, particularly ones telling her son to wake up! Although a mobile device would not remove this dilemma, it would provide the family with a number of options to control their exposure to devices.

7.4.2 Awareness: There is already awareness information in the home

The most common comment on the awareness service provided by the Nabaztags was that it was of little or no use. However, there was an interesting reason for these comments: all of the families said that they felt their houses were too small to require an awareness system. The father in Family A's comments suggested that in compact houses of the kind studied, the structure of the home was a built-in awareness device:

"it's probably more beneficial to communicate if you've a bloody big house, if you've got a three storey house or something, but in ours… when it's quiet in his bedroom, he's watching the telly; if the light doesn't vibrate, he's not crashing about, so I think that's a good point actually, it may be more beneficial if it was used you to your mate, or you to me at work, or something like that."

***Father*, Family A.**

The above excerpt reiterated concerns raised already about the usefulness of encouraging opportunistic interactions except when long distances were involved. However, it also illustrated that the awareness information necessary to link family members together is available through the infrastructure of these compact UK homes, and is valuable to family coordination, making investigation of the use of these devices in larger homes, or over a distance, desirable.

7.5 Findings: Supporting privacy and trust

Generally, privacy and trust were individual things. In Family B the mother used the Nabaztags a lot to remind the son of appointments and events, as can be seen in Figure 7.5a. Family B was the only family who used the time setting on the Nabaztag messages in this way, and the mother commented that this was unique to her relationship with her son:

"That to me, is something that is specific to us because you'll forget, do you know what I mean, and it's not, not as a horrible way, but he genuinely will forget so that was good for that purpose… It wouldn't have been as useful for [my daughter], because she wouldn't forget in the first place, you

know… To me it was a forward planning system rather than a sort of off the cuff here and now sort of thing."

"Yeah. So did you feel that that was useful?"

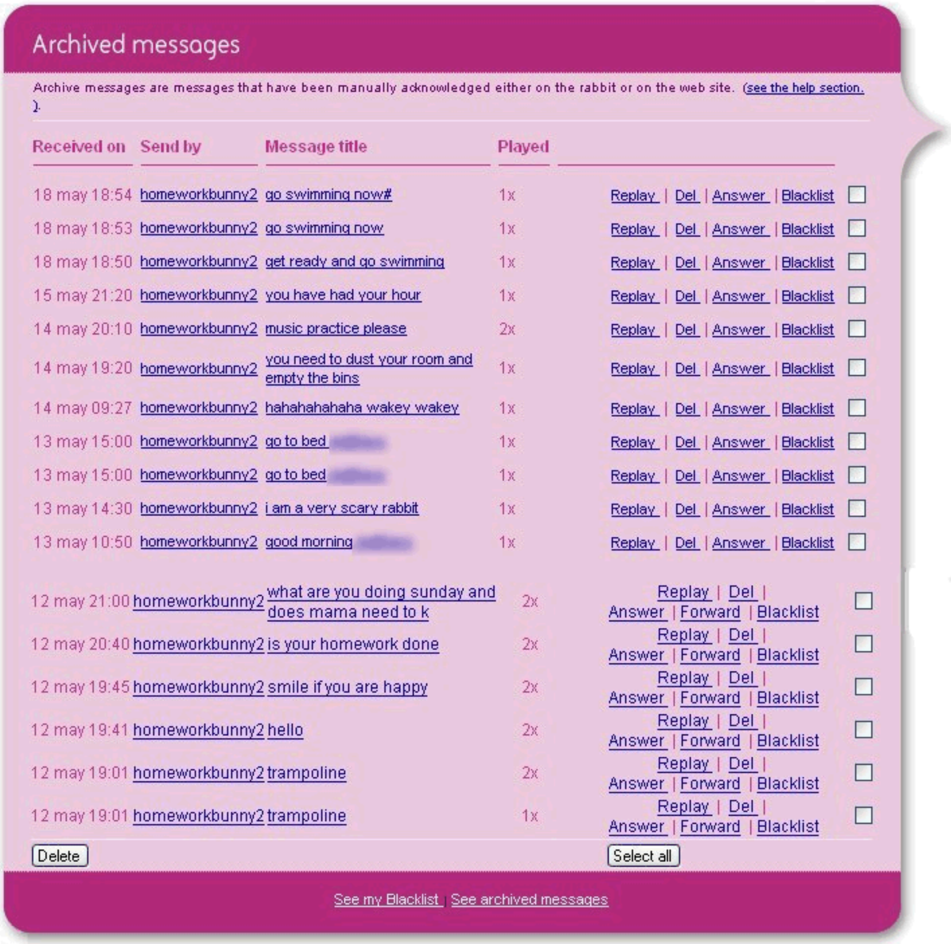
"Yeah."

"Or was it an alternative electronic nagging system?"

"Both really! Yeah, it was kind of like an alarm clock only with this reminds you at times but as well as being an alarm, when you set an alarm you don't know what the alarm's for but that tells you what the alarm's for as well. Rabbit super alarm clock!"

Mother*, *Interviewer and Son, Family B.

Figure 7.5a. Family B: Nabaztag 2 usage logs



The exclusive use of the Nabaztag as a reminder system for routines indicates again the variability of expressing privacy and trust in different families, or even, as the mother indicated, between different parents and children. This reinforced the finding discussed in Chapter 6 that privacy and trust need to be negotiated between parent and child, rather than implemented according to designers' assumptions. In this families' case, the son's particular weakness meant it was acceptable for the mother to track his routine in some depth: during previous conversations she had indicated that his poor memory was related to his dyslexia, so it was seen as a problem requiring extra support, rather than an area for criticism. In any other child, however, such intensive reminders might have been considered inappropriate.

7.5.1 Ambiguity and control: It is necessary to balance privacy with information

Ambiguity and control of messages were chosen as ways of allowing interpretable signals to pass between child and parent without invading children's privacy in the home. However, the opportunity to provide this through the ear signals of the rabbits was hardly used by the families in these studies. The father in Family A went into some detail explaining that it was the level of information that the Nabaztag sent that was a problem for their family, suggesting that communication via the ear signals seemed too basic for his son:

> *"I can't think of a better way of describing it, other than to perhaps say you would do that with a younger child, rather than babyish, do you see what I'm saying?"*
>
> *"More of a play thing than a communication thing?"*
>
> *"You know, as a development tool for younger children whereas a thirteen year old is, or even younger kids, ten and eleven year olds, are ready to deal with a more sophisticated, the more sophisticated side of it, like using the actual voice messaging part of it, rather than just using its ears…"*
>
> *"It was more the sort of level of it?"*
>
> *"I think if we would have had three PDAs each, we would have been using those, do you agree? I just think we would, and I think it sounds like we're really calling it childish, and it's not childish at all."*
>
> ***Father and Interviewer, Family A.***

Although the ear signals provided privacy for the child, then, they did not show respect for the child in the way the father wanted. However, in other discussions of the Nabaztag's ear signals all three families felt that awareness information was already provided, and was used through their home's infrastructure.

The main difference between the transmission of information through the rabbit ears and via the structure of the house was that the child was also allowed control of the information sent by the Nabaztags. In trying to ensure that children maintained their privacy, it appeared that the ear signals went too far by including both ambiguity and control – reducing the level of information shared to childlike simplicity. The other side of the danger of violating privacy and endangering relationships between child and parent or family and school through sending too much information was therefore sending too little information, and not providing a useful service. Balance is thus the key challenge for designers.

7.5.2 Appearance and More: Placing technologies in the microsystem

Lastly, there was the question of appearance. Several factors dictated where and how the probes could be placed. These varied from physical constraints – the need for electrical sockets to charge the static technologies, or the need for a secure shelf on which to place the laptop – to aesthetic constraints – the need for technologies to fit with the ecology. The technologies ended up in five distinct varieties of ecological habitat:

- The kitchen: Nabaztag 1 and the laptop in Family A.
    - The design of neither Nabaztag 1 nor the laptop seemed to fit particularly well in the kitchen, which was quite a traditional kitchen area, as seen in Figure 7.3b and Figure 7.3c.

    - There were adequate plug sockets to allow both technologies to be placed around the kitchen.
    - Nabaztag 1 was pushed to the periphery of the kitchen to allow it to look out onto the lounge, and the laptop was at the centre of activity: the family's mail was originally displayed in this space.

- The relaxed family lounge: Nabaztag 1 and the laptop in Family B.
    - The lounge was a relaxed area with modern furniture, and the design of Nabaztag 1 in particular fitted into this theme, as seen in Figure 7.3f.
    - There were many plug sockets available, and the family had a wide number of spaces to choose from.
    - Nabaztag 1 was placed on the floor, in a casual manner. However, the laptop was considered too easily breakable to put on the floor, and ended up placed on a table on the periphery of the room, as seen in Figure 7.3g.

- The traditional lounge: Nabaztag 1 and the laptop in Family C.
    - The lounge was a formal, adult room. Nabaztag 1 in particular fitted poorly into this theme, as seen in Figure 7.3j.
    - There were plug sockets available, but these were all at the corners of the room, and so the technologies could not be placed centrally.
    - The laptop was placed with other electronic devices in a hard-to-get-to corner, seen in Figure 7.3k, and Nabaztag 1 was also placed in a

little-used corner on the periphery, as the dark tone of both pictures indicates.

- The child's room: Nabaztag 2 in Family A.
    - The playful design and educational purpose of the Nabaztag fitted well with this habitat: in Figure 7.3d it can be seen by a globe and a desk tidy.
    - There was only one plug socket available, and Nabaztag 2 was not always plugged in: the child chose to plug in the PDA charger in preference.
    - Nabaztag 2 was seen as too intrusive: the child complained about the lights in the night, and turned the Nabaztag towards the wall.

- The PC area: Nabaztag 2 in Families B and C.
    - These areas were full of devices: printers, scanners, remotes and controllers visible in Figure 7.3h and Figure 7.3l. Nabaztag 2 fitted well among these gadgets.
    - The location next to a PC meant that there was support for electronic devices. Plug sockets were available and extensions were provided.
    - In both cases Nabaztag 2 was placed among the other devices, near to the computer so it could be viewed while using the screen.

Relationships between family members were embodied in the aesthetic of the home. For example, the 'grown up' nature of the lounge in Family C reflected the older children in that family, whereas the more playful nature of the lounge in Family B reflected the younger children in that family.

A number of variables seemed to determine ecological fit and it is worth noting that those technologies which seemed to fit well in an area were the most used: the Nabaztags in Family B, and Nabaztag 2 in Family C. The obvious issues of whether the device fitted aesthetically into a given niche, and whether there was a plug socket available determined whether the technology would be placed centrally to or at the periphery of everyday patterns of activity.

Homework technologies which focused on opening up forms of closed work to others were often placed in the bedroom, and this was a particular room in which appearance seemed to be critical. The sons all showed the researcher their rooms themselves in the tour: the bedroom was private, and allowing children to take charge of this space was clearly one of the ways in which children were ‘trained’ for responsibility. As seen in these examples, the sons were particularly likely to be critical of technologies introduced in their territory, making the importance of fit particularly strong.

7.6 Conclusions

The families tried all out these technologies as novel mediators of their homework activities for a week. They had some reservations about their ability to try the technologies based on the limitations of time, but even the lack of use of some technologies provided data about the relative popularity and immediacy of the technologies they used. The success of the design solutions in supporting homework activity are considered below, alongside lessons about the ‘fit’ of the technology into the home.

Design solutions

There were three major design elements supporting homework in this chapter, mobility, awareness, and ambiguity and control.

Mobility

This chapter showed that one useful property for a device in the ecology of the home is mobility. Echoing the micro- and macro-mobility properties seen with paper-based technologies in Chapter 5, the PDA allowed flexibility of use, and removed many of the obstacles facing the integration of the other probes in this study: their lack of use when family members could not tie activities to a particular ecological habitat, and when family members were in situations where they could not sensibly take a static device, like the workplace. Mobile devices also allowed flexible transitions between using and not using devices: a mobile technology need not necessarily fit into the activity centre in which it is used, as it can be put away elsewhere in the long-term.

Awareness

The benefits of the awareness that these technologies provided were somewhat overshadowed in this study by parents’ revelation that they already had some degree of awareness of children’s homework activities available to them through the fabric of their houses. However, the fact that they were aware of and used such information, and the fact that they indicated they would appreciate such information shared over greater distances through networked technologies suggested that this mode of information is likely to be useful for opening up and closing down homework. Overall, the families in this study indicated that they would like some way to maintain contact between home and the parent's workplace, and, given the feedback from parents about their ability to access technologies such as PCs within that workplace, it seems advisable that a mobile and quite simple device could be used to maintain awareness, and perhaps indicate when children would like feedback at a later point.

