Improving Validity and Reliability in Children's Self Reports of Technology Use

by

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Abstract

Researchers working in child computer interaction are constantly seeking new methods and new techniques that will enable them to carry out more valid and more reliable research. Much of this research typically considers the design and development of new products and of new interactive techniques and researchers seek to understand how easy such innovations are for children, how much fun they are to use and how attractive they may be for use.

The impact of prior technology use on the children's responses in those contexts is the core concern of this thesis. The thesis provides a set of tools (survey instruments and guidelines) that can be used by the CCI research community to ascertain the prior experience of children with any technology and with any task. These tools are generated using theory, experience and literature and are validated through user studies.

The PETT survey tool comprises three questionnaires, CTEQ, CTUQ and CTHQ and an associated user guide that clearly articulates how to use PETT and demonstrates the flexibility of PETT to be used in many contexts. The guidelines (RWC, SWC and SRT) can be applied on three levels, for general use in research with children, in the design of surveys and in the specifics of designing self-report tools for prior technology experience.

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1 CHAPTER ONE: INTRODUCTION

This thesis contributes to the use of survey methodology with children by providing guidelines and a set of questionnaires to enable researchers in HCI to carry out valid and reliable surveys with children, focussed particularly on children's self report of technology use. The research presented in this thesis follows an exploratory approach using user centred design to inform the guidelines created and conduct pretesting of the questionnaire set.

This chapter provides an overview of the research conducted in this thesis. Section 1.1 provides the motivation for undertaking this journey. Section 1.2 places the research in the context of Human Computer Interaction and Interaction Design, specifically in the area of Child Computer Interaction. Section 1.3 presents the aims and objectives of the research followed by an overview of the research methods used (section 1.4) and the ethical issues related to this work. The chapter ends with an overview of the structure of the thesis and the chapters within it (section 1.5).

1.1 Research Motivation

Having worked in the field of Child Computer Interaction for the past 10 years I have spent a lot of time conducting research studies with children. Initially the focus of this thesis was on the use of multi-layered interfaces to assist children in learning how to use software. This subject was pursued for a few years and although interesting, never really provided, to me, the necessary motivation and drive needed. It was during this time that an irritation grew in me after reading academic papers where assumptions were being made and results being justified on the basis of responses to generic questions about prior technology experience which in my mind were not nearly sufficient to give credibility to the research presented. My favourite response to these questions was '*so what!*'

I could not see how an academic researcher could, for instance, state that all participants have prior experience of using a computer because they reported they had one at their house. This could be true – but with no mention of how often they use the computer, whether they have ever used it, and what they have used it for, I was left wondering how any reliable conclusions could be drawn.

It was because of this that the focus of the research was changed to its current subject. Starting from scratch after two years would not be easy but I had finally found a subject that I had a real passion for and a subject around which I felt I could make a real difference by providing a valuable resource for my own research community that would enable them to carry out better surveys with children. It was here that I began my quest that has resulted in years of work with hundreds of school children resulting in the document I present before you with pride.

1.2 Research Context

This research is situated in the field of Child Computer Interaction (CCI), which is a subfield of Human Computer Interaction (HCI). The work follows the methods from HCI and from its thematic area which is broadly computer science. The work may have applications for researchers in social science, psychology, educational technology and education.

Child Computer Interaction is a relatively new field; at the time of writing, it has been holding its own annual conference for the past ten years. CCI brings together researchers from HCI, Interaction Design, Educational Technology, Learning Sciences and Psychology – it tends to focus on the design of novel technologies for children in homes, schools and play contexts. Much of the research in CCI is done in HCI research groups where the CCI researchers may have little support for the specifics of working with children. Methods specific to children are sometimes not known to the senior researchers in these groups. In recent years, the CCI community has highlighted a need to provide resources for researchers especially in terms of more robust methods and new methods (Jensen & Skov, 2005; Read & Bekker, 2011).

In terms of technology, new products and new devices are prevalent. The experience that children, and adult users, have with technology can have a significant impact on their attitudes and skills when meeting new technologies. In order to evaluate the usefulness and the appeal of new technologies, researchers typically gather opinion data and often report, in research papers outlining their new innovations, that evaluators like their new products, can use their new products and want to have their new products without grounding these results with details of the evaluators earlier experiences. When these sorts of studies are done with children, it is known that they are enthusiastic in reporting (Read & MacFarlane, 2006), but it also acknowledged that prior experience matters (Lee, 1986).

The research here bridges these two areas by providing solutions and knowledge around the gathering of experience data from children within the context of CCI. The findings are intended to primarily be used by researchers in HCI, CCI and Interaction Design and Children (IDC).

1.3 Research Aim and Objectives

The aim of the research is to study survey design with children in the context of self-report of technology experience and to provide tools and techniques that will improve the reporting of children's prior experience with technology in order that researchers within CCI can better situate their research by providing valid and reliable data that describes their research participants or the evaluators of their innovations.

The objectives were to:

- RO1: Develop a generic survey tool to gather self-report experience data from children
- RO2: Better understand how to design surveys for children for self-report
- RO3: Derive a set of guidelines for use by CCI and HCI researchers intending to survey children

The research questions were:

- RQ1: To what extent can a usable survey tool be designed for children that can be a) generic and b) user friendly
- RQ2: Given that such a tool can be developed, what knowledge is required to administer and adapt such a survey?
- RQ3: What is best practice in terms of surveying children for their prior technology experience within the context of CCI?

The aims and objectives were all met and the research questions were answered.

1.4 Contributions

The key contributions of this thesis are:

- RC1: The PETT (Prior Experience of Technology and Task use) survey tool, designed from an extensive study of the literature and from the findings from a set of pilot studies and validated with user testing and expert testing over three iterations – this is a generic survey tool consisting of three specialised tools (CTEQ, CTUQ and CTHQ) together with instruction for manipulating and populating the questionnaires for specific use cases as well as guidance for the creation of additional questions specific to the research context within which it is being used.

- RC2: Three sets of theoretically grounded, experientially validated guidelines (RWC, SWC and SRT) that can be used by researchers in HCI and CCI to better carry out research with children (RWC), surveys with children (SWC) and surveys for the self-report of technology (SRT).

- RC3: Research data that demonstrates a clearer understanding of technology use by children – this data evidences the timely shift toward multifunctional devices to carry out tasks that were original considered mono device and data from the pilot studies that show the current use of technology, and the terms used, by children.

1.5 Methodology

The research followed the approaches of grounded theory and user centred design. Figure 1.1 shows the research stages in a schematic.

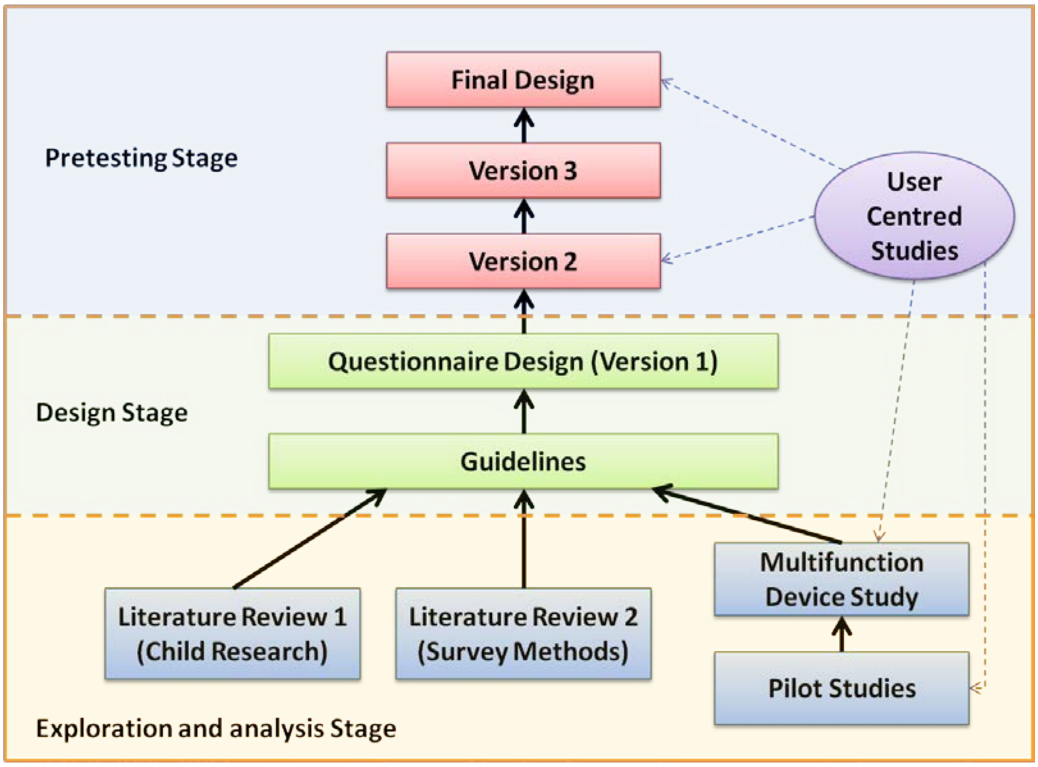


Figure 1.1: Stages of the research

Throughout the research pilot studies, literature and the experience of the author were distilled in a grounded way to provide data for the products and theories for the guidelines. For the practical product (PETT) user studies were deployed to refine and iterate the individual questionnaires and observational data from these user studies was used to further populate the guidelines both for general survey design and for the anticipated manipulation of the generic PETT survey.

Data was analysed in a variety of ways in accordance with the research needs. For the generation of the 3 guidelines sets, closed coding was initially used, followed by data set merging. In analysing the results of the user studies appropriate statistical methods were deployed to interpret the data and thematic analysis was used to create the questions used in these studies.

Throughout the research children contributed as testers and informants to the extent that they pretested the surveys, participated in pilot studies, and were observed during question completion by the author of this thesis. The children were recruited from five schools in Lancashire, UK; these schools included different economic areas, an appropriate diversity of ethnicity, and were situated in both rural and urban areas. It is believed that the children who participated provided a good representative sample.

1.5.1 Ethics

The research undertaken for the thesis has been submitted to, and approved by, the University Ethics Committee. CRB clearance was obtained in accordance with UK laws for working with children.

Before the children were allowed to participate in the studies in this thesis, full information was provided to the Head Teacher of the participating school who gave permission for the research studies to take place. The children participating in the studies were also informed of its purpose and given the option of whether or not to participate. No videos or photographs were taken during the studies and personal details were not recorded unless it was deemed absolutely necessary. The data from studies was kept in a locked room or on person at all times to ensure it was not accessible to others.

Children were always given the opportunity to stop participation in a study at any time and on occasion were asked if they would like to stop if they looked uncomfortable or stressed. Care was always taken to put the needs of the children and the school before the needs of the research even if this caused inconvenience to a study.

When studies were conducted within the university all safety and fire information was given to both the teachers and children and refreshments and toilets facilities were made available.

1.6 Thesis Structure

Following this introduction, Chapter 2 presents an overview of conducting research with children and the important issues associated with working with this unique user group. Insights into the effects that child development can have on research studies are presented followed by a look at the important ethical issues that need to be addressed. The chapter ends with an overview of Child Computer Interaction as a research discipline identifying major themes, the unknowns of working in this field and the future direction in which the field is headed.

Chapter 3 introduces prior experience and the field of survey methodology. Important aspects of this field are identified in order to fully understand this discipline and be able to create a successful survey. The chapter ends with a look at the literature on the use of survey methods with children, the similarities between surveying children and adults, and identifies a set of pre-existing guidelines that exist to aide in the creation and administration of surveys with children.

Chapter 4 presents an overview of the research methods that have been employed in the work presented in this thesis. The stages of the research are presented followed by the different methods used within each stage.

Chapter 5 presents the initial pilot study conducted followed by four additional studies that were identified as the work progressed. This resulted in a set of contributions to be used alongside the ones uncovered within the literature chapters. Two of the studies also identified the growing issues that multifunctional devices were having on research with children which provided the motivation for the following chapter.

Chapter 6 takes a deeper look into the literature of feature creep and bloat in order to better understand this and its effect on prior experience in children. A study into children's growing adoption of multifunctional devices is presented and a final set of contributions are presented to be used in the creation of the guidelines presented in chapter 7.

Chapter 7 begins by presenting the good practice guidance and contributions obtained from chapter 2, 3, 5 and 6. The contributions are then categorised into one of three defined areas before a data-set merging technique is used to merge similar contributions and remove contributions that were not required. Following on from this the guidelines for each category are then defined and detailed descriptions of the guidelines are presented.

Chapter 8 presents the method for how the initial sets of questions were created. Thematic analysis is used to identify question themes from the similar survey area of computer experience which were then used in conjunction with extensive researcher knowledge to create each question.

Chapter 9 presents three pretesting studies that were used to test the validity and reliability of the questionnaire set focussing on the language used within the questions. At each stage the questionnaires were refined until the final questionnaire was created.

Chapter 10 provides guidance for researchers wishing to use the questionnaire set in conjunction with the guidelines created in chapter 7. Each question is presented and instructions on how to edit them in the context of a research study is provided. Guidance is also given on how to create further questions specific to the focus of a research study.

The concluding chapter 11 provides a summary of the research undertaken followed by the answers to the research questions identified in chapter 1. The main contributions of the research are noted together with the limitations of the work and future directions in which the work will be taken.

1.7 Summary and Conclusions

This introductory chapter has outlined the motivation for this thesis and the research objectives it set out to achieve. The research was motivated by both the personal desires of the author to produce a practical solution for a known problem and the broader academic requirement, from the CCI community, to develop methods that are robust and well grounded.

The thesis aimed to therefore develop a practical tool and a set of associated guidelines using a user-centred approach in order to ensure that the products so created would be highly usable by children, researchers, and evaluators.

2 CHAPTER TWO: CHILD RESEARCH

This chapter presents an overview of doing research with children, and an introduction to the field of Child Computer Interaction. Section 2.1 begins with a brief overview of the history of research with children before defining the population known as children (Section 2.1.1). The known issues of doing research with children are then identified (Section 2.1.2) followed by a look at child development in order to understand the effect this can have, focusing on the cognitive development theories of Jean Piaget and Lev Vygotsky (Section 2.1.3).

Section 2.2 deals with the ethics of working with children, introducing the three key concepts; informed consent (Section 2.2.1), privacy and confidentiality (Section 2.2.2), and vulnerability (Section 2.2.3). This is followed by a brief section looking at the role of ethics boards and the peril of relying solely on their judgment (Section 2.2.4).

Section 2.3 ends this chapter with an introduction to the field of Child Computer Interaction (CCI) giving a brief overview of the origins of the field and exploring how it has grown (Section 2.3.1). The major themes of CCI are then discussed (Section 2.3.2) followed by a look at what is missing within the discipline (Section 2.3.3) and what the future holds (Section 2.3.4).

The chapter ends with a brief discussion about the literature covered and its importance in underpinning the research in this thesis. As part of this, the key elements are summarized into coded points that will form the basis of the guidelines to be produced in chapter 7.

2.1 Research with Children

Research with children has been carried out for several decades in disciplines such as sociology and psychology (Vaillancourt, 1973), (Fine & Sandstrom, 1988), (Rossiter, 1977). It is only since the emergence of the Child Computer Interaction (CCI) and Interaction Design and Children (IDC) communities, in the late 1990's, that this unique research area has begun to establish itself within HCI.

Traditionally children have been the focus of research but often treated as objects to be studied, rather than as participants or subjects (Barker & Weller, 2003) within the research itself. The assumptions and requirements of the adult researchers have taken precedence over the views and opinions of the children themselves (Valentine, 1999) with adult researchers being content in the knowledge that they were once children and therefore know how children think, knowing their likes and dislikes, and understanding their view of the world around them. It is through the introduction and adoption of user-centered and participatory research methods that this stance has been challenged, highlighting the importance of children's own ideas and opinions. When working with children, researchers must address considerations and challenges that may not exist with other user groups.