Ambiguity and control

In Chapter 6 this thesis considered the dangers of ubicomp devices, pointing out that when theses were combined with homework networks, and the ability to collect information about context, they could be seen as having vast potential to intrude on the privacy of children. The idea of using ambiguity in signals and control of signals presented a way in which the sharing of such information is possible without violating privacy. However, this study showed that there needs to be a balance: providing ambiguous and filtered information was far too low resolution, and could be seen as patronising the child. Nonetheless, the lack of privacy concerns reported in this chapter from the devices showed that, while erring on the side of caution, these solutions seemed to be heading in the right direction. The presence of sound travelling through the house and communicating information about the child's activity was a problem in this study: it undermined the usefulness of the Nabaztag's awareness property. However, it could be used as an inspiration for the design of awareness devices which join the child doing their homework, and the parent at work, as it is a good example of an ambiguous awareness system which is successfully integrated into the ecology.

The application of these design tactics will be further considered in Chapter 8.

The ecology of the home

In general, the major additional feedback on the technologies concerned their 'fit' into the ecology of the home. This consisted of several dimensions.

Routine

Technologies needed to fit into the routine of the family and the Nabaztags in particular suffered from a lack of use because of their awkwardness in fitting into these routines. One family found themselves unable to use the Nabaztags to signal to each other as their routine did not involve the child doing their homework in a private room while the parents were in a family room. Two families encountered difficulties in using the Nabaztag as an always-on signalling device as they needed to use the bedroom as a place to sleep as well as work, and its lights made this difficult to do. This can be related to the need for homework itself to fit in among the family's routine established in Chapter 4.

Aesthetic

The aesthetic of the ecology was a further dimension of 'fit' with families varying in how appropriate the technologies seemed in terms of their own aesthetic preferences, and, in the case of the children, their parents' aesthetic preferences, and how these affected the overall aesthetic of the house. Technologies which failed to fit on this dimension were marginalised in the rooms in which they were placed. Whether devices were marginalised through dislike, and also unused through this dislike, or were simply marginalised and then forgotten about, is arguable, although it seems likely that a combination of the two is in effect. Again, considering the control of the parent over the aesthetic of the majority of the home, it is possible that devices will be marginalised in family spaces by the parent, and then become difficult to use for the child, regardless of their feeling about the technology in question.

Physical structure

The physical structure of the home is also an aspect of its ecology, and one that often gets forgotten in sociocultural work. Several examples of the effect of the physical structure of the houses in which the family lived were seen on technology use. The placing of the technology was largely influenced by the structure of the home. Even when largely driven by the social meaning of a technology's location – for example, wanting to get messages on a laptop as soon as they enter their house – families are constrained by the design of their home – needing to choose somewhere near the door, and being forced to consider where appropriate surfaces lie. The position of plug sockets was a particular issue for the families in this study, and it is worth bearing in mind that the provision of a home network removed a potential further problem for the majority of households, the need to place Internet-dependent technologies near a phone socket.

As well as constraining families' choices, the structure of the home also provided information. The transmission of activity information through the infrastructure of the house by noisy floorboards was mentioned in this study as a source of information for families. However, such information flows that are already present in the home could combine with new information flows introduced through technologies in unexpected ways: perhaps confirming or denying supposedly ambiguous signals.

Family relationships

Finally, individual relationships within the ecology of certain homes can drive technology use in unpredicted ways. The major example of this seen in this study was a child with dyslexia and how this affected his relationship with his mother. She indicated that she constantly sent him reminders with the Nabaztag, because she was aware that his memory was poor as a consequence of his dyslexia. However, she was keen to clarify that she would not do the same with her daughter, feeling that this would be patronising and unnecessary. It is easy to imagine how personality traits or medical conditions might affect the way in which families used technologies to mediate activity in this way, either in the case of child, siblings or parents.

None of these aspects of 'fit' are useful in suggesting a 'one-size-fits-all' approach to design which might be taken up and simply applied to homework technologies. However, they do explain why so many approaches to supporting homework are currently in use. The simple explanation for the variety of technological solutions seen in Chapter 3 was that because of poor access to technologies children did not always have the option of using the most up-to-date equipment. However, it is also possible that the variability seen – for example, the use of floppy discs, CDs and USB pens to transfer media alongside networked solutions – reflects a more general property of the home ecology, the need for a fit between the technologies used and the home of the child in question.

There are some simple steps which can be taken to address some of the problems of fit. Making technologies as mobile as possible is one way to ensure that they are not marginalised due to awkwardness, appearance, or a lack of plug sockets. However, other kinds of flexibility can also be harnessed to try and increase the chance of fit between a device and different kinds of home ecology. This could vary from ‘skinning’ of technologies to fit with their aesthetic environment, to building in long term support for homework devices, and allowing software updates to introduce new functionality for homes which fall outside the parameters assumed by designers when the technologies were originally built.

General thoughts

Overall it appeared that the design tactics developed in this thesis were successful in their aims. Although families were keen to provide feedback on the technologies, and how they could be developed to better serve their needs, they were comfortable with the privacy offered by these systems, and felt that they could be used to offer genuine educational experiences.

The probe technologies, most importantly of all, offered children new opportunities to negotiate the involvement of those around them in their homework experiences. Unlike the personal computers studied in the video diaries in Chapter 5, children were able to open up and share their work with other family members where and when they wanted using these ubicomp technologies, and where design flaws were encountered these centred on the ability of these prototypes to support the full range of activities needed, rather than the ability of children to negotiate involvement and / or privacy.

However, this ecology-based probe study did confirm the importance of iterative design, even when heuristics have been used to identify areas where issues with networked technologies are likely to arise. The usability of technologies is not a novel challenge for design, but it is still a central one for designers.

The concluding chapter will look again at the importance of these findings for the processes of opening up and closing down homework both face-to-face and across a network – whether it be a network within the family, or outside the home. It will also consider how these new understandings of the homework design space and networked technologies can be carried forward into the future of lifelong learning.

8 Conclusions

This thesis aimed to explore how the increased use of networked technologies might affect interactions within the home and between home and school, using the lens of homework to explore the design space of homework technologies. Its primary aim was to identify issues that are likely to arise from the introduction of networked technologies into homework and how these could be avoided or addressed. Two core contributions arose from this: one looking at issues associated with currently proposed technologies; the other looking at issues associated with more complex implementations of technological networks.

Findings from the empirical studies were used to produce these conclusions. The major contributions are centred on the interactions between parents and children, and provide a contrast to the typical educational stance on homework seen in previous research, and the priorities of the school seen in Chapter 3.

8.1 Mediating involvement face-to-face

Children benefit from actively structuring their homework activities to involve or exclude other family members, and the networked technologies which teachers plan to use in homework fail to mediate these processes successfully.

This thesis found that the home-school computer networks that Heads of ICT wanted to introduce into homework, as seen in Chapter 3, were likely to interfere with a key aspect of homework activity, children's negotiation of their families' involvement in their work.

Properties of traditional technologies allowed children to negotiate their families' involvement in their homework activities effectively. Video diaries of children carrying out genuine homework activities in their homes in Chapter 5 showed children engaging in a range of styles of homework activity. In around a quarter of the examples of homework activity seen in the diaries, the children were working in ways which discouraged involvement in homework completely. The properties of the technologies used made it difficult for their family to become involved: the technologies contained all the information necessarily to complete the homework task, meaning children were absorbed in, and difficult to distract from their activities; they also offered poor visibility, making the content of the activity difficult to observe. This polarised style of work was called 'closed' work, as the children were constructing their activities in a manner that closed them off from the outside world. The properties of the technologies 'closed down' homework, as they were used by the children to close the activities down from outside involvement.

In a further quarter of the examples of homework activity from the video diaries, the children were working collaboratively with family members. The properties of the technologies used made it easy for their family to be involved: the technologies presented highly visible information, making it easy to understand the activity and become involved; they were also visually appealing, making the activity seem more attractive. This polarised style of work was described as ‘open’ work, as the children were constructing their activities in a manner that opened them to the outside world. The properties of the technologies ‘opened up’ homework, as they were used by the children to open the activities to outside involvement.

As well as engaging in open and closed work in separate activities, children also engaged in activities which involved a mixture of family involvement and independent study. In the remaining half of the examples of homework activity seen in the video diaries, children were working in places where family members were present, but not always involved in homework. In these final cases, the properties of traditional, paper-based homework technologies could be used to negotiate the involvement of family members in homework: when a child wanted to involve a family member in homework they could use actions, verbal negotiation, and body moves (Gill, 2004; Gill et al., 2000) – gestures around a technology – to indicate when involvement was required and when it was not. These processes were supported by two properties of paper technologies – variability of expression and micro-mobility. Paper offered variability of expression, meaning that there was a range of information that could be gained at different distances from paper, with the depth of information about the content of a piece of work gradually increasing as family members inspected it more closely. Variability of expression allowed children to draw attention to their activities at different levels, as appropriate, for example communicating progress by giving a parent a distant view of the structure of a piece of writing, or getting in-depth help with the content of a task by using a body move to draw direct attention to a specific passage of text.

Paper also had micro-mobility, meaning that ‘micro’ changes in position and orientation of paper technologies could be achieved because they were light and easy to move. Micro-mobility allowed children to give different levels of access to their work, for example handing their parents a piece of work to gain in-depth help, or rotating a piece of homework to show or hide their work. The process of closing down homework in an area where it would otherwise be open to involvement was known as huddling: children were working in places where their work would be open to involvement from family members but used signals – such as huddling over the paper to obscure it – to indicate to family members when involvement was not welcome. The properties of micro-mobility and variability of expression facilitated huddling – allowing children to open up and close down their work fluidly within a single homework activity.

However, the desktop and laptop computers ICT Coordinators proposed as the home interface of their home-school computer networks offered neither variability of expression nor micro-mobility. Desktop computers are not even macro-mobile – they are fixed to one place and cannot be carried about. Activities conducted with a desktop computer occur in a place which is usually either peripheral and private within the home, closing down homework completely, or central and public within the home, opening up homework significantly (Kerawalla & Crook, 2002). Even laptop computers are fixed to certain locations by power points and convenient places of use (Woodruff et al, 2007). Both types of personal computer (PC) supported huddled work poorly in the vignettes from the video diaries in Chapter 5. The PC screen offered poor variability of expression, displaying all its information when viewed directly, and none when viewed from the side, and the PC interfaces of keyboard and mouse made it difficult for more than one person to act on or gesture at content. Together these properties of the personal computer made it difficult to open up and close down homework flexibly within an activity, or sometimes impossible to open up or close down homework at all. However, ubiquitous computing technologies such as the PDA discussed in Chapter 7 could be used to offer networked information with micro- and macro-mobility similar to paper.

Supporting children in closing down and opening up their homework is important in meeting the aims of homework. Independent study and family or parental involvement are two important parts of homework activity: the first allows the child to develop independent study skills, and the second increases parents' investment in contributions to their child's educational activity. This is possible because homework is out of school so teachers are not present to supervise children's activity, and in the home so parents are present to join in, and so these aims cannot be met by any other type of current educational activity. Children in the discussion groups in Chapter 4 stated that decisions about elements such as the locations where they did homework were deliberate attempts to control family members' involvement in their homework activities. Therefore introducing technologies into homework which did not support the opening up and closing down of activity would either severely limit children in terms of the places they could attempt their homework and the kinds of work they could attempt within a single activity, or potentially remove one or more of homework's aims and benefits. A major contribution of this thesis is to identify this potential issue in the use of home-school computer networks. However, there are ways to overcome this issue, by using novel technologies such as ubiquitous computing technologies which can support variability of expression and micro-mobility while maintaining the networked links that teachers require. These design implications are discussed further in Section 8.4.

8.2 Mediating involvement across a network

Details of homework activities transmitted across a network can potentially include too much information about a child or a family's wider activities, violating privacy and leading families to reject technologies.

This thesis also found that the increased information sharing offered by the use of networked technologies in homework activities could easily make families uncomfortable, and that this discomfort was elicited and expressed in different ways depending on the relationship in which information was shared.

ICT Coordinators mentioned that when they used ICTs in homework they faced issues in using these across between home and school, as described in Chapter 3. The particular issues they mentioned were the differences in values assigned to ICTs in home and school, and the discomfort caused by the uncertainly of ownership introduced by technologies' dual locations – in terms of who should buy the technologies, who had the responsibility to maintain them, and who controlled the software which was installed on them. This suggested potential difficulties with using home-school computer networks.

Families also identified issues in using ICT across home and school contexts, but they focused on the problems of sharing information through ICT. Networked technologies offer the ability to share information about the homework process which can improve homework outcomes for both home and family, for example by allowing contact between teachers and families, by providing situated educational information based on children's activities, or by allowing parents awareness of children's homework. However, the more detailed information that a system gathers about a homework activity, the more likely it is that additional information about the home and family will be revealed through such devices, and this made families uncomfortable, as described in Chapter 6.