2.1.1 What are Children?

In the UK, there is no specific law that defines or states the maximum age of a child. The UN Convention on the Rights of the Child (UN Assembly, 1989) states that *"a child means every human being below the age of eighteen years unless under the law applicable to the child, majority is attained earlier"*. The majority of research undertaken with children as a unique user group focuses on children aged sixteen and below (Barker & Weller, 2003) with older children considered to be bordering on adulthood and therefore their opinions and ideas are more often in line with adult user groups. Within the UK education system, sixteen is used as a convenient cut off point due to this being the age children leave high school.

In research, children are often perceived in one of two ways; either the same as adults or completely different. The stance taken by the researcher will dictate what methods they will employ (Punch, 2002). When a child is seen as the same as an adult the research methods used will be the same as with adults whereas when a child is considered unique these methods may need to be adapted, new methods created, or child focused methods used. Children are increasingly being seen as a competent social group in their own right (James & James, 2001; Jensen & Skov, 2005) but it is important this is not used as an excuse to see them as indistinguishable.

2.1.2 Known Issues

Recurring issues appear in the literature across a multitude of disciplines evidencing a set of unofficial guidelines for carrying out effective research with children. These 'guidelines' help to instruct and inform the research community on how to carry out effective research by minimizing effects such as the environment, researchers, and child development.

Children's lives are predominantly situated in two locations; the home, and school. These provide a child with a sense of safety and comfort which is almost impossible to replicate. Taking children out of their natural environment will have an effect on their emotions and perceptions, and therefore affect their participation in a research study. The effect may not necessarily be negative and may differ for each individual child; where one child is excited about coming to a research laboratory and therefore very positive in their contribution, another may be scared or nervous about the unfamiliar surroundings. There is a strong focus on the use of field studies in child research with the apparent need to keep children in a natural environment evident (Jensen & Skov, 2005). If research has to be carried out outside of a natural environment such as in a research lab, making the lab more child-friendly can help ease the children. However, any such interventions do need to be designed in such a way as to not cause too much distraction from the task at hand (Hanna, Risden, & Alexander, 1997).

Due to the natural unequal power relationship between adults and children, researchers themselves can unintentionally affect a research study (Read & MacFarlane, 2006) due to:

- Increased possibilities of researcher bias.
- Children trying to please, or not to upset, the researcher.
- Not building up a relationship with the child participants.

Children spend the majority of their time with adults who are in a position of power over them. Spending most of their time at home and at school, it is the children's parents and teachers who they interact with the most and these are the adults who children have become accustomed to taking instruction from and being disciplined by.

Researcher bias is where the views and opinions of the researcher can affect the answers given by a child in variety of ways these include; the biased wording of a question, positive or negative wording or gestures towards a specific answer and probing answers for more information that gives off the perception that the researcher does, or does not, agree with the answer of the child. Children in their very nature want to please adults making it important that the researcher shows neutrality towards any answers given and thinks carefully about the wording of questions so as not to lead a child to a particular answer. If a child is of the belief that a researcher wants him or her to answer a specific way, or feels the researcher is not happy with the answer that has been given, then there is a tendency for the child to answer in a manner in which will be designed to please the researcher.

Relationship building is a vital role to reduce this effect, as the more comfortable children are with a researcher the more likely they are to tell the truth and provide opinions and feedback that is accurate. Different approaches have been used to try and break down unequal power balances such as getting to know the children well before the study by working with them on non-research related activities (Alderson, 2001), engaging in small talk (Hanna et al., 1997), playing games, team building activities (Druin, 2002), all of which are designed to get the children used to being around the adults and allow the researchers the opportunity to prove that they are not teachers and to build up a rapport with the children talking to them on their own level about their own interests. Punch (2002) notes that researchers also need to build up a rapport with the adult gatekeepers of the children and not just the children themselves.

In a study considering participatory design with children, Kam et al. (2006) found children to be extremely nervous having their class teachers present, to the extent that this hindered the different relationship the researchers were trying to build with the children. Their solution was to, politely, ask the teachers to leave the room where the study was being conducted. However, when evaluating the involvement of teachers in usability testing, Pardo, Vetere, and Howard (2006) found that teachers involvement, as an obstacle in this regard, was not critical and did not inhibit children’s participation, a finding that is strongly supported through my own research experience where teachers are most likely to introduce their own biases when trying to support children in studies, rather than affect the relationship between the children and the researcher.

Language skills are an important consideration, particularly when working with younger children and when carrying out studies with children of different ages. Children develop their reading and writing skills at different speeds therefore the abilities of children of the same age group could differ significantly (Markopoulos & Bekker, 2003; Read & MacFarlane, 2006). Researchers need to ensure the language used in their research is age appropriate and if necessary provide instructions in more than one format to assist and support the children as much as possible. When working with children of different age groups the gulf in ability may be sufficient to require different language and different methods to be used even though the researcher is trying to gather the same information from both. Children use language differently to adults, they use slang words and terminology that may have different meanings to adults. Listening to children interacting with each other and discussing language, and methods, with the children and their gatekeepers, can help researchers choose the right techniques to ensure children have the best chance of participating in a research study properly and providing more valid and reliable data.

When carrying out research with children it is important for the researchers to be flexible and creative in the methods used. Children are still developing their capacity to concentrate and therefore tasks of different size and complexity should be used with children of different age groups (Markopoulos & Bekker, 2003). There is an agreement that research studies involving children should not last too long but not on what this length of time should be. Hanna et al. (1997) state that activities should last around 30 minutes which is in line with Barendregt, Bekker, and Baauw's (2007) recommendation they should be less than one hour, but ultimately not the same. There may also be instances where parts of a study require adapting or changing due to unforeseen circumstances or unexpected responses (Darbyshire, MacDougall, & Schiller, 2005). Children’s participation in research studies is discussed in more detail in section 2.1.4 with regards to informed consent and the right to refuse or withdraw. With children, particularly when working with (school) classes or groups, the right to participate can be equally important. It may be the case that a study requires a certain number, or sample, of children but the opportunity to take part should be given to all, even if the results from some children are not actually used. Children are used to inclusion and the exclusion of some in a group can lead to undue stress on children who are not even participating in the study - this is unacceptable.

2.1.3 Child Development

In relation to human beings, the term ‘development’ relates to the growth and changes that occur both mentally and physically from birth to death. The most dramatic of these changes occur before birth, through early infancy, and during childhood (Smith, Cowie, & Blades, 2003). Pre-natal and early infancy development is beyond the scope of this thesis and so this section focuses on the cognitive development of children under the age of sixteen – especially considering children between the ages of 7 to 11 years.

Children develop both mentally and physically at different rates, even children of the same age may differ greatly in height, weight, communication skills, and their ability to carry out different tasks and activities. To better understand how children develop, psychologists have sought to understand the development of children for many years with many differing theories including:

- Psychoanalytic (Freud, Erikson)
- Cognitive (Piaget)
- Behavioral (Watson, Pavlov, Skinner)
- Social (Vygotsky, Bowlby, Bandura)

It is the cognitive development of children that is most relevant to underpinning the research within this thesis and so this will be further discussed. Cognition in its simplest form relates to the brain and in particular thinking. Children’s cognitive development not only concerns the way in which they attain knowledge, but also how that knowledge is stored, modified, and used to determine future actions based on past experiences. Jean Piaget (1952) has provided the most referenced and used theory on cognitive development and his work has heavily influenced the work of Borgers, Hox and colleagues (Borgers, Hox, & Sikkel, 2004; Borgers et al., 2000; De Leeuw, Borgers, & Smits, 2004) who provide the most comprehensive research of conducting survey research with children (discussed in more detail in chapter 3). Work done around the same time as Piaget by Lev Vygotsky (1978) provides a more social cognitive theory with greater emphasis on social contributions to the process of development. This is more in line with child centred research as child research focuses heavily on collaboration and facilitation by adult researchers which has commonalities with Vygotsky's (1978) theory of the Zone of Proximal Development (ZPD).

2.1.3.1 Jean Piaget

Piaget's theory of cognitive development is based on the notion that the acquisition of knowledge is a self-continuous process where knowledge is gathered and re-invented as children develop and interact with their surrounding world (Driscoll, 2005). Within this theory he identifies three different types of knowledge children can acquire (Piaget, 2001):

- Physical Knowledge – knowledge about the world and objects within it.
- Logical Mathematical Knowledge – acquired through the mental processing of information (inventing answers to explain observations).
- Social Knowledge – social or cultural knowledge learned from people close to them.

Piaget recognised that children are not adults and do not think alike instead having their own structures and logical reasoning based around their own needs and wants (Ackermann, 2001). He also noticed that question responses differed between younger and older children in a qualitative manner suggesting that it was not simply a case of younger children being less intelligent but rather that younger children answer questions differently to older children (Huitt & Hummell, 2003). Piaget concluded that children think and reason differently at different stages of their lives. His 'genetic epistemology framework' stated how knowledge develops through four main developmental stages that are biologically based with a child travelling through them as they mature (see table 2.1 taken from Smith et al, 2003).

Table 2.1: The stages of intellectual development according to Piaget (Smith et al., 2003)

Stage	*Approximate age (years)*	*Characteristics*
Sensori-motor	0-2	The infant knows about the world through actions and sensory information. Infants learn to differentiate themselves from the environment; begin to understand causality in time and space; and develop the capacity to form internal mental representations
Pre-operational	2-7	Through the symbolic use of language and intuitive problem-solving the child begins to understand about the classification of objects. But thinking is characterised by egocentrism, children focus on just one aspect of a task and lack operations like compensation and reversibility. By the end of this stage children can take another's perspective and can understand the conservation of number.
Concrete operational	7-12	Children understand conservation of mass, length, weight and volume, and can more easily take the perspective of others; can classify and order, as well as organize objects into series. The child is still tied to the immediate experience, but within these limitations can perform logical mental operations.
Formal Operational	12	Abstract reasoning begins. Children can now manipulate ideas; can speculate about the possible; can reason deductively, and formulate and test hypothesis.

Whilst these stages appear quite discreet, Piaget believed the stages to be continuous with children moving between them at different ages and different points, although, the order in which children move between the stages is concrete. However, this view is not universal as work by Lutz and Sternberg (1999) has shown that children do not always show performance levels appropriate to their stage in Piaget's framework. Their research shows that the familiarity with a task, or lack of it, can lead to performance that is above, or below, the level that the child is at. This has provided evidence that development might not be as stage like as Piaget claims, seen by some as a failing of Piaget's theory (Keenan & Evans, 2009). Work by Cole (1990) looking at cognitive development from a cross cultural perspective found that adults in many tribal societies never even reach the formal operations stage, a point supported by Rogoff (1998) who suggested all stages of Piaget's theory may not occur in all people and that the progress through these is heavily dependent on social and cultural factors.

Piaget's work is classed by many as the most influential work in the area of child development. His theories managed to encompass information from a wide variety of fields and have been acknowledged as the main reason for the development of research in this area (Meadows, 2006; Keenan & Evans, 2009). The notoriety of Piaget's work and subsequent study by many others has led to challenges to many of his theories, along with the emergence of new theories to embrace these different stances. Today, Piaget's theories are lauded for their contribution to the field but are no longer considered the most appropriate in the field of child development (Smith et al., 2003).

The choice of Piaget's theories as the basis of the survey research conducted by Borgers et al. (2000) is interesting as many of the arguments against his theories are based around his poor use of question wording, and the over complication of task scenarios that he based his findings upon (Donaldson, 1978; Wood, 1998). Piaget's work appears to be a good basis for understanding how children perform in survey research even though his research, and survey methods, with children are questioned.

During the sensory-motor stage, Piaget states that children go from being newborn babies to toddlers. There is a shift from immediate sensory and motor experiences to the basic capacity of thinking (Smith et al., 2003). Through this stage children begin to notice the effect their behaviours have on objects around them. They begin to behave in ways they know will bring about certain results and start to experiment with objects, both physical and mentally (Ormrod, 2004). The major achievement of this stage is object permanence which is the idea that an object still exists even when it is out of sight. Piaget's observations at this stage have been confirmed in subsequent research but it is often suggested that children can learn abilities at an earlier age, a theme that appears to follow his conclusions through all four stages of his theory (Smith et al., 2003).

During the pre-operational stage children begin to recognise objects and events. It is in this stage that memory and imagination are developed. Children will not be able to cope with more than one part to a problem at a time and will view the world from an egocentric viewpoint where they cannot comprehend the perspectives of others (Lutz & Huitt, 2004). Donaldson (1978) believed Piaget was too insensitive to the nature of tasks and created a simplified version of Piaget's three mountain task (class inclusion task) by asking children to place a doll where it could hide from two policemen. She found that much younger children were able to pass the task showing that children aged as young as 4 could understand other viewpoints and therefore did not always view the world from an egocentric viewpoint, a finding that has been supported in other studies (Borke, 1975; Wimmer & Perner, 1983)

During the concrete operational stage, Piaget believed children become less egocentric and are able to view the world from more than one perspective. Children's knowledge is developed into 3 categories; physical, logical (and mathematical), and social knowledge. As the name of this stage suggests, children are still limited to applying their knowledge to concrete objects and stimuli and still cannot comprehend abstract concepts (Lutz & Huitt, 2004). This again has been questioned, and again, simplification of the task has been the key. Ruffman et al (1998) showed that children as young as 6 were able to understand the relationship between a hypothesis and evidence to prove, or disprove, it provided that simple variables or relationships were used, thus evidencing their ability to understand abstract concepts.

During the formal operational stage children learn the ability to hypothesise and use deductive reasoning. Abstract concepts extend their logical thought processes as they begin to understand things that are not real or tangible. This is Piaget's final stage and the stage in which he believed a human's cognitive development reaches its full potential (Cook & Cook, 2005). A study by Keating (1990) found that 40 – 60% of college students failed the tasks that Piaget used to confirm children were within the formal operations stage. This may go some way to further supporting Rogoff's (1998) claim that not all people reach this stage.

2.1.3.2 Lev Vygotsky

Vygotsky's work was carried out around the same time as the work of Piaget although it was not until the 1960s – 1970s that his work was really discovered when it was translated from Russian (Smith et al., 2003). Miller (1993) notes that this relatively recent entry into the cognitive development research means his work has had less scrutiny than that of Piaget.

Unlike Piaget's view that a child's learning and progression through the cognitive stages is self taught and carried out alone, Vygotsky believed that children acquire their cognitive structures from social interactions with their families, peers and other people within their cultural communities (Cook & Cook, 2005). Cole (1990) is quick to point out that Piaget's view is often misinterpreted and he highlights many instances with Piaget's work where the importance of both the individual, and the social world in a child's development is noted and therefore argues that Piaget's theory is more closely aligned to Vygotsky's that is often stated.

Vygotsky believed the interaction between a child and a more knowledgeable person or tutor who is able to provide instruction and guidance to the child, enables the child to learn new skills and structures, and also confirms the skills that have already been acquired. An example of this could be where a child attempts to complete their first jigsaw and alone performs this task poorly until a tutor such as a parent sits with the child and helps them by putting joining pieces close together or talks to them about strategies such as completing the edges first. The parent is there to provide guidance, support and encouragement and as the child becomes more adept the parent can give them more freedom and less help to complete the task (McLeod, 2007). Wood, Bruner and Ross (1976) coined the phrase "scaffolding" to describe this instruction by a more knowledgeable person but noted that this instruction is not always successful and a person may need to try different techniques in order to successfully "scaffold" a child's learning (Wood, 1998).