Firstly, families were uncomfortable about sharing a large degree of information within the family. While parents felt that they should trust their child to complete tasks on their own as part of the child's development of responsibility, children admitted that they did not always take responsibility, and would not always complete homework activities. Children could also demonstrate that they trusted their parents by sharing tasks, but both parents and children were worried that observation could be seen as monitoring and disregarded children's rights. In face-to-face homework scenarios, families tended to negotiate disclosure of information dynamically, alongside the changing needs of the activity and their relationship. However, although roles and relationships drove the sharing of information, families did not use any hard and fast rules. The sharing of information about homework activities within the family was too complex to be modelled within a computer system, and, Chapter 6 argued, an attempt to do so would be likely to draw attention to the contradictions within the parent-child relationship, causing friction within the family.

Secondly, families were uncomfortable with sharing a large degree of information with the school, but a different relationship was involved which created different issues. There was not a great deal of trust between home and school, and families wanted to have strong controls over any information sent outside the family. Families, in other words, wanted ownership of the information that was generated about their activities, rather than necessarily the technologies themselves.

Increasing families' acceptance of homework technologies by giving them the means to negotiate access to networked information was therefore identified as a key need. This was particularly true as the families indicated that poor management of networked information could lead them to deliberately sabotage the information sent through these systems, or that they could refuse to have some systems in their house at all. The identification of these potential issues for the uptake and use of homework technologies to support homework within the ecology of the home and across home and school ecologies is therefore the second contribution of this thesis. Design implications for addressing these issues are discussed further in Section 8.4. However, the basic approach for sharing information between home and school recommended by this thesis is providing families with easy-to-use and configurable controls of information sharing across the home and school. Within the family, the ability of family members to manage information sharing themselves could be returned by giving children controls over when and where parents were able to help them in their activities, and by making awareness information about children's homework activities ambiguous. For example parents could be aware of a child's claims that they have gone to their room to do their homework, but this information would be somewhat ambiguous, as they had no actual information about the activities or confirmation of any work. Design tactics could therefore be used to help families negotiate privacy-related aspects of involvement, as well as practical aspects.

8.3 Implications for Design

The primary goal of this thesis was to establish challenges of design and use that networked technologies were likely to encounter in homework, and the empirical studies presented in Chapters 5, 6, and 7 achieved this by identifying core properties of the design space that need to be supported in homework.

- In face-to-face homework situations children needed to be able to negotiate access to their homework activities to achieve a balance between a lack of distraction – necessary for independent work – and help – a major benefit of family involvement. Support for this could include providing different technologies to 'open up' homework and 'close down' homework, or by using a single technology to move between these two states.

- In networked communication within the family children needed to be able to preserve family roles and relationships by negotiating or limiting access to information about their homework activities. Support for this could include changing the character of information shared, making it more ambiguous, and allowing family members to negotiate its meaning.

- In networked communication between home and school the family needed to be able to preserve their privacy by controlling access to information about homework activities. Support for this could include providing easy-to-understand and configurable controls to allow and encourage family members to fine-tune what information was shared.

The main question that a designer needs to ask in approaching any homework design challenge is ‘which stakeholders will I be connecting, how will information be shared between these stakeholders, and how well does the relationship between those stakeholders support the sharing of that information?’ Four steps designers can take to answer this question are given below:

1. Obtain a basic design brief and identify what information will be shared, how and with which stakeholders.

2. Identify the type of information that is being shared between stakeholders in the particular activities planned.

3. Identify frictions between the stakeholder relationship and the type of information shared. Ease these frictions through the implementation of design tactics identified to address these issues in this thesis, the development of new design tactics, or a reduction in information flow.

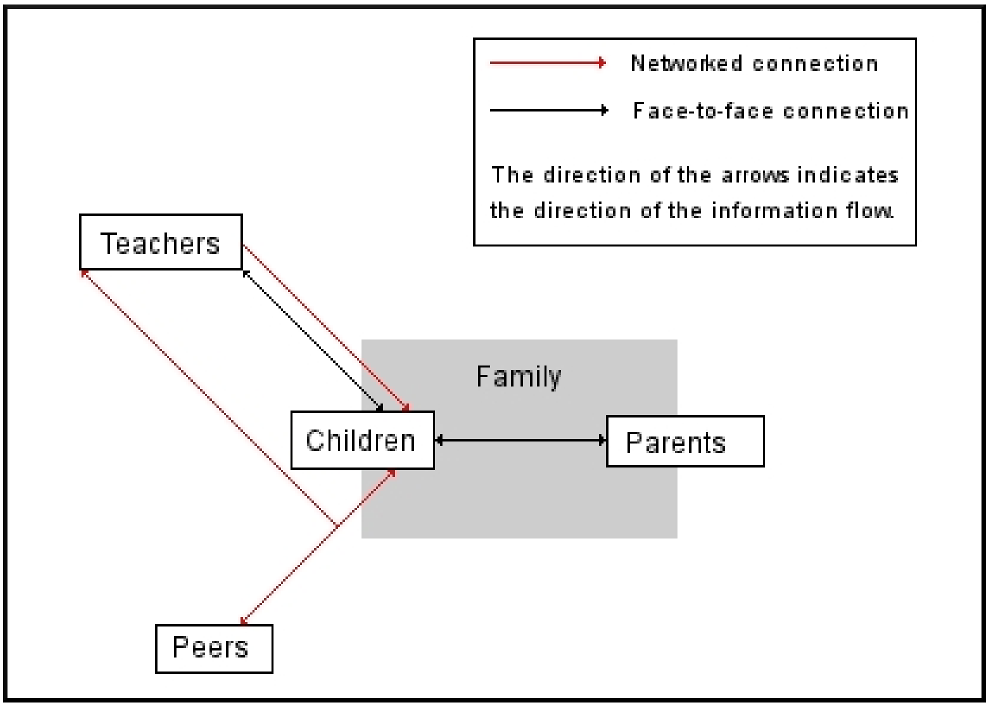
4. Assess success and fine-tune with iterative development – finally testing the prototype homework device within the domestic environment to identify emergent issues that occur when it is used.

These four steps can be unpacked further.

1. Obtain a basic design brief and identify what information will be shared, how, and with which stakeholders.

An obvious first stage is establishing what the design client wants. However, this thesis has illustrated that there are often unspoken aims and links to be made in homework. For example, this thesis has discovered that children use the properties of technologies in negotiating face-to-face involvement of homework, however, when schools are commissioning the development of a new home-school computer network, they usually focus on its networked properties.

Figure 8a. Showing how the connections between stakeholders can be mapped



A complete diagram of the connections between stakeholders, and a discussion highlighting the connections between stakeholders which do not need to be supported, as well as those that do, can be used to uncover these unmapped links, as demonstrated in Figure 8a. In addition to mapping the links between individual stakeholders, and their format, this diagram also emphasises where information travels into or out of the family.

2. Identify the type of information that is being shared between stakeholders in the particular activities planned.

There are two polarised forms of information which can be shared through homework technologies. At one end of the spectrum is information about the content of the homework activity. This is the kind of information about homework that is typically shared using traditional paper-based homework technologies, such as the information about the homework task written down in a homework diary, or the mathematical sums written in a textbook. When co-located with other family members, children may accidentally share information by lacking methods for 'huddling' over – closing down – their work.

At the other end of the spectrum is contextual information around the homework activity. This is the kind of information that networked technologies can record about homework, such as information about when or where the homework activity is completed. When networked technologies record and share information in depth, contextual information can often be derived that provides information about children's and their family's activities and homework practices that they may not wish to share.

Therefore identifying whether content or contextual information will be shared – or rather, given the spectrum, how content-specific or how contextual the information that the homework technology will share is, is the second step.

3. Identify frictions between the stakeholder relationship and the type of information shared. Ease these frictions by the implementation of design tactics identified to address these issues in this thesis, the development of new design tactics, or a reduction in information flow.

The third step is to take issues – where the sharing of a certain type of information is not well supported in the activity required – and identify design tactics which can be used to address these issues.

This thesis has identified reasons why children might want to open up or close down the sharing of content information in face-to-face situations, to either study independently or involve family members. When parents are face-to-face or present in the same general area it is already clear where and when activity is taking place and therefore it is only content information to which children need to negotiate access. Tactics to control access to content information in face-to-face situations, such as visual properties, variability of expression and mobility are discussed further below.

Across a network content information can be accessed when required – it is not possible to 'accidentally' find out details about the homework activity as it is when parents and children are co-located. However, when networked technologies are used, contextual information can be shared at a higher level than children or their families want. Therefore it is particularly important for children and their families to be able to negotiate access to contextual information. Tactics to negotiate access to contextual information in networked systems, such as ambiguity and control, are also discussed below.

Finally, it may be possible to address these issues through alternative means, so the use of design tactics within this step can be replaced by an alternative strategy. For example, information shared across networked connections can be stripped of contextual information, and reduced to a simple sharing of sum answers, or homework tasks. In addition, this thesis does not claim to have exhausted all the possible tactics for addressing these problems, and new tactics can doubtless be developed.

4. Assess success and fine-tune with iterative development – finally testing the prototype homework device within the domestic environment to identify emergent issues that occur when it is used.

Finally, much like the process of heuristic evaluation (Nielsen & Molich, 1990) this thesis uses a general set of observations about homework technology to observe when and where issues are likely to occur, but does not claim to be able to exhaustively identify every potential problem in every potential user group. It is therefore recommended that designers trial prototypes of these systems, in a similar method to the evaluation of the design tactics conducted in Chapter 7. Aspects likely to cause emergent issues include the appearance of the device, which, as seen in Chapter 7, can affect where technologies are placed within the home, and from there how families continue to interact with them. Other aspects of ecological fit should also be considered.

8.3.1 Design tactics for supporting the negotiation of face-to-face homework involvement

Face-to-face involvement occurs when children are in rooms where other family members are potentially present. However, children in Chapter 4 discussed that they could be distracted when around other family members, and the idea that children should be working in spaces without distraction is fairly pervasive (Hong, 2001;

Hughes, 2001; “Students ‘lacking homework space’” 2006). Homework can also partly be opened up in a face-to-face context with social engineering with teachers asking families to make homework more of a social and sociable activity. For example, previous research by Balli et al. (1998) gave families involvement prompts to encourage them to join in work.

Two main types of design tactic were identified as ways to support children in their face-to-face negotiation of involvement in homework: visual properties, including variability of expression, and mobility.

Visual properties and variability of expression

Some of the main supports of awareness seen in the traditional technologies used in Chapter 5 were visual properties. When family members could see what was happening in homework – the technologies had high visibility – this facilitated their involvement in the task. When technologies were visually appealing – as with unusual and tactile-looking materials – this increased the likelihood of family members becoming involved. Lastly, when technologies offered variability of expression – when they could be viewed from a distance, giving reduced but valuable information, they offered increased opportunities for children to vary the involvement of others.

As well as being used to open up homework by offering increased awareness, visual properties could be used to close down homework by reducing visibility, decreasing families’ awareness of activities, and their ease of involvement.

In new technologies to be used face-to-face, visibility, visual attractiveness and variability of expression can be built into systems to allow fine-tuning of others' involvement. In the video diaries presented in Chapter 5, variability of expression was not offered by laptop computers, as it was difficult to see the screen from an angle, but too easy to see the screen from directly behind, meaning others were either completely involved or completely uninvolved in homework activities. Using the design tactics given here, designers might choose to open up homework on a laptop by making the screen visible from a range of different angles – perhaps simply by increasing a screen's viewing angle – and make the text on the screen large and easily visible, and visually appealing to increase involvement. A designer might also fix visibility at a low level, by using small, more or less uniform text, and reducing screen size to close down a homework activity. However, it would also be possible for a designer to provide variability of expression by allowing a child to adjust the display or by moving homework information between display screens with different properties and affordances.

Mobility

Two forms of mobility facilitated the manipulation of involvement in homework activities. Firstly, macro-mobility allowed children to carry homework technologies around. This allowed them to transfer activities between places where they were free from distraction, and could learn independently, to places where other family members were around and could become involved.

Secondly, micro-mobility could be used to negotiate access to homework within face-to-face interactions. This could be used to manipulate the visibility of technologies to other family members by turning papers around or huddling over them. It could be used to arrange technologies in a barrier around children, so that no work was visible and family members might feel uncomfortable in intruding upon their study. In these ways, the adjustability of the technology adjusted others' awareness of the homework activity. Micro-mobility could also allow body moves to be performed, drawing attention to the homework at certain times, or to specific elements of the homework.