The two major principles of Vygotsky's work that provide an understanding of this social-cultural theory of child development are the More Knowledgeable Other (MKO) principle and the Zone of Proximal Development (ZPD).

A More Knowledgeable Other (MKO) is predominantly any person who has a higher level of understanding or ability than the child with regards to the current task, process, or concept that is being carried out. Often with children this is a teacher, parent or older sibling. The MKO could also potentially be a peer or a younger child as at times children in these groups may in fact have a greater ability or higher level of understanding. The MKO does not need to be a person; we do not always learn via assistance from a person. Computers and mobile devices are being used more and more for learning and can also be considered MKO's when a child is learning via a programmed tutor or program.

The use of an MKO is not only relevant to a child. An MKO is simply a tutor (whether it be a person or computer application for example) who has more knowledge and understanding of a task than the learner. In this respect, current day research with children follows this belief as the researcher, or a suitable administrator, is always present to conduct a study with children, having greater knowledge about the task at hand and being able to assist a child when required. The roles of tutor and learner could switch from task to task, an example of with could be a child teaching their parent how to play the latest game on the computer or how to use a mobile app - in this case the child becomes the MKO.

The principle of the MKO is fundamental in Vygotsky's more well known principle; the Zone of Proximal Development (ZPD). The Zone of Proximal Development provides an explanation of how a child learns with the help of others and was defined by Vygotsky as:

"the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers. " (Vygotsky, 1978)

The ZPD is an area of a child's development that lies between the child's actual level of development and their potential level of development that can be obtained through the guidance or tuition of an adult, peer or any MKO (Smith et al., 2003). Beyond this zone children are not capable of learning new constructs as they do not possess the mental knowledge or ability to learn the constructs even with the help of a tutor. Beneath this zone, a child has the skills and knowledge to complete tasks on their own. This differs to Piaget's view that the child will reach their potential level when they are ready without any help. Vygotsky believes this can occur under the guidance of a tutor. Cook and Cook (2005) illustrated this process together with the continuation of the learning process and increasing position of the ZPD (see Figure 2.1).

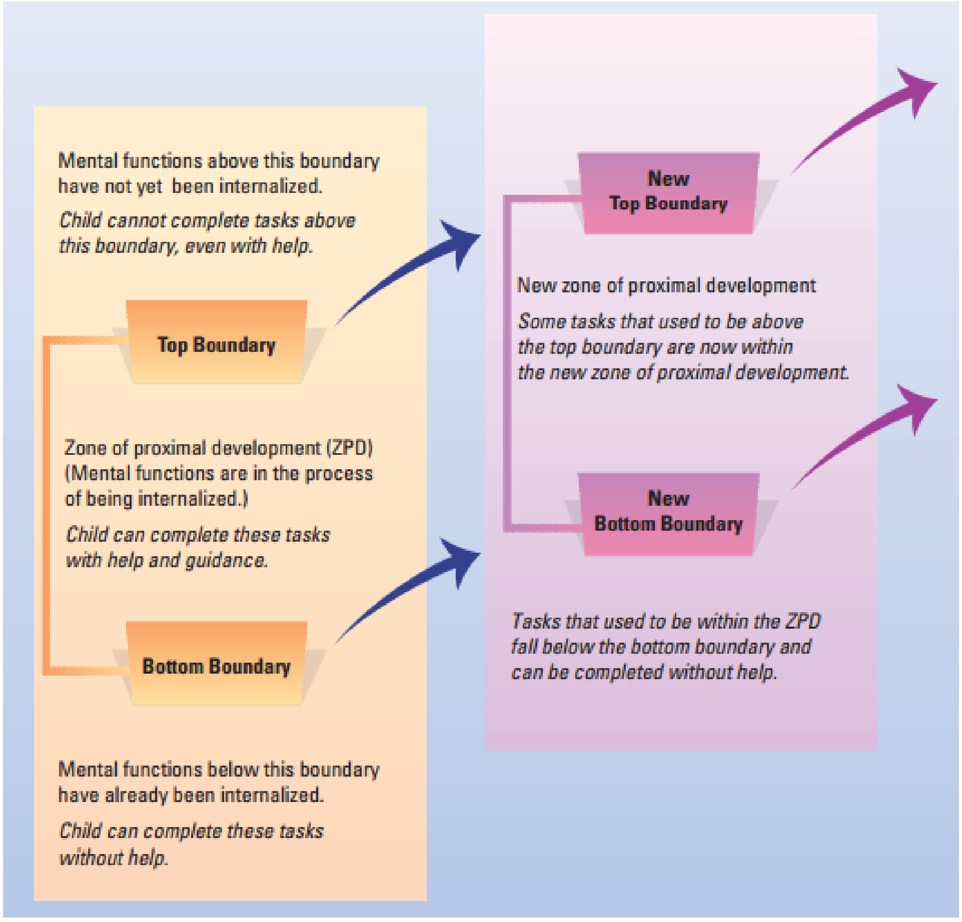


Figure 2.1: The Zone of Proximal Development (Cook & Cook, 2005)

Despite the lack of scrutiny in Vygotsky's work, Keenan and Evans (2009) state that:

"Vygotsky's theory has little to say about how children's developmental level serves to constain or enhance their opportunities in various contexts"

and they note that challenges for researchers in this area include; how goals are measured, the dynamics of groups of more than two people, and how adults and children collaborate outside of experimental settings.

2.1.4 Ethics

Morrow and Richards (1996) define ethics as a *'set of moral principles and rules of conduct'* and promote Sieber's view that ethics in research is *'the application of a system of moral principles to prevent harming or wronging others, to promote the good, to be respectful, and to be fair'* (Sieber, 1993).

Ethics are a necessary part of any research study and are vital to ensure fair and honest research is carried out. Whatever the group of subjects participating in a research study (children, adults, animals etc.), the ethical implications of the study must be addressed along with the wellbeing of the research subjects. Ethical issues are widely regarded as one of the major differences and most important factors of doing research with children as opposed to research with adults (Punch, 2002). Literature highlights three major ethical factors that should be taken into account when carrying out research with children, these being informed consent, confidentially/privacy (Lewis & Lindsay, 2000; Morrow & Richards, 1996; Punch, 2002; Thomas & O'Kane, 1998) and vulnerability (Blandford, Cox, & Cairns, 2008; Mauthner, 1997) with the latter being more generic and relevant to other subjects but vitally important for research with children.

2.1.4.1 Informed Consent

Informed consent is a much-debated area of ethics with children. In essence it is an agreement by the child, or suitable parent/carer that they are happy to take part in a research study and that this consent has been given freely. This involves the subject, or person responsible for giving the consent, receiving as much information about the research that is taking place to be able to make an informed decision as to whether they wish to take part.

The choice to participate in a research study is quite often not down to the child themselves but comes from an adult gatekeeper (parent, teacher etc.) who is responsible for the child at the time the research is being conducted (Mauthner, 1997). Often it is not that the child has not been given the right to choose, more that the child feels they do not have the right to refuse. At school, children are used to following instructions given by their teacher and participating in activities as a group and also at home they are used to obeying the directions of their parents (Backett-Milburn & McKie, 1999).

Whether or not a child should receive the right to give their own consent often comes down to the beliefs of the researchers involved in a study with some believing that children are the property of their parents and therefore devoid of any right to choose (Morrow & Richards, 1996), or not competent enough to give their consent and this must be sought by a more competent adult (Fargas-Malet, McSherry, Larkin, & Robinson, 2010). This view is not supported by all with more and more researchers beginning to understand the importance of giving each child the choice to take part in their research whether consent has been sought from an adult gatekeeper or not (Danby & Farrell, 2004; Horton & Read, 2008).

The ability to retract this consent at any time during the study should be seen as equally important as the concerns over gaining consent in the first place but is often not considered by researchers. A child should have the right to withdraw from a research study at any time whether it is because they are uncomfortable with the study or simply uninterested in continuing with it. Even if it was an adult that gave consent in the first place, the child should be able to revoke it. Often young children are uncomfortable withdrawing their consent and, particularly with younger children, it is the job of the researcher to identify when a child may wish to withdraw. Cree et al (2002) note that when carrying out research with young children, it is possible to identify whether or not they wish to take part in the research as they are capable of showing it in different ways such as crying or refusing to engage with the research (Cree, Kay, & Tisdall, 2002).