The desktop computer was highlighted in the video diaries in Chapter 5 as offering very poor macro- and micro-mobility. It is difficult to provide the same level of mobility offered by paper in computerised technologies to be used face-to-face. However, there is ongoing research into 'e-paper' to develop screens that mimic paper's flexibility and portability. In the meantime, mobile technologies such as the PDAs seen in Chapter 7 could be used to afford changes in both location and orientation, and designers might even consider allowing the transfer of information between multiple devices to support study in multiple locations.

8.3.2 Design tactics for supporting the negotiation of networked access to homework information

The design implications established for managing the privacy of children and families across a network were primarily social in form, but required technological support.

Ambiguity

The subtlety of signals used to provide access to homework in the home means it is often difficult to judge why children are doing their homework in a certain manner, and this thesis has gone a long way towards describing how ambiguous a ‘distracting’ location can be, describing how the potential for distraction can go hand in hand with the potential for help.

Allowing children the opportunity to create socially acceptable stories around their homework activities is one way of maintaining their privacy, and is particularly useful within the family, where it maintains the message that children are trusted to manage their own homework activities. Chapter 6 outlined how critical this appearance of trust was to the parent-child relationship.

Across a network the default way to represent information about children’s use of homework styles and contexts would be unambiguous. Technologies tend to send detailed information where it is available, and the more detailed the information recorded, the less ambiguous the activity that produced that information becomes. One way to get around this would be to intentionally build systems where information collected about activities is ambiguous. For example, recording a child’s use of a homework textbook by the amount of time it was open for would be more ambiguous than recording their active reading of that textbook. Eye tracking while they read the book, however, would be extremely unambiguous, as it would be possible to tell where and when children were engaging with the book. To take a more realistic learning example, in the lab demonstrations in Chapter 6 the idea of using locational information about a child to provide context-sensitive learning content was discussed. A detailed locational trace of the child would be unambiguous as to their location, and could therefore record quite sensitive information about the child’s whereabouts. However, if information about their location was only triggered when they were near specific educational opportunities – a library, or a museum, for example – then it would be ambiguous how children travelled between these locations, and children would be less sensitive to the idea of 'being tracked'.

Control

In other situations, particularly between home and school ecologies, there was less implicit trust, and therefore control of signals was considered as a privacy solution. The school had a less complex role in developing the children as responsible adults, and could demand that accurate and unambiguous information was provided about their activities. On the other hand, the school elicited less trust from the home, and therefore giving families the ability to control how and when information about activities was sent was important. The interviews in Chapter 6 suggested that families would be keen to send such information when they could see the potential benefits to themselves – such as proving homework was done, and tracking children's progress – but that they demanded efficient controls.

Families indicated that automatic control of outgoing signals would be unsatisfactory. They specified that they should have direct personal control over these signals, the ability to filter them or turn them on or off. This could mean, for example, that any information gathered by an educational system would only be sent to the school with an authorisation password held by the family.

Together these design tactics suggest a number of ways in which the use of technologies in homework can be facilitated. Their goal is to improve the homework process, and this is likely to have an indirect effect on learning outcomes by allowing the space for learning to take place without interference from ecological incompatibilities.

8.4 Pedagogy and technology

This thesis has not focused on any particular learning outcomes of ways of learning as the 'best' way to achieve homework outcomes, looking instead at the range of homework practices that already occur and how new technologies might support these, or fail to support them. The methodology chapter differentiated between socio-cultural and situated theories of learning and socio-cultural and situated pedagogies. This thesis has drawn upon socio-cultural theories in their wider sense, using an ecological view of how learning activities occur, and emphasising the importance of the meaning of homework activities to those involved in them, and the role of culture in producing these meanings. However, many studies using socio-cultural approaches to research have drawn upon socio-cultural pedagogies, their central premise being that learning is most successful when it is socially based. This means that if learning is culturally and socially applied, then making sure it is learnt in activities which mimic its application will ensure activities are more meaningful to the learner and have a greater possibility of transfer.

Those using a socio-cultural pedagogy might therefore wish to emphasise 'open' forms of work in homework: by increasing interactions between children and helpers. This could be either in face-to-face technology use or across a network. In Chapter 6 it was suggested that one way to overcome the prohibitions against information sharing between home and school would be to transform the child-teacher relationship to one based on a greater amount of trust. This opening up of homework across a network through trust bears great similarity to the empowered children described in Chapter 1 (e.g. Lewin et al., 2003; Somekh, 2000). This opening up could involve direct participation in the homework activity, as seen in the

Zone of Proximal Development (ZPD) or the more passive participation in the learning activity possible in legitimate peripheral participation. However, as well as empowerment, these views of the future also envision children as autonomous learners, deciding on their own curricula, which suggests that there is still a role for more closed work. Even in apprenticeship models there is often a role for the internalisation of information (Cole, 1996) which may involve individual reflection on learning material in a closed manner, suggesting that this may remain an important mode of work to support even if teaching focuses on activities that are predominantly open in style.

Nonetheless, it is clear that sociocultural pedagogies are most strongly related to open work, and therefore the role that trust plays in facilitating information sharing has important implications for future design. Trust between teacher and child can be beneficial within any instructional relationship. However, if technologies are used to transmit and receive large amounts of information, then apprentice models of learning will require a good deal of trust between master and apprentice to support them.

8.5 Reflections on the ecological approach

Chapter 2 introduced some previous research relevant to homework. Educational research into homework has largely focused upon attainment in homework, and the lack of evidence for its impact upon test scores. However, this thesis has indicated that there are some benefits to homework other than its impact on attainment, certainly in the development of independent and collaborative work skills outside the school. In addition, some research providing descriptions of the way homework took place in the home, similar to that seen in Chapter 4, was available (MacBeath and

Turner, 1990; Hughes, 2002; Hughes & Greenhough, 2003a, 2003b) but this had not gone beyond the face properties homework to a more analytical view of activities and the relationship between practice and tools.

Studies of technologies in the home, and particularly the use of the home PC had also provided information about the way these were socially embedded in the home, and also went some way towards identifying the importance of the relationship between physical location and social meaning in the home – with studies such as Kerawalla and Crook (2002) and Screenplay (Facer et al., 2003) noting that PCs were placed in the home based on the meanings assigned to them by families, and that this placement affected future use. This thesis not only explored the impact of such placement in the homework context, but also investigated how technologies themselves, even pen and paper, mediated interaction further, encouraging or discouraging involvement in work.

In addition, the literature review identified some previous study of the difficulties in introducing technologies across home and school ecologies. In previous studies and policy the digital divide had taken a front seat in discussions of these difficulties. However, as uncovered in Chapter 3, concern about the divide is not necessarily productive, and the literature review itself uncovered that families with children are in fact the least likely group to be affected by the divide. However, it was clear that there was limited uptake of home-school links, and the difficulties of implementing technologies across home and school technologies are offered by this thesis as an explanation for this.

Lastly, some research had looked into the introduction of new technologies into the home from a design standpoint, focusing on the physical and social place of the home, much as in this thesis. However, this research has expanded the domestic design agenda, by taking it beyond its inward focus on the provision of services for and based on home activity, to consideration of links between domestic and other ecologies.

This thesis has used an ecological approach to learning to structure its research and findings. In this approach 'ecology' was used to describe the physical, social and cultural context in which homework occurs. Its main principles were as follows:

- The activities of humans originate from and occur under the influence of the ecology (or ecologies) in which they are embedded
- Understanding of this ecology can be achieved through study of the everyday activities of humans and their subjective reports of the meaning of these activities
- These activities are mediated by tools, or technologies, which themselves form a culturally meaningful part of this ecology

The five empirical chapters used these principles to investigate homework. Chapter 3 looked at the subjective meaning of technology use in homework for ICT coordinators. Chapter 4 presented a shallow but broad picture of current homework practices, and Chapter 5 looked at how the elements of context explored in Chapter 4 interacted in genuine homework activities. Chapter 6 explored family's reactions to potential downsides of new technologies, and Chapter 7 looked at new technologies in use, one again supporting genuine homework activities.

The emphasis on subjective experience and meaning has encouraged consideration of the meaning of homework for stakeholders. In Chapter 3 this uncovered ICT coordinators internalisation of government messages about access to ICT, and how concern about access seemed to be holding them back in their use of new technologies. In Chapter 6, this allowed the investigation of prospective new technologies for homework, and Chapter 7, feedback on the use of new technologies in genuine homework activities.

As well as studying opinions and meaning, this thesis has also studied activity. In Chapter 5 video diaries were used to record homework activities, and analysis focused on the mediation of homework activity with technologies. In Chapter 7 genuine homework activities were supported with homework technology, and while these activities were not captured in such depth as with the video diaries, records of activity such as the logs of the Nabaztag rabbits and photography were used to compare feedback with empirical records of use. In Chapter 5 in particular the observation of actual activity allowed the processes of opening up and closing down homework mediated by technology to be observed, when it is unlikely that the process for doing so is always conscious. On the other hand, the groups in Chapter 4 indicated that children seemed to consciously select certain work locations for the involvement of others, and it is only in the combination of subjective meaning and activity in this way that the full process of opening up and closing down work could be understood.

Lastly there was the concept of ‘ecology’ itself. Ecology is used here to mean the cultural, social and physical context. Homework occurs across two ecologies: that of home and that of school; it is (predominantly) physically based in the home, but socially and culturally it is influenced by both home and school ecologies. This does not only mean that the community present in the home – largely parents and siblings – and the community present in the school – teachers and peers – will influence children, but also that children will have to view their activities from the point of view of both ecologies, as participants in both. This thesis has looked at the point of view of ICT coordinators as core stakeholders in the use of homework technologies from the school ecology, and parents and children (separately and as part of the family) in Chapters 4 to 7 as core stakeholders in the home ecology.

However, there were some weaknesses in this research strategy. The inclusion of stakeholders in homework from school and home was identified as highly important to successful design. However, there was some trade off between buy-in in the studies and representativeness of the families. Families included in this thesis were those who could be convinced of the usefulness of the research; due to the recruitment strategies used, the participants in the video diaries filmed in Chapter 5 consisted of those interested through their links with education, and the participants in the probe studies conducted in Chapters 6 and 7 consisted of families with a particular interest in technologies, of improved learning support, or of research. Within these groups those families and those individuals with the greater interest in the technologies tended to participate most enthusiastically. Thus, although the families were often self-selected, this self-selection seemed largely responsible for the quality of the results gained. An inability to guarantee the representativeness of the participants is therefore an acknowledged weakness of the thesis, but in exploratory work requiring in-depth work with a small number of participants, a necessary artefact of the research type. The sampling strategies demanded by this need to obtain buy-in are detailed in Table 8a. There is bound to be some impact of studying this narrow range of families. For example, more disadvantaged children in smaller homes might not have a quiet area in which to do independent homework, and so fully closed work styles might be extremely difficult for them to achieve. Only further research with other socio-economic groups would establish this.

Table 8a. Showing the sampling strategies used in the thesis

Chapter	Sample	Strategy
3	Questionnaire: 39 of 200 ICT Heads from list of contacts the university education department had worked with.	Convenience sample – available through department.
	Interview: 5 of the 25 local ICT Heads from the questionnaire who were willing to participate in an interview. These coordinators were involved in interesting uses of ICT. 1 additional local ICT Head chosen for socio-economic balance.	Purposive sample – choice of the ICT coordinators was made on the basis of their interest in terms of ICT use, and on the basis of obtaining a varied, if not representative socio-economic sample.
4	39 groups of 5 children (195 children total) from 2 secondary and 2 primary schools.	Schools were selected via quota sampling, with local schools contacted until two of each type agreed to take part. Within schools teachers were asked to select groups of five children, but were specifically asked to choose a range rather than a 'type' of children, i.e. a judgement sample.
5	Video diaries with 7 families recruited through snowballing of the researcher's friends and family.	This was an opportunity sample, based on the limited number of families that could be persuaded to take part.
6 and 7	3 families recruited from previously interviewed school, volunteers from a mail-out.	The school was chosen through purposive sampling, to obtain families with knowledge of technology, but the families were essentially obtained through self-selection.

The usefulness of studying multiple stakeholders was confirmed by the fact that the two major design-related contributions commented on the flow of information between these stakeholders. The stakeholders identified in the literature review as core to the homework experience were children, parents and teachers, with a wider view of the family taken in order to see how siblings and other family members might contribute to homework activities. However, in practice, only a limited number of children lived with other family members and their participation in homework activities varied widely. This meant that there was not enough information about other family members to make general conclusions about their role in homework. Where siblings, the major family member discussed by children, were included – for example in the video diaries in Chapter 5 – they were mainly seen acting in similar roles to parents.

By drawing upon the views of different stakeholders, this thesis was able to provide a contribution to each community involved. Schools and teachers could benefit from better design, educationalists in general from a better understanding of homework itself, and parents and children from a foregrounded role in technology design. Future research can take inspiration from this inclusion of a range of participants in multiple settings, encouraging those on the educational side of homework to reflect on the likely impact of homework practices and technologies on the domestic environment, and encouraging families to discuss their views of future technologies. In particular, a future avenue for research would be to test the ideas developed in this thesis in a genuine homework technology, perhaps using a system implemented especially for the study, as with the 'HomeWork' tablet PC project (Luckin, 2006).

However, there was a limit to this ecological approach, and this was the lack of a study which crossed home and school ecologies. In the cultural probe study attempted in the project forming this thesis an attempt was made to develop activity packs which tracked information between home and school, asking children to record the 'lifecycle' of their homework activities. However, situating the study neither fully in the home nor in the school meant that children lacked guidance from adults in either context, and lacked buy-in to the activity. Instead, the thesis used a number of lenses to view homework, which often situated research fully in one ecology, but focused results on the concerns of both ecologies through the method. This was achieved by asking teachers for parents' reactions to ICT in the questionnaire and interview studies described in Chapter 3, by using genuine homework activities in the family-based video diaries and home trials described in Chapters 5 and 7, and by asking families to comment particularly on educational uses of the demonstrator probe technologies in the lab demonstrations and interviews described in Chapter 6. Overall, the focus of the thesis leaned towards the home rather than the school, but this was a strategy used to compensate for the more school-based educational focus of previous research, and this thesis' concentration on the activity and practices of homework itself. However, it would be a step forward for the work conducted in this thesis to study homework's activities by following them across the school and home ecologies. To do so would need greater buy-in from teachers and parents than found in this project, and would perhaps require a researcher to be closer to the process themselves, such as a practitioner-researcher working with their own class.

Altogether, this research has used an ecological approach to studying homework which has expanded understanding of homework in general. Running throughout this thesis, and defined in Chapter 7, has been the theme of 'fit', and the importance of technologies fitting into the ecology of the home in particular. In Chapter 7 it was discovered that technologies needed to fit into the routine of the home, its aesthetic, its physical structure, and family relationships. More of the findings can be understood in terms of a fit between technology and ecology: for example, the opening up and closing down of homework can be seen as a culturally embedded set of cues for negotiating joint activity, with new technologies needing to fit into this cultural pattern. Discussion of how new approaches to the teacher-child relationship might make families less sensitive about the travelling of information outside the home can be considered as the fit between open information sharing and educational policy – which at the moment is poor. However, it is the wide study of the cultural, social and physical ecology which has made understanding the world into which homework technologies need to fit possible, and this is what this thesis has achieved

8.6 Implications for lifelong learning technologies

This thesis started with a rationale for studying homework as an example of the kind of activity which would be involved in the future in lifelong learning. Lifelong learning technologies are highly likely to face difficulties like the homework technologies described in this thesis. When used by children lifelong learning networks would be likely to link together educational and domestic worlds: the same ecologies as described in this thesis. There would also be further opportunities to link additional stakeholders in homework as well as just those considered in this thesis. In fact, lifelong learning could potentially link together almost limitless stakeholders in domestic, educational, organisational and recreational contexts.

The processes of opening up and closing down homework identified in this thesis can be applied meaningfully to lifelong learning. As one of the major aims of homework is to increase independent learning skills – requiring the closing down of activity – one of the major aims of lifelong learning is to increase learners' autonomy and control in their learning activities – similarly requiring them to be able to close down their activities if and when they wish. On the other hand, as increased parental investment and contribution is one aim of homework, increased ability to draw upon community and contextual help and resources is one of the aims of lifelong learning

– meaning learners need to be able to strategically open up their learning activities as appropriate. Lastly, when further ecologies are involved in learning concerns about privacy are only likely to increase.

However, one of the major findings of this thesis notes that the sensitivity and nature of information sharing depends strongly on the relationships between stakeholders, and it is not easy to predict exactly what the relationships between stakeholders in lifelong learning will be like. One of the key arguments made for lifelong learning is that it offers the opportunity to reframe the relationships between learner and tutor, making learners empowered and autonomous in their learning activities. The design tactics identified in this thesis apply to the relationship between home and school as it stands at the time of this research. New relationships created by the introduction of new technologies – for example, empowered student and supportive mentor – might support the sharing of information in a completely different manner. Understanding these new relationships will be a new challenge for research; however, this thesis has identified key aspects of any relationship – trust in particular – on which the sharing of information hangs. As lifelong learning technologies emerge, it is envisioned that support for sensitive information sharing in these new relationships will be investigated in the development and use of genuine lifelong learning systems, drawing on the ecologically aware research begun here.

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Appendices

Chapter 3 Appendices

Appendix 3.A: Letter and questionnaire to Heads of ICT

4th May 2005

Dear Head of ICT

You are receiving this questionnaire as part of a three-year research project, looking at the use schools make of ICT for homework. This research is being undertaken by the Learning Sciences Research Institute, a joint venture between the Schools of Computer Science, Education and Psychology here at the University of Nottingham. As part of this research, we are interested in finding out how much ICT is currently used by schools in setting homework, and the kind of issues that surround its use.

To tell us more about this, we would be grateful if you could fill in the short questionnaire attached, outlining how ICT is used for homework in your school. Feel free to consult with colleagues to establish a picture of overall school practice and policy. In addition, we would be interested in getting in contact with schools that have a high level of ICT use for homework. If you would be willing to talk to us about this in more depth, there is a space to fill in your details at the end of the questionnaire

Many thanks for taking the time to fill this in. We would be grateful if you could return the questionnaire within the next three weeks, in the freepost envelope provided.

Yours faithfully

Katie Fraser

If you have any further questions about the research, please contact:

Katie Fraser, BA, MSc
Learning Sciences Research Institute
University of Nottingham, Jubilee Campus, Nottingham, NG8 1BB

E-mail: xxxxx
Telephone: 0115 xxxxxxx

ICT IN HOMEWORK

Name of School:

____

Area of School:

Nottingham / Nottinghamshire / Derby / Derbyshire / Other (please delete as appropriate)

1. **Does your school use ICT in any of these ways? (please tick as appropriate)**

Often	Sometimes	
☐	☐	Homework relying on online resources (e.g. Internet searching)
☐	☐	Requiring computer processed work from students (e.g. word processed documents)
☐	☐	Setting of homework involving external websites (e.g. SAM, BBC Bitesize)
☐	☐	Setting of homework through an internal website (e.g. school webpage)
☐	☐	Homework completed with school-owned or sponsored ICT resources (e.g. CDs, DVDs)
☐	☐	Homework completed with other school-owned or sponsored equipment
☐	☐	Submission of homework by email
☐	☐	Submission of homework by portable media (e.g. CDs, floppy discs etc.)
☐	☐	Homework completed with school-owned or sponsored laptops
☐	☐	Other homework submission / setting / completion using ICT (please give examples below)

____

____

____

____

2.	**What is the school's general attitude towards the approaches in Q1?**
	☐ Would like to adopt ☐ See no reason to adopt

3.	**What barriers do you foresee or have you encountered in setting homework using ICT?**

____

____

____

____

____

4.	**How do you think parents would react / how have parents reacted to use of ICT in setting homework?**

____

____

____

____

____

Lastly, would you be prepared to talk to our researchers about your school's use of ICT in homework? If so, we would be grateful if you could provide contact details below.

Name: ____

Contact details: __________________________________

____

____

____

Appendix 3.B: Barriers

Appendix 3.C: Example interview transcript

- This was the first part of the interview with the Head of ICT in School A.
- An example screenshot of the analysis can be seen in Appendix 3.D.

Interviewer: I got a bit of information from the questionnaire about what kind of technology the school is using in homework and I was wondering if you could tell me a bit more about it…?

Head of ICT: In what ways do we use it? One of the main ways at the moment of using technology is we're making use of a web resource for revision – it's called SAM Learning

It's a name that's been coming up again and again but it's not something I know a lot about…

I think it's particularly popular in schools because it's all ready to go, you buy it in as a package and each student, very quickly each student can be set up with their own account so that they can access anywhere they can get Internet access, and it keeps a record of all of their progress. The do various revision exercises and they can do exam questions and it marks and grades them. There's a small amount of honesty required from the students when they, er, when they. They mark them themselves using a mark scheme, so they will produce a printout of exam questions, complete it, and they mark it themselves. It does require a little bit of honesty for the exam questions, but it raises that, it gives them instant feedback on their revision and also the, er, there's a lot of drag and drop activities so they'll, the revision exercises are all blanks, and they'll have to select from maybe three or four options and it scores them. They'll have to mark it. If they get it wrong, and it tells them instantly, they'll have the chance to mark another one just to find out what the right answer was, so they'll always know what the right answer is, and the idea is that they can – if they get a score they're disappointed with they can go back and redo it. So it's knowledge-based, it doesn't deal really with thinking skills or understanding too much, it's just do they understand the terms, do they understand how they can be used. So really it's aimed at the C/D boundary, and not, sort of, at the B / A / A* students. It does have an A level section, but I wonder how useful that is, given that it is knowledge- based. And so obviously, A-level students are doing, like to do a bit more, in terms of understanding and independent thought. So it's got its limits, but it is very good for students who don't like to revise from books, because they can, they can get online, it's interactive, it gives them instant feedback, and it's just another resource that they can use. So we've used that – we've only just started using it, so, erm, the students have clocked up about 1700 hours of work, roughly – it counts each activity as about 15 / 20 minutes, so, erm, there's been a lot of time students have spent working on it, and they seem motivated by it, but as I say it does have some of its limitations. There's, it is possible to set homeworks, so staff can set a homework, which when the student logs in, a message will appear saying 'your English homework is' and tell them how many pieces they've got to do. And then the staff can go in, call up their class group and see who's completed it and who hasn't. And it's all assessed. The downside is that some students can keep doing it until they've got maximum marks. But some staff use that as an activity: 'do this exercise until you get 100%' or 'until you get above 80%' and it works as a reinforcement exercise for the topic.

So we've been doing a fair amount of that. It's effective, and it's been used by a lot of schools, as it's been easy to use. We've looked at using email to set homework and to collect homework, but it's very cumbersome, and collecting thirty emails and opening all the attachments and dealing with that. Often, the value is lost in dealing electronically. Because you spend so long with the process of getting to the resources, and then the inevitable problems you may have with attachments or student difficulties in their own Internet access at home so often electronic methods of getting work home and back have been problematic, and only the really very keen members of staff who want to trial ICT things have gone for that. It's extra work.

How do you find kids have reacted to that? It's usually a sort of mixture of enthusiasm and…?

Definitely. Like most things, any strategy that we try in school work better with the more motivated students. Because what you'll tend to find is that there'll be a group of students that wouldn't be motivated by book work, or paperwork that they've got to take home, who, it would just capture a few, there are a few extra students who'd be motivated by that. And particularly with this web learning, I think they've found that students who are on that C/D boundary, which because of the statistical drive in Education at the moment to target that D. So that's the big area of interest, that A* to C that schools are measured on. So, erm, something that will make an impact on students in that area, erm, is obviously of big interest to schools.

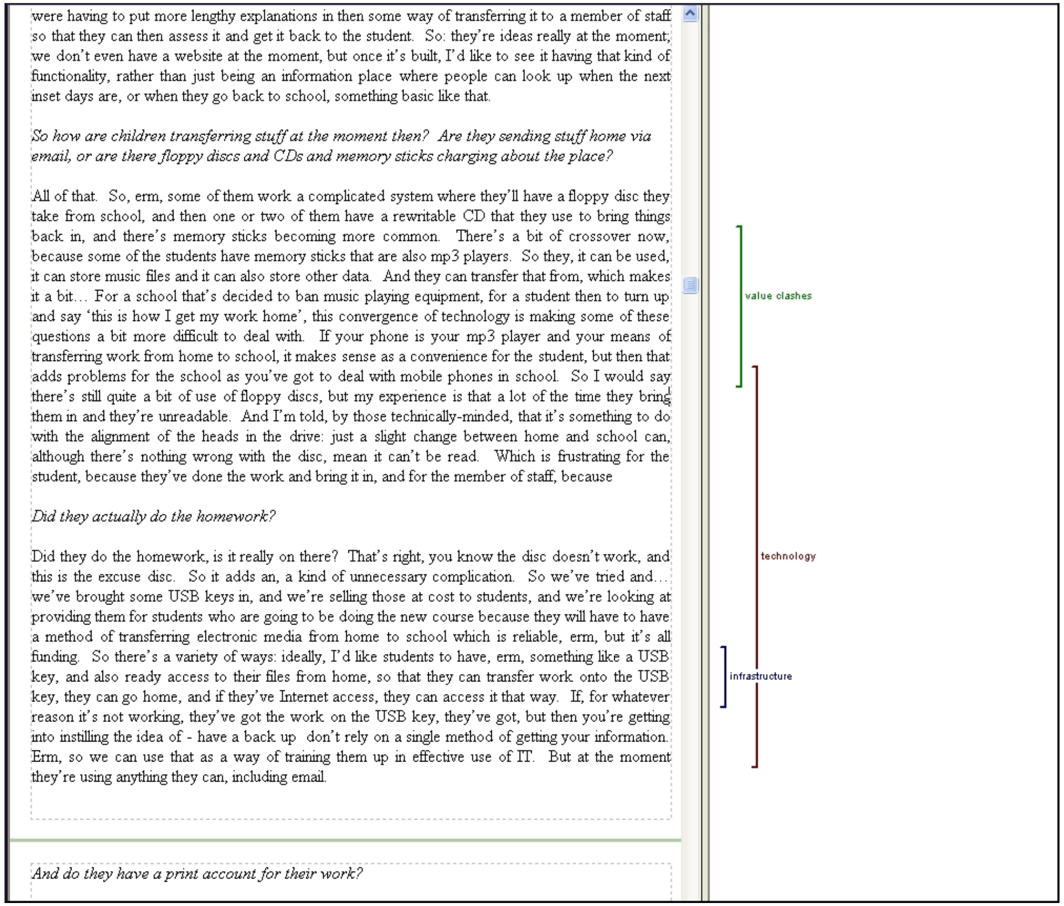
And you mentioned something about the more enthusiastic staff being the ones who go for the email, and that kind of thing. Is there a lot of difference in the amount of ICT? Is there a school-wide policy, or a departmental one?