Whatever method is chosen to obtain informed consent it is the quality of the information given about the study that is most important. All involved should receive simple and concise information about the study, the participation level required, how the outcomes of the research will be used along with information about privacy and data security. It may be a case of this information being created more than once to cater for different audiences (Fargas-Malet et al., 2010). More often than not, consent gained is not ‘informed’ appropriately, particularly with the children participating compared to their adult gatekeepers. Read et al. (2013) have tried to address this through the creation of the CHECk tool which is designed to make researchers think about all aspects of a research study and how they can convey this to children.

2.1.4.2 Confidentiality/Privacy

Protecting the privacy and confidentially of children is just as, if not more, important than in research involving adults (Morrow & Richards, 1996). Although similar in meaning, privacy in research with children relates more to the collection and storage of research data whereas confidentiality covers the conversations between the child and researcher in relation to potential issues uncovered by the research regarding the potential health or safety of the child.

When collecting data in research it is easy to record data that could potentially identify the child or children involved in the study. It is therefore vitally important to consider what data is being collected, whether it could potentially lead to a violation of a child's privacy, and if personal data is being collected, is it really necessary. Even obtaining small amounts of personal information such as the name and age of a child could be enough to identify them. When this information is used with the name of the child's school for example, it is potentially possible to identify exactly which child it is. An example being if you have data for Molly aged six from Park View Primary School then it is likely that only one or two children at the school fit this profile. Even just knowing the name and school could potentially narrow down which child was involved, particularly with children with uncommon names. This leads to the question of whether or not we need to record the child's name in the first place? The use of a unique code for each child is an easy way of removing the need for a child's name and also eliminates any issues such as two children sharing the same name.

There are situations when it could be dangerous for children to be identifiable such as if the child is part of a family dispute, legal action or witness protection for example. This is perhaps a bigger issue if photographs are involved as the child and their location could be identified by a potential dangerous person in their life through an innocent photograph appearing in a research paper or publication.

Allison Druin has potentially taken the bounds of privacy to its extreme by including child members of her design team as authors in her publications (Alborzi et al., 2000; Druin et al., 1999). Within these, the full names of the children can be found, locations where they have worked, and photos of the design team which includes the children. On the current HCIL website (http://www.cs.umd.edu/hcil/kiddesign/) the photos of the current 'KidsTeam' can be seen along with their first names and other distinguishing information such as their home town, school, favourite colour, favourite food and so on. In truth many of these children are the offspring of faculty members at the University of Maryland so it is hoped that full consent has been obtained for this information to be freely available, although whether this is from the child or their parent is unknown.

There are simple precautions that can be taken to reduce potential privacy risks including:

- Only collecting personal data when it is absolutely necessary.
- Keeping any identifiable separate at all times.
- Storing all data gathering securely.
- Destroying the research data once used.
- Obtaining extra consent from schools and parents when collecting photographic, audio and video data.
- Ensuring faces of children do not appear on video or photographs unless absolutely essential.

Confidentiality has a strong connection to vulnerability in children as it is because of the vulnerability of children that confidentiality problems can arise. To reduce crossover between this subsection and the next, vulnerability will only be discussed in relation to confidentiality and will not relate to the vulnerability issues of the child during the research study or working with an adult researcher.

The major confidentiality dilemma that can be faced by a researcher is the discovery of abuse, potential mental or physical issues, or illness. It is important therefore that children are informed about the potentially limitations of confidentiality as this could have a direct effect on their informed consent (Williamson, Goodenough, Kent, & Ashcroft, 2005). The discovery of illness or signs of mental or physical issues (these could be potential disabilities such as dyslexia, asthma etc.) is perhaps easier for a researcher to deal with as they have not been caused by another person and may already be known about. Highlighting signs or symptoms associated with these to an appropriate adult carer of the child will often not affect confidentiality as such, or not in a way that could damage the relationship between the child and the researcher and will allow action to be taken by the carer (Fargas-Malet et al., 2010).

The disclosure of potential abuse or harm by a child requires researchers to carefully consider the different approaches that can be taken which may differ in different cases. As good practice, the British Educational Research Association's Ethical Guidelines of Education Research (BERA, 2011) state:

"At all times the decision to override agreements on confidentiality and anonymity must be taken after careful and thorough deliberation. In such circumstances it is in the researchers' interests to make contemporaneous notes on decisions and the reasoning behind them, in case a misconduct complaint or other serious consequence arises."

Discussing concerns with the child and how they would like to deal with it could help keep the bond of trust between the child and researcher but the researcher must be aware that breaking their confidentiality could cause irreversible damage their relationship (Morrow & Richards, 1996). Asking the child to discuss the issues with an appropriate adult negates the need to break confidentiality although if they refuse then breeching the confidentiality may be the only action. This view is not taken by all, with Hill (2006) arguing that sensitive information should only be disclosed to a responsible adult if the child has consented to it after discussion with the child first and it should never be disclosed without this consent (Fargas-Malet et al., 2010). Thomas & O'Kane (1998) took the view that *"Any disclosure of information to us during the research would be an indication that the child was ready to pass on the information to someone they trusted"* although only in exceptional circumstances would it be without the consent of the child first.

2.1.4.3 Vulnerability

Children are just one of many groups considered to be vulnerable participants in research studies (Blandford et al., 2008). Children are often considered vulnerable due to their physical size and strength, their developing cognitive abilities and their lack of knowledge and experience which together renders them dependent on the adults around them (Lansdown, 1994; Morrow & Richards, 1996).

BERA (BERA, 2011) provide guidance on the vulnerability of children, in particular:

- Researchers must ensure that they themselves, and any collaborators or research assistants and students under their supervision, comply with legal requirements in relation to working with school children or vulnerable young people and adults.

- Researchers must recognize that participants may experience distress or discomfort in the research process and must take all necessary steps to reduce the sense of intrusion and to put them at their ease. They must desist immediately from any actions, ensuing from the research process, that cause emotional or other harm.

In the UK the need for Criminal Records Bureau (CRB) checks is a legal requirement for lone working with children and many schools insist on a valid CRB form being produced by researchers whether lone working or working with children in groups.

2.1.4.4 Ethics Boards/Committees

Ethics boards and committees exist to ensure all ethical aspects of the research have been considered and they aim to provide an independent non biased view of the research and the ethical documents submitted. Their goal is not just to protect the subjects of the research but all the researchers and institution for whom they have been elected to represent (Morrow & Richards, 1996). They provide researchers with rules and guidelines to follow in order to reduce any ethical issues or problems that could arise from carrying out research where the ethics could be questioned. Morrow and Richards (1996) highlight an important point by noting the dangers of assuming a piece of research is ethical just because it has been passed by an ethics committee.

2.2 Child Computer Interaction

Child Computer Interaction (CCI) is an area of Human Computer Interaction (HCI) that specifically focuses on the interactions between children and technology. The community is also known under the guise of Interaction Design and Children (IDC) although for the most part these two communities are one in the same. Most of the underlying methods and theory within the area originate from HCI although these methods are often modified for use specifically with children. Due to the nature of children, and their development, the area is also strongly linked with other disciplines such as psychology, education and computer gaming. CCI is a relatively new discipline with the majority of the research in this area being carried out within the last 10 years. However, the first major works in this area date back to the late 1970's and early 1980's with Papert's work on the Logo programming language (Papert, 1978), Lego Mindstorms (Papert, 1980) and his constructionist child development theories (Papert, 1988), Papert is widely accepted as the originator of CCI as a discipline (Druin, 2002; Read & Bekker, 2011). Like its parent domain of HCI, CCI is weakly defined - Read and Bekker (2011) defined CCI as *"a study of the Activities, Behaviours, Concerns and Abilities of Children as they interact with computer technologies, often with the intervention of others (mainly adults) in situations that they partially (but generally do not fully) control and regulate"* in a paper capturing the nature of CCI as it currently stands.