There's no school wide policy. Obviously, within ICT, our faculty makes a lot more use of that, so our students regularly make use of email to communicate, to send work to and from school. Some of that's an access issue, in that we have the computers available to us every lesson so a student can email the work in and it's ready to go. So some of it's to do with that. Some inevitably down to staff IT skills being confident to deal with work being emailed in and out and attachments. There are staff development issues to sort of influence on stuff like this, and erm, so I'd say it's definitely not across the board. I'd like to do something where we have a system that was regularly in place, really at the moment, I guess it's what you'd call your cham... your ICT champions in each faculty, who are at the leading edge, they're driving things forward, and what we need to do is, is pack as many people into that leading edge if you like. If we can get enough and keep on moving forward with it…

… then everyone else will get carried along?

Well, it, particularly if it's effective, if sending, using email to send and receive homework is cumbersome and problematic, then staff who aren't eager to try things and who aren't willing to put up with the hassle of things going wrong, would much prefer to set homework on paper and collect it and mark it, because they're busy, and they don't want to take on something that's going to make more work for them. And that's the trick, I think, if the technology either makes their work better, so they can see that the technology is making the students work, or their product, or is making their teaching better, or is making it faster or more efficient, then they'll use it, I think. But if it's making more work for them, or increasing frustration, or whatever, then staff will inevitably, being busy people, they will ditch that in favour of a more efficient method, even if it's low tech.

Appendix 3.D: Example NVivo screenshot of interview transcript



were having to put more lengthy explanations in then some way of transferring it to a member of staff so that they can then assess it and get it back to the student. So: they're ideas really at the moment; we don't even have a website at the moment, but once it's built, I'd like to see it having that kind of functionality, rather than just being an information place where people can look up when the next inset days are, or when they go back to school, something basic like that.

So how are children transferring stuff at the moment then? Are they sending stuff home via email, or are there floppy discs and CDs and memory sticks charging about the place?

All of that. So, erm, some of them work a complicated system where they'll have a floppy disc they take from school, and then one or two of them have a rewritable CD that they use to bring things back in, and there's memory sticks becoming more common. There's a bit of crossover now, because some of the students have memory sticks that are also mp3 players. So they, it can be used, it can store music files and it can also store other data. And they can transfer that from, which makes it a bit… For a school that's decided to ban music playing equipment, for a student then to turn up and say 'this is how I get my work home', this convergence of technology is making some of these questions a bit more difficult to deal with. If your phone is your mp3 player and your means of transferring work from home to school, it makes sense as a convenience for the student, but then that adds problems for the school as you've got to deal with mobile phones in school. So I would say there's still quite a bit of use of floppy discs, but my experience is that a lot of the time they bring them in and they're unreadable. And I'm told, by those technically-minded, that it's something to do with the alignment of the heads in the drive: just a slight change between home and school can, although there's nothing wrong with the disc, mean it can't be read. Which is frustrating for the student, because they've done the work and bring it in, and for the member of staff, because

Did they actually do the homework?

Did they do the homework, is it really on there? That's right, you know the disc doesn't work, and this is the excuse disc. So it adds an, a kind of unnecessary complication. So we've tried and… we've brought some USB keys in, and we're selling those at cost to students, and we're looking at providing them for students who are going to be doing the new course because they will have to have a method of transferring electronic media from home to school which is reliable, erm, but it's all funding. So there's a variety of ways: ideally, I'd like students to have, erm, something like a USB key, and also ready access to their files from home, so that they can transfer work onto the USB key, they can go home, and if they've Internet access, they can access it that way. If, for whatever reason it's not working, they've got the work on the USB key, they've got, but then you're getting into instilling the idea of - have a back up don't rely on a single method of getting your information. Erm, so we can use that as a way of training them up in effective use of IT. But at the moment they're using anything they can, including email.

And do they have a print account for their work?

Chapter 4 Appendices

Appendix 4.A: Consent form

Dear Parent / Guardian

Katie Fraser, from the University of Nottingham's Learning Sciences Research Institute, will be coming into xxxx this xxxx to conduct some short discussion groups as part of her involvement in a project concerning children's homework patterns.

We are writing to request your consent for your child's involvement in these discussion groups - which should take the form of two sessions, each no longer than half an hour, spaced over up to a week. The groups will take place in school hours, but have been arranged to fit around the school's timetable.

Information concerning your child's individual homework patterns, or which can be linked back to your child (such as your child's name) is considered confidential and will not be made available to anyone outside the research team at the University of Nottingham. The study merely aims to establish an understanding of how homework occurs across homes. Hopefully, in the long term, this study should lead to better understanding of how homework can and should be set.

Please sign the attached consent form to confirm that you agree to your child's participation, and return it to the school as soon as possible. If you permit your child to participate either you or they still have the right to withdraw from the research at any point, without having to give a reason.

If you require any further information on the study, or its results, please feel free to contact Katie using the details given below.

Katie Fraser, BA, MSc
Learning Sciences Research Institute
University of Nottingham

Telephone: 0115 xxxxxxx / Email: xxxxx

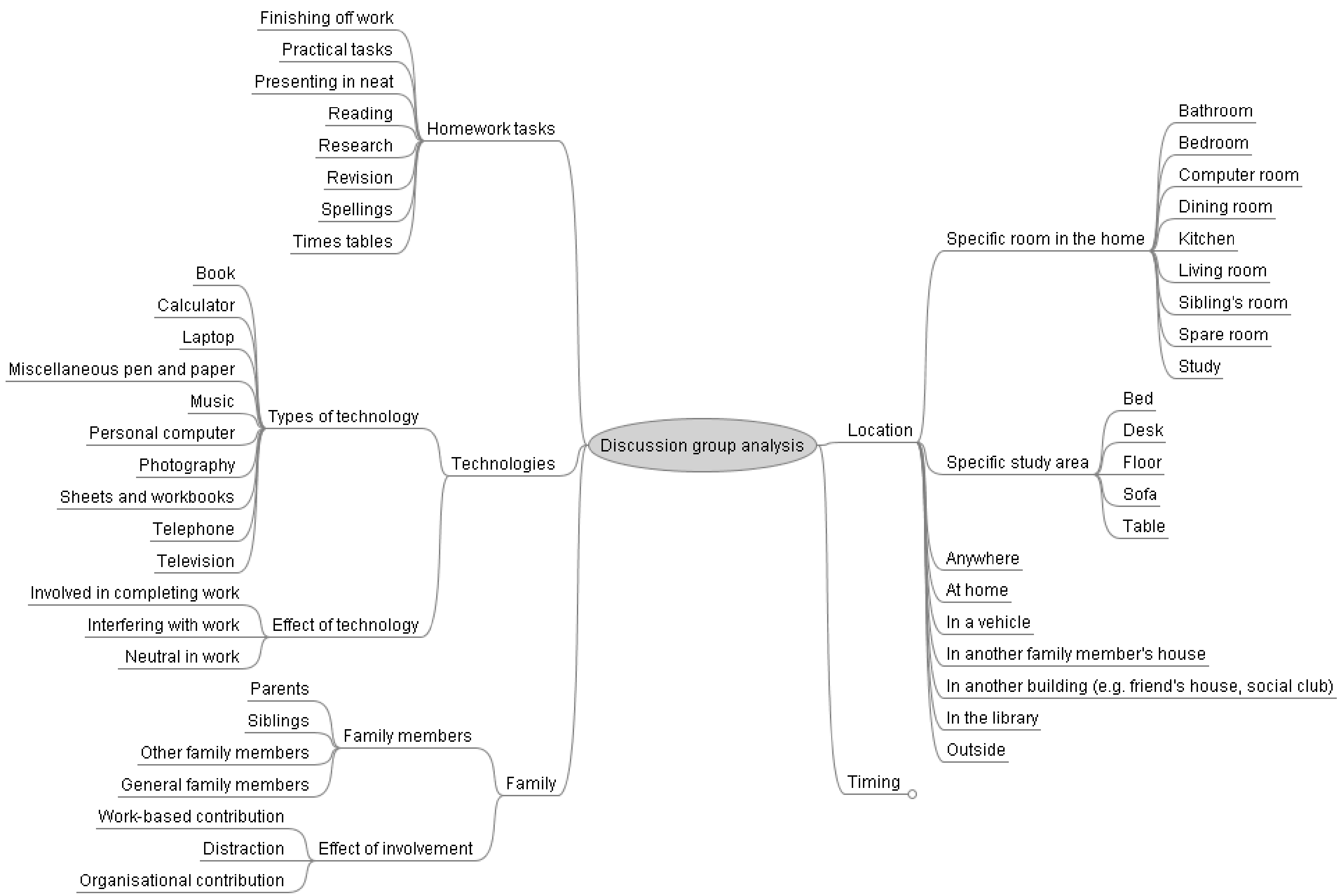
CONSENT FORM:

I agree that ____________________(name of child) may take part in the Learning Sciences Research Institute homework study, and understand that either my child or I have the right to withdraw from this study at any time without giving a reason.

Signature of parent / guardian: ____________________________ Date: ___________

Name of parent / guardian (please print): __________________________

Appendix 4.B: Elements of context



Appendix 4.C: Example discussion group transcript

- This was the first part of the interview with Discussion group 1, Year 6, Primary School 2.
- Individual children's responses are colour coded.
- An example screenshot of the analysis can be seen in Appendix 4.D.

Interviewer: If you'd like to start off by telling me about the kind of homework you get at school.

Child 1: What we get for our homework, we get this really hard literacy thing, where it's like a literacy book, and you've got two books, you've got a book which tells you what to do and there's four things, there's practice, challenger and erm forgot the rest of them, and then you have to get this other book and answer these questions and everything.

Child 2: There's a maths one as well.

Child 1: It's really hard.

So do the rest of you find that hard as well?

Child 3: The literacy one is quite hard.

Child 2: I found that one easy but I found the maths one hard.

Child 4: I've never had them.

Child 2: It depends which group you are in as well, you get more, cos I'm in the highest group for maths so I get challenger and everything to do, practice and check-it-out.

Child 4: But I'm not in the highest so I just have to do Practice and Check-It-Out.

Child 3: I enjoy the maths one more than I enjoy the literacy one.

Child 5: I enjoy the literacy one more because I'm better at it than maths.

What about other types of homework, is there any other type of homework that you get?

You can get fun homework sometimes; we had this fruit challenge where we had to write down everyday what fruit we have had.

And we got this colouring one where we had to answer these maths problems and the answers in the picture, we got to colour the answers in.

That was wicked.

We only had it once.

Yeah, we're not going to get that again.

Anything other kinds of things?

We have to learn our lines if we're doing a play or something.

We have spellings, every week.

How about in the last week or two, have you had any particular homework to do?

We haven't had homework for quite a long time.

We had spellings.

Yeah but not homework.

I have to say I don't think we have as much homework as some schools have. I think we've got, well I don't know if it's just this school or not, cos sometimes the teachers forget to give us some. But when we do get it we get really hard homework, so we don't really like getting it.

Especially with the literacy one, I don't mind maths, but not the literacy, I hate it.

So you'd say you get spellings every week, is that the most common type of homework you get?

Yeah nearly every week.