CCI arose from the realization that children cannot just be considered as small adults. Their needs, abilities and expectations are different from adults and children of different age groups, and need to be taken into account. Because of this, research methods used with adults are often not effective when done with children without modification.

2.2.1 The Emergence of CCI and IDC

Although the origins of CCI date back to the 1970's and 1980's it was the work of Allison Druin in the late 1990's that really began to bring this area to the forefront. Druin established Chi-kids community as part of the ACM SIGCHI group that ran at HCI's largest conference series CHI between the years of 1996 and 1999.

In Europe it wasn't until a workshop in 2002 on Interaction Design and Children, (Bekker & Markopoulos, 2002; Markopoulos, Read, Hoÿsniemi, & MacFarlane, 2007) run by a research group at the Technical University of Eindhoven, that the area really began to form its own identity. Following on from this workshop, that was attended by 100 participants (Read & Bekker, 2011), the international conference on Interaction Design and Children was first run at the University of Central Lancashire in Preston, UK. The conference has since been held across the globe, annually with the most recent being IDC2013 in New York, USA.

In 2008 a special interest group (SIG) on CCI was proposed and accepted (Read, Markopoulos, Parés, Hourcade, & Antle, 2008) at the CHI conference CHI2008 held in Florence Italy. Since then the SIG has been granted its own CHI community (Read, Markopoulos, & Druin, 2011). An IFIP SIG was established in 2009 (http://www.idc-sig.org) under the TC13 Group and CCI has recently (2012) been granted its own International Journal of Child-Computer Interaction which is published by Elsevier.

2.2.2 Major Themes of CCI

The major themes in CCI research are, not surprisingly, evaluation, design and research methodology. In the area of evaluation, early studies focused on the performance of children using devices and technologies that had in general been designed for use by adults and certainly not designed specifically with children in mind. Revelle and Strommen (1990) found the mouse to be superior in a study looking at the effects of practice on input devices with children which was supported by Jones (1991) who concluded the mouse as being the easiest to use when evaluated against the joystick or trackball. Inkpen (2001) found children performed better and produced fewer errors when using point and click to drag and drop. In recent years, this focus has shifted towards user experience evaluation studies where the experience of children using software, devices, and technologies has been used to improve the design of such products, or confirm their suitability and appeal with children. Vanden Abeele, Zaman, and De Grooff (2011) used their Laddering methodology to compare three cuddly toy interfaces. This method identified the preferences the children had with the different tangible aspects of these interfaces. Hourcade et al (2013) compared apps on a tablet computer with similar none app based applications in an evaluation that showed tablet apps can improve the social interaction of children with autism. In 2008, Markopoulos et al (2008) wrote the first book specifically focused on evaluation studies with children.

In design, there has been a significant focus on designing with children (Scaife, Rogers, Aldrich, & Davies, 1997; Mazzone, Xu, & Read, 2007; Sluis-Thiescheffer, Bekker, & Eggen, 2007) with the extensive early work by Druin on participatory design (Druin, 2002; Druin, 1999b) and co-operative enquiry (Druin, 1999a) being highly influential in advocating the involvement of children in the design of interactive products and technologies. Other design work predominantly focuses on the design of novel interactive technologies for example the Water Games (Parés, Durany, & Carreras, 2005) and the Ambient Wood (Rogers et al., 2004).

Several seminal papers have reported new methods and adaptations to old methods (Barendregt et al., 2007; Markopoulos, Read, Hoÿsniemi, & MacFarlane, 2007; Bekker, Beusmans, Keyson, & Lloyd, 2003; Read & MacFarlane, 2002; Zaman & Abeele, 2010). The CCI community is relatively young and is still exploring research methods that can be used in this area. In 2005 a workshop on methodological methods in CCI was held at Interact and from that workshop, some key papers emerged including a study of research methods (Jensen & Skov, 2005), methods for evaluating interfaces by inspection (Baauw, Bekker, & Barendregt, 2005) and by survey (Read, 2007). Although new methods have emerged there is still a lack of child specific methods being used or developed in this field. Jensen and Skov (2005) highlighted the need for new methods and greater detail from researchers in describing methods that have been used. In 2011, the CHI community established by Read, Markopoulos and Druin (2011) set out the following as one of its key aims:

"At CHI, the CCI community will want to attract papers and contributions that represent real advances in the understanding of, or development and refinement of methods for, child computer interaction."

More recently, a workshop was run at CHI2013 (Read, Horton, Iversen, Fitton, & Little, 2013) with the specific aim of filling an identified gap in teenage specific research methods by:

"bringing together practitioners and academics that have developed and used novel methods for carrying out research with teenagers in the interactions design area. The workshop will also refine and develop existing methods, create new methods, foster new collaborations, and define new research agendas to grow the research and literature in this area."

2.2.3 Unknowns of CCI Research

Research in CCI is often very innovative, especially in regards to what is measured when evaluating children's use of different technologies. Fun and learning are two such areas that are very important to the successful interaction with technology by children (Blythe, Overbeeke, Monk, & Wright, 2004). These alone bring up some interesting questions.

- How do we measure fun?

- What causes something to be considered fun?
- What are the children meant to learn?
- Has a specific technology assisted in their learning?
- Does fun affect learning?

With many factors affecting these questions it is easy to see why researchers have questioned whether it is possible to measure such factors and also why there are many questions about the validity of the results produced (Sim et al, 2006; MacFarlane et al, 2005).

With fun we must firstly look at what the term fun means and is it actually fun that we are trying to measure or something similar such as satisfaction. The context the task has been carried out in can also be very important, for example, the location alone could have an effect on whether a child finds a task fun.

Measuring learning has similar ambiguities to that of fun. This is especially true of a technology that is designed specifically to teach a child. Children are learning all the time and often a task designed to teach a specific skill requires a child to use or develop other secondary skill sets. An example could be a mathematics computer game requiring the use of mathematic symbols and numbers on a keyboard, therefore improving a child's keyboard skills at the same time. One must also consider additional subject learning when measuring learning. This is where a child may be using an application to help learn a subject but the child is also being exposed to other learning materials for the same subject.

The final point to consider is whether fun affects learning and learning affects fun. Studies show that if a child is having fun whilst doing a task then he or she will be more engaged with the task which in turn can lead to a greater level of learning (Bisson & Luckner, 1996). So does this mean that if a child is having fun, he or she is learning more and therefore can fun be used as a measurement of learning.

In support of this view, Rose and Nicholl (1997) state that *"a brain enjoying itself is functioning more efficiently"* implying that it is more effective at learning in this state. Ackerman (2000) goes as far as saying that *"Play is our brain's favorite way of learning things"*. However, this view is not universal. Bloom and Hanych (2002) warn that linking learning and fun suggests that if a person is not having fun then they are not learning. In relation to HCI, Setzer and Monke (2001) view the fun aspect of a computer as an artificial stimulant that covers up children's distain for learning, making it more palatable.

The intersection between fun and learning is therefore especially influential in CCI as it creates a new landscape for research. Whilst HCI is sometimes also concerned with this space, typically HCI work is focused around task oriented systems designed for people for whom little learning is taking place. There is a need to plan experiments very carefully to eliminate as much interference from external forces whilst also making sure that the research is looking for exactly what it is supposed to. If several methods are available then there is a need to use more than one to help increase the integrity of the results by showing consistencies or inconsistencies in the results between the methods used.

2.2.4 The Future of CCI

Technology is changing constantly and the speed of this technology change is getting faster. The children of today are different from children 10 years ago. Tasks that the previous generation of children had to learn as new technologies emerged are becoming natural to the current generation, as the new technologies are now the old technologies that this generation has grown up alongside. Children are becoming the owners and users of personal computers, mobile phones, music players, games consoles (Dutta & Mia, 2011) from earlier and earlier ages and the community will have to adapt not just to the new and emerging technologies, but to the new and emerging children growing up with different skill sets to those of their predecessors. Methods will need to be modified, new methods created, and assumptions challenged and updated due to these constant changes.