Now some researchers like me, Dr Cooper and the people who worked with him, asked a lot of parents and most of them said they give their children a lot of help with their work, even if they don't want them to. So would you say that's true for you, do your parents, grandparents, brothers and sisters help you?

Yeah.

Yeah.

Not when I don't want them to, but if I needed a little bit of help I would ask my mum, but if I don't need help my mum wouldn't help me.

My mum just says "do you need any help?" usually, if I'm struggling on the literacy she'll watch what I'm doing cos I usually need help.

I don't have much trouble with my homework, but when I don't understand something, normally with maths, then I get my dad to help me.

I ask the teacher if I'm stuck with something with my homework.

So you'd ask them first before you ask your mum and dad?

I ask the teacher first and if they something and I still don't understand then I ask my mum or dad. Unless you get it Friday and it's in for Monday, then you can't ask the teacher. I just ask my mum and dad then.

It puts pressure on you though I think, because if you have things on it puts pressure on you and you can get distracted, I cant have my sister like watching TV in the same part, so I have to go up to my bedroom, cos I get distracted easily.

Usually where I do my homework, it's downstairs and if someone just walks in, then you can't concentrate, and I think that's one problem. I think we should be allowed to have, the teachers say it's got to be in for a certain day, I think we should like have a week and then bring it in any day of the week, not just that day.

So do you find the time pressure's quite…?

The pressure.

Yeah, as well because you have things on and you think, 'I don't want to do it now, but I don't know when I'm going to do it'. And you're like 'ooh, I've got something on', but when you're supposed to be like going out, you've got this homework in the back of your mind, going 'I've got to do this now, I've got to do it but I don't want to do it'.

It's like spellings, cos usually I do things Monday and Tuesday and go out Sunday and Monday, and you're thinking 'oh no, I've got to learn them' and sometimes you've got hard ones and you're trying to practice doing them and you cant, then sometimes because you're like doing other things, and you know that you've got to do them…

So what about, whereabouts you do your homework, do you usually erm, do it in the same place in your house or?

Erm, sometimes I do it at my friends, sometimes I do it at my house and I've done it round my mum's friends before when we went round.

And what about where in the house do you do it?

In my bedroom or in the living room.

Conservatory or in the bedroom room, or if I go round to my Grandma's and Granddad's sometimes I do it there.

Sometimes I get a magazine and lean on the floor and do it, cos then I can watch telly at the same time, sometimes, but sometimes it like distracts me, so I go in my bedroom.

So does it depend on the kind of homework you've got then?

Yeah.

Yeah.

Yeah.

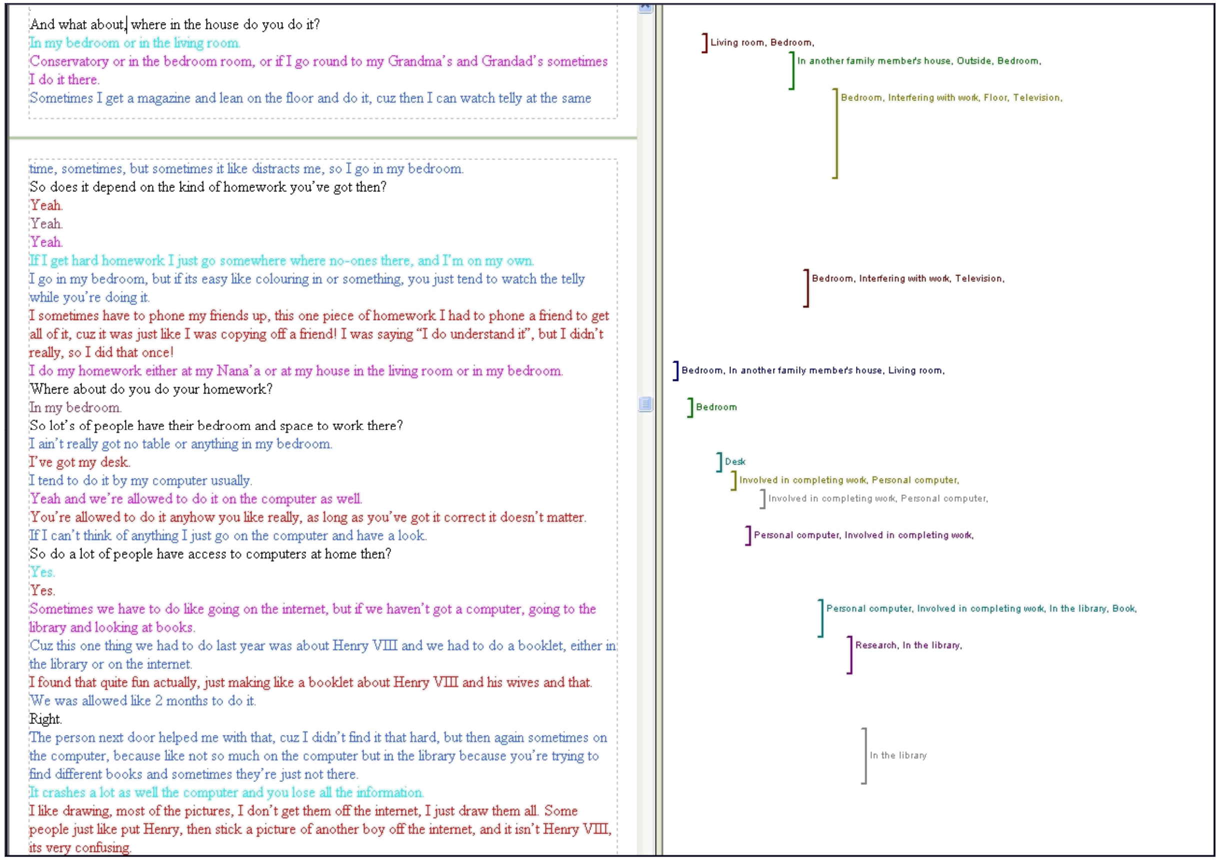
If I get hard homework I just go somewhere where no-ones there and I'm on my own.

I go in my bedroom, but if it's easy like colouring in or something, you just tend to watch the telly while you're doing it.

I sometimes have to phone my friends up, this one piece of homework I had to phone a friend to get all of it, cos it was just like I was copying off a friend! I was saying "I do understand it", but I didn't really, so I did that once!

I do my homework either at my Nana's or at my house in the living room or in my bedroom.

Appendix 4.D: Example NVivo screenshot of discussion group transcript



Chapter 5 Appendices

Appendix 5.A: Consent form

CONSENT FORM INFORMATION

Your raw video data will be stored securely at the University of Nottingham, and will only be studied by a small team of researchers. To preserve your family's anonymity your names will not be used in any published research.

Clips and stills from the videos will only be used in the presentation of research as agreed by you on the consent form attached.

All research within this project takes place in line with University of Nottingham and British Educational Research Association guidelines.

You should keep this section for your information, and detach the consent form below.

VIDEO DIARY CONSENT FORM

I am happy for myself and my children (where appropriate) to take part in this video diary study, and have read and understood the briefing and consent information provided.

Please delete below as appropriate:

I consent to let video footage be used in conference presentations
Yes / No

I consent to let still images from the videos be used in publications
Yes / No

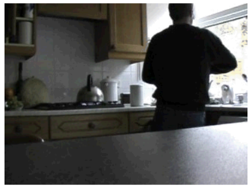
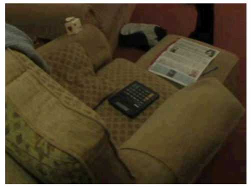
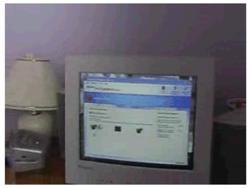
I consent to let still images from the videos be used on web pages
Yes / No

(All members of the family over 18 should sign to indicate their own consent. Children are covered by the consent of the parent / guardian).

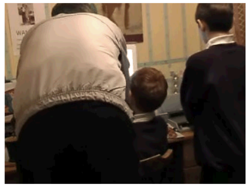
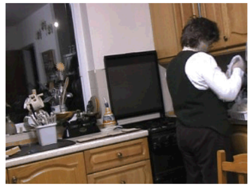
Signatures: ______________________________
____
____

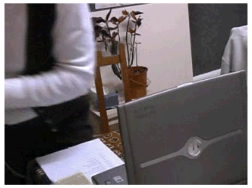
Date: ____________________________________

Appendix 5.B: Data produced by the Eddison family

					
Homework diary 0.42 minutes / seconds	Tour 1.05 mins / secs	Homework 0.49 mins / secs	Making drinks 2.31 mins / secs	Packing h/w 0.18 mins / secs	Computer game 0.46 mins / secs
					
Spyware 0.11 mins / secs	Dancing game 8.35 mins / secs	Preparing food 5.51 mins / secs	Preparing food 5.06 mins / secs		

Appendix 5.C: Data produced by the Simpson family

					
Coming home 1.26 minutes / seconds	Evening plans 2.57 mins / secs	Preparing food 16.15 mins / secs	H/w + meal 10.48 mins / secs	H/w at PC 23.16 mins / secs	Piano 0.02 mins / secs
					
H/w + dishes 5.34 mins / secs	PC search 5.30 mins / secs	H/w + phone 0.17 mins / secs	Clarinet 4.19 mins / secs	Preparing food 10.11 mins / secs	Games console 8.25 mins / secs

					
Breakfast 4.18 mins / secs	H/w + music 6.47 mins / secs	Laptop 9.31 mins / secs	Monopoly 3.22 mins / secs	Toys + TV 8.49 mins / secs	Preparing food 7.31 mins / secs
					
Preparing food 1.12 mins / secs					

Chapter 6 Appendices

Appendix 6.A: Letter to parents at School E

Dear Parent / Guardian

I am currently working with a group on a research project in the Learning Sciences Research Institute at the University of Nottingham. We are interested in looking at the design of new technologies for homework. The present focus is on the impact current resources and Information and Communications Technology (ICT) are having on homework practices, in order to inform the design of future technologies.

I am writing to you as I am interested in talking to families from <School E> about how you have reacted to ICT in your home – particularly within the context of your children's homework. My particular interest is in how the rising use of ICT in schools has impacted on home life: including whether this has influenced your family's use of ICT in the home; if, and how your child uses ICT in their homework; and your reactions to the school's ICT set up.

If you would be prepared to meet with me, I am available to travel for a chat wherever is convenient to you. I am hoping this will also provide valuable feedback for <School E> on their use of ICT, as well as contributing to my research. In return, I am willing to fill you in on the work we do at the Learning Sciences Research Institute. There is also the opportunity to become involved in the project further, getting involved in the design and trial of new technologies, if you would be interested.

If you might be available to participate in the research, please feel free to contact me for more information, at the details given below. In addition, you can check out my personal website, which links to the Learning Sciences Research Institute and our partner, the Mixed Reality Laboratory, to find out more about what we do.

Yours faithfully

Katie Fraser

Katie Fraser, BA, MSc
Learning Sciences Research Institute, Jubilee Campus
University of Nottingham. NG8 1BB

Email: xxxxx
Website: xxxxx
Office: (0115) xxxxxxx / Mobile: (xxxx) xxxxxxx

Appendix 6.B: Follow up letter to parents

Dear Family

Thank you for agreeing to take further part in our research on new technologies for the home and homework. We are looking forward to seeing you on Thursday 29th September at 5.30pm. The whole session will last no more than two hours. Events planned include a tour of our Mixed Reality Laboratory, demonstrating some of the technologies we have developed and use in the lab, including our lounge area, where future home technologies are trialled. There will also be some food, and a general chance to have a look around the department and ask questions.

The entire family is encouraged to attend – there should be plenty to do and look at, and we are interested in hearing the opinions of all the family members on what technologies you would like to see in your homes. As a result of this session, you will get the chance to take home and try some mocked-up technologies, put together from your feedback. We have cinema ticket vouchers as a thank you for this visit, and once you've had a chance to tell us what you think of the technologies, there is also a final thank you of around £75 for taking part – to take the family out for a meal or other treat.

I have enclosed a map of the Jubilee Campus, where we are based, and have marked the Computer Science Department entrance closest to the Mixed Reality Laboratory with a cross on the map. Either myself or a colleague will be there to show you where to go on the day. Car parking is available on campus, or we can be easily reached by bus on the Trent Barton Rainbow 5 or Nottingham City 35, 36, or 38 routes along Derby Road.

Once again we look forward to seeing you, and are hoping the evening will be a lot of fun.

Yours faithfully

Katie Fraser, BA, MSc

Email: xxxxx
Website: xxxxx
Office: (xxxx) xxxxxxx / Mobile: (xxxx) xxxxxxx

Enc.

Appendix 6.C: Consent form

Thank you for agreeing to take part in this project, looking at the use of ICT in homework. In order to make sure you are comfortable with your family's involvement, please take a few seconds to read through this information.

You will be asked a few questions about how homework takes place in your family, and the uses of ICT within this. All information will be kept confidential, will only be used in connection with this project, and will not be made available to anyone else. Your name and address will not be stored, and to preserve your family's anonymity your names will not be used in any publications or presentations about the research. Tapes will be destroyed after the research has been completed and published.

All research within this project takes place in line with University of Nottingham and British Educational Research Association guidelines. You, or any of your family, are free to withdraw from the research at any time. You should keep this section for your information, and detach the consent form below.

✂--

Consent form

I have read and understood the information about this study and I give my consent to the involvement of myself and my children in the project. I understand that I, or my children, are free to withdraw from the study, or any of its elements, at any time, even if I have already given my consent.

(All participating family members over 18 should sign to indicate their own consent. Children are covered by the consent of the parent / guardian).

Signatures: ____

____

____

Date: ____

Appendix 6.D: Example demonstrator probe session transcript

- This was the first part of the interview around Demonstrator 2: Embedded information capture and access in the mock-lounge area conducted with Family A.

Interviewer: Right – sensor demo. So the one in the lounge? Same question, what is your initial reaction to having sensors in your home?

Son: Good, because the book's there and then you don't get in detentions or whatever, because you know, you know that you've brought the right books in and everything, and you can sort of look on that timetable thing on the wardrobe and you can see, and the computer things you can scan the book on and you get more information, and you don't have to search for one of the websites, and that, it just comes up without the page searching.

Interviewer: Yeah, really useful, it just immediately puts up

Father: Yeah, I suppose from our point of view, this is relevant to life, the difficulty is to start with the fact that things are being monit… you're feeling like you are being monitored all the time, because you're just not used to it. It's getting into that change thing again, isn't it?

Interviewer: Mmm… changing the habits

Father: Once you've had it and you've got it and you've got used to it, I'm sure you'd be fine, but you're thinking, what… Plus, I'd need to be convinced more, what, what do I need it for – I don't mind it being there if it's going to serve me a purpose, but unless someone can convince me it's gonna, you're gonna benefit or it's gonna, I'm gonna get some gain out of it, I would be thinking 'what's the point then'?

Interviewer: What kind of benefits?

Father: Exactly, so I would need to be convinced of that, and then I would do it. If not, I would think, it's not that I don't want to, I just don't see the point.

What kind of benefits can you think of?

Erm…

Gran again.

Pardon?

Gran again.

We talked about, erm, more use for, again, I think it goes back to the earlier point made, about, I'm not so bothered about what I'm being monitored, so much, about in the house, because I can't think of any real gains from that, but as regards using if for looking out after my mum.

Yep

Who lives, seven / eight miles away, yes, I think that would be an excellent idea, her having monitors around the house, to supplement, you know, the locator thing, the tracking thing with the mobile phone. For something like that, but at home, I'm not bothered really, I don't know why I'd be bothered that he spends 2.6 hours in his bedroom and .3 hours in the bathroom, and all the rest of it, if, 'cos that's how I can see it being used, until you say, perhaps, 'no, you can do this, this and this with it' then I would see.

Like you mean, creating the location system, and things like the location would tell you which she is in…?

Yeah

And then the sensor one could take a picture and show you exactly what she was doing.

Exactly, right, just to be sure. And then I could know she hasn't, not that I want to spy on her, but she hasn't collapsed on the floor, or whatever

Or probably, like a warning thing, if she's in a room for a certain length of time, then, like, it, like it beeps or whatever, so you can just check on her, or whatever.

That's an, that's idea, isn't it?

So at night, it'd be alright if she's in the bedroom.

Yeah, but you could set it for separate rooms, so she wasn't necessarily: like, the front bedroom or something, what does she want to be in there for four hours for, you know what I mean, whereas like the living room or something like that, that she spends a lot of time in, you could lengthen the time and stuff. It's like a check, isn't it, really? That's how I could see the, I could see some real benefits for something like that, looking after my mum and stuff.

What about the homework area?

Well, like the comp, the book scanner thing, that's good for the homework, so, go to the website, thing, and then checking whether, seeing how long we've been doing the homework for, just to make sure you do it properly.

Yeah, well, we thought that erm, the exams are getting progressively more important, as he goes, he's only in his second year at senior school. So the exams are important, I was sort of saying to Tom, the other, if he failed them all, it wouldn't be very nice, but it's not the end of the world, but if you could use something like this to demonstrate that, yeah, he used the maths, in that sort of situation, if you got 89% in maths, and you could should a record of amount of revision time.

Oh right.

Compared to Latin, where you revised less and got a lower mark, you could perhaps use that to perhaps encourage them to say look if you revise more for that subject then you get better marks. But I guess that, I think that only becomes really relevant, if you like, for say GCSE, you know, your mocks, the exams you do before the proper GCSEs and stuff.

Oh right, mm hmm.

So I can see some use for that, for that perhaps.

Maybe in the primary schools not so much.

Erm, yeah, that I'm not convinced it could be that useful to be honest, I'm not sure, I'm not sure, I don't think it would, to be quite honest. Plus I think as, we have to be careful as well, that we don't develop this so far, these sort of things, that they then stop thinking for themselves.

Ah.

Do you know what I mean? Because there's a real danger that this technology available just around either now, or just around the corner, that really, he shouldn't need a computer printout to tell him to take which books to school, do you understand what I'm saying?

Yeah, keep focused.

Yeah, we're adults here, or young adults here, they should at least be able to think for themselves to some degree, I would be careful that we don't take, it doesn't do everything for them, so we literally get up, and the alarm goes off and a printout tells them you need that book, that book, that book and that book because I think that's taking it… do you know what I'm saying?

Chapter 7 Appendices

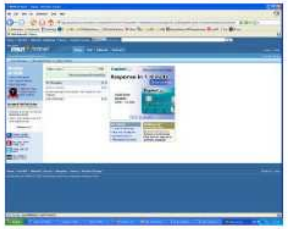
Appendix 7.A: Nabaztag instructions

MESSAGING RABBIT

 Place one rabbit in an area where you tend to do your homework on your own.	 And another in a family area.	 You can make your rabbit's ears horizontal to show you're working...	 ... and the information will be mirrored on the rabbit downstairs.
 Change them back to show you have stopped working. You can arrange other signals amongst yourselves	 • When the rabbit is purple underneath it is communicating correctly • If the rabbit's nose is purple this means you have received a message and not archived it • Press the rabbit's head once to listen to an old message, twice to archive a message	 The rabbit can also speak. We've put up a website, that's on the laptop, & the PDA, or on your card.	 The website will let you send a message straight away, or enter a time for the rabbit to speak out the message.

Appendix 7.B: Messaging laptop instructions

EMAIL TERMINAL

 You have a laptop set up with an email programme.	 This is set up to use the email address [redacted] And the inbox is displayed on the screen at all times.	 You can send messages to the family area on the laptop screen...	 ... from your own PC...
 ... or any other PC with an email programme and account.	 Or from any PC or the PDA too by going to a free email site.	We have set up email accounts at [redacted] for you to use in case you do not have your own, with the username [redacted] or and the password [redacted].	We have left the laptop so it should run all week, and will not need to be restarted. The password is [redacted]. If there seem to be any problems with it, just ring me on [redacted] or email me at [redacted].

Appendix 7.C: PDA instructions

PERSONAL ASSISTANT

The main programme of interest is the calendar.  You will be using this as a homework diary and social calendar.	 You can view events by hour, day, week or month.	 You can enter events in your calendar by selecting the date or time you want, then 'New'.	Enter the details, plus an alarm if you want to be reminded of a time to go and do something, or as a reminder that you need to do a task around a particular time.
 The main screen will show your next 'appointment', and there will be an alarm at that time if requested.	 You may need to charge it should the battery fall low, the charger is provided.	 You can also use the MSN Messenger facility to send messages to the laptop when you're at home.	 And the Internet similarly, when you're at home, to send messages to the rabbits.

Appendix 7.D: Example in-home trial transcript

- The first part of the interview around in-home technology use.
- This was the interview conducted with Family B.

Interviewer: I'm just going to get you to tell me what you thought and what you made of the week, and er, when they weren't going wrong. So, if you just want to start off and tell me what you thought, just off the top of your head.

Mother: Erm, I like the idea behind the rabbits, but I think, to me, they're more of a gimmick, because I could see the, I can see the use for things like, when we were going out with leaving a reminder so that he didn't miss a specific time when he was supposed to be doing something.

Son: Yeah.

Mother: So that, yes I could see the use of, but the majority of the time because we're all in the house, you're not living in a huge house, you just tend to shout and give them the instructions, rather than going through that, so I can see its use as kind of like a, an answer machine type thing but for giving prompts about events, if you like.

Father: An alarm clock.

Son: Yes.

Mother: We did do that with you, didn't we?

Son: Yeah, and then it went off at the wrong time.

Mother: Well, no, but we did it on you, was it Saturday morning when I set it?

Son: Ah right, I unplugged it because it was flashing purple and I wanted to sleep so I unplugged it. I got up about 11 and I plugged it in, and it went 'get up now' at eleven!

Mother: Yeah, so maybe that's the thing, it'd need to be somewhere where it wasn't flashing lights all night, because he obviously unplugged it, which I didn't know.

Son: Yeah I unplugged it every night, it was kind of a purple glow and it'd go on and on and you'd close your eyes and then it'd rile you.

Interviewer: Excellent.

Erm, I mean there was cer..., I mean it was, I think the thing is that because the majority of the time that we've been using it, obviously, we've been at work, he's been at school, so, you've, you're not sending him messages during the course of the day, you know like maybe if he was at home and we were at work, or at school

Yeah

Then yes I could I think use it to sort of tell him 'do this at the moment, do that' but because it was only that we're all here in the evening, that was the only time.

So there's quite a lot of overlap in the times that you're here?

Yeah, that's it, because I say literally, I take them and drop them off into the way into work and I pick them up on my way home, so when he's in the house, generally, I am.

Mmm.

So it's not, but as I say, it was, last night, we did set up, but it, obviously because our electric had gone off, that did mess it up a bit, but we did set it to leave him a reminder because we were going out, and he'd got to go swimming, so I left it to come on to say get ready and go because I knew if he was busy doing something else he wouldn't see what time it was, so I can see its use for things like that as a reminder that you could set up in advance.

[note: the sister later revealed that she had actually set a reminder at the wrong time to confuse her brother, so this was not a fault in the rabbit]

Yeah, and it was quite useful for you to be able to send that to it.

Yeah because literally to know that, sort of last weekend, I could be, ooh, there's a need to do that then?

Mmm.

And you can type it in there and then, leave a message for it to do at the right time.

Yeah.

So you weren't as well having to do it as a last minute job, which was good, you've got some forward planning to it, so I think a lot of it, it was because, I think it's got to be a different scenario if it was a school holiday that you were trialling it over, because then you wouldn't necessarily be in at the same times and, you know what I mean, because of their age they're doing different things, they're not going here there and everywhere with you, then you could use it for more instructions if you like.

Yeah.

What did you think?

Well, yeah, I mean, there's that thing about it can do where you type in the keyboard it reads out the words which seemed quite useful, though it's not the first device I've seen do that

The extra speech bit of it.

When you first brought it it reminded me of that old dog we used to have, because that used to do different things, and I imagined that you could perhaps use that as a device round the house. But then is the mobility really going to enhance the practicalities of it anyway?

I think the thing as well, because it's in one, you'd have to have quite a lot of them to me, because you're not always in that one place

Yeah

I am!

Well, yeah, you are, but, do you know what I mean, it's like, if you've got it set up in a living area, but maybe, maybe there was a message on it that somebody had left you, for me, I could be doing things for a hour and a half before I ever got to the living room from coming in, so you wouldn't necessarily know, but then equally if you put it in an area where you could see it as you walked in, you wouldn't necessarily know in an evening if something had happened with it.

Yeah.

So I think you'd probably need more than one, or you'd need some way of knowing that it'd got a message that you needed to listen to, or…

Yeah

You know what I mean? Without you having to specifically go and check it?

Yeah, that's interesting.

You know, it's like when you come in and I tend to walk through to check if there's a message on the answer machine.

Mmm.

And you'd have to do that to know, necessarily whether you'd got a message depending on where you'd got it, so it'd be a specific 'ooh, I must go and check' as opposed to 'ooh look' it's there as a like and you know it's happened.

Oh, okay.

I mean the ears thing became a massive bone of contention, because there's two of them, so one kept moving it, and the other kept moving it back, and the other kept moving it, and the other kept moving it back, then you'd get a message through, and it'd say 'stop moving the ears!' [mother and father laugh] So that's ideal for one child, it doesn't work where there's more. The poor rabbit's ears were going like rollo at certain points in the week!

That's great!

Yeah!