As previously discussed there is certainly a need for more child centered research methods within CCI. Methods that have been designed specifically for use with children are tested against methods designed for adults, an unfair comparison as these methods are designed for different user groups, showing child methods to be more effective as would be expected. There are pockets of research beginning to emerge to test and compare child centered methods such as Sim and Horton's (2012) study comparing two child centered evaluation methods, the Fun Toolkit (Read &

MacFarlane, 2002) and This and That method (Zaman, 2009) showing that both methods produced comparable results. The need to do more of this type of research has recently been acknowledged by the community. Finally, design and evaluation studies tend to focus on specific user groups such as adults or children but often do not take into account technologies or interactions that may require more than one of these user groups, potentially at the same time.

2.3 Summary and Conclusions

The primary aim of this chapter was to examine the current literature on doing research with children. Although the term ‘child’ covers people up to the age of eighteen, the research in this thesis focuses on children between the ages of seven and eleven and therefore the majority of literature discussed is based on this age range.

The major issues associated with doing research with children, including ethical ones, are identified as these must be considered when doing any research with children and therefore must be considered at all stages of the research carried out in this thesis, and not just as part of the contributions to survey methods that are proposed.

As such, the research carried out within this thesis will take place when possible within the schools where the participating children attend (Jensen & Skov, 2005). When research is conducted within the university, the specialist labs run by the Child Computer Interaction Group will be used as these have been specifically set up with children in mind (Hanna et al., 1997). All research studies with children that are carried out will be conducted by the author the using skills and knowledge obtained during 10 years’ experience in this area to minimize any researcher bias. Teachers will not be permitted to interact with the children during the research studies but will be allowed to be present in an observational capacity. The language used within studies will again be influenced in large from experience gained from conducting research with children, and where necessary both teachers and children will be consulted to further minimize any effect language issues could cause. Language will also be revisited in the literature relating to survey methods and children.

The child development theory of Piaget is essential to the survey research methodology that is important to this thesis and therefore has been set out. Problems, and disagreements, with Piaget’s theory have also been identified highlighting that the use of this theory may well not fit survey research with children as well as Borgers et al (2000) intend it to. It is hoped that any discrepancies in the findings reported, compared with the work of Borger’s and colleagues, can be explained, at least in part, by these issues. The work of Vygotsky was also included as it follows many similarities with the work of Piaget although has some clear differences that appear to be more in line with the research methods employed within the field of CCI today, predominantly relating to the use of a more knowledgeable other. From conducting research with children for the last ten years it has become apparent that the need for a researcher to be present is vital to ensure the smooth running of the study and act as an MKO when required. The level of scaffolding required in these situations varies from child to child, study to study, but in all cases having the person there is no less important.

Ethical considerations will take a high priority during the work undertaken. As previously acknowledged, ethical approval was granted for this work. Consent of participation will be gained for each study from both the teachers at participating schools and the children themselves. Both the teachers and children will also be given full information in which to make an informed decision (Fargas-Malet et al., 2010), and both groups will be given the opportunity to revoke that consent at any point. Care will be taken to observe children during participation in an attempt to identify children who may wish to cease participation (Cree et al., 2002) but are too nervous, or scared, to convey this.

All research data will be stored within a locked room on the university campus and will only be analysed in this location. Analysed data will be stored on password protected computers and codes will be used to identify unique participants. Personal data will not be collected from children unless deemed essential for analysis purposes and no photographs or videos will be taken. The details of schools participating in studies will also be codified and kept separate from the study data. It is hoped that no sensitive information will be disclosed by children during this work. If such an incident does occur then this will be judged case by case as to what actions should be taken. A detailed write up of the whole incident will be created and supervisors will be informed of what has occurred.

It is intended that the contributions set out in chapter 1 of this thesis will be written up into academic publications so that the CCI community can benefit from this work.

One such contribution of this thesis is a set of guidelines for the creation and administration of surveys with children, some specific to surveys themselves, and some more generic guidelines concerned with carrying out research with this unique age group. It is not the case that these guidelines will be created from scratch. The guidelines will be brought together from existing good practice identified within the academic literature, existing related guidelines by other authors, and as a result of the studies conducted within this thesis. The important points, predominantly related to generic survey research with children, identified within this chapter come from existing literature and are therefore identified with the code LR (short for literature review). These important insights will be used to inform the research studies carried out within this thesis (as discussed previously in this section) as well as forming part of a more complete guideline set in chapter 7.

The key insights identified in this literature chapter are:

LR2.1 **Location of studies –** studies should be carried out wherever possible in a location that is comfortable to the child such as school or their home. If a study has to be carried out in a research laboratory then steps should be taken to make the location more child friendly such as making the laboratory look more like a school classroom or adding items such as toys, or sofas, in an attempt to minimize any anxiety that could be experienced by a child in unfamiliar surroundings.

LR2.2 **Researcher effect –** it is important to build up a relationship with children prior to carrying out a research study. This can help decrease biases such as a child trying to please the researcher by breaking the traditional unequal power relationship between adults and children.

LR2.3 **Perceived preference** - reducing positive and negatives in questions, misleading gestures, and other factors that can lead children to perceiving a preference in the response wanted by a researcher.

LR2.4 **Language skills –** children use different language to that of adults so it is important to phrase research and questions in a language that children are familiar to. As children are developing these skills constantly different versions may be required for different age groups.

LR2.5 **Study length** – children have relatively short attention spans so ideally studies should be kept to 30 minutes or less and must never go over an hour.

LR2.6 **Inclusion –** children are used to inclusion and therefore all children in a group should be given the opportunity to participate in a piece of research even if their results are not going to be included. Exclusion can cause undue stress on children that is easily prevented in this way.

LR2.7 **Consent** – all children should be given enough information about a study to be able to give consent. It may be necessary to gain consent from gatekeepers also but the children are most important. They should also be given the option to revoke that consent at any time.

LR2.8 **Privacy –** ensure that only personal data that is essential to the study is collected. All data from studies should be held in a secure location, only used for the purposes consent was given for, and should be destroyed once the study is concluded.

LR2.9 **Confidentiality** – children should be informed about the confidentiality of the research and any cases where the researcher may consider breaking this confidentiality.

LR2.10 **Vulnerability –** researchers must comply to the legal requirements of working with children and be trained to interact with children effectively in research, and to notice signs of anxiety or stress in children and how to deal with this.

The next chapter presents a review of the important concepts of survey methodology, survey methods and techniques used with children, and guidelines into conducting surveys with children.

3 CHAPTER 3: SURVEY METHODS

This chapter introduces the concept of prior experience before presenting a review of the important concepts of survey methodology. Section 3.1 introduces prior experience as a key component of this research leading into the need to understand the survey methodology literature to assist in this. Section 3.2 begins with an introduction to what surveys are followed by a brief history of the use of surveys in society. Different survey instruments are then introduced (Section 3.3) followed by an introduction to populations and sampling techniques focussing on the sampling method to be using within this thesis (Section 3.4). Section 3.5 defines what a variable is and focuses on the importance of minimising the effects of confound variables. Question types are then introduced focussing on the difference between open-ended and closed questions, and the relative merits and issues with both methods (Section 3.6). The importance of pretesting surveys is introduced with ways to improve questionnaire design during this phase (Section 3.7). Section 3.8 and 3.9 introduce the concepts of validity and reliability which are vital to ensure a survey measures what it is supposed to measure and has consistent results.

Section 3.10 looks at the literature on survey methods with children and on specific child friendly survey techniques that have been created in the CCI domain, including the Thumbs-up scale and Frequency of Use scale (Section 3.10.1). How children answer questions comes next, focussing on the question-answer process and the effects child development has on this (Section 3.10.2). Satisficing theory is then introduced and related back to the question-answer process (Section 3.10.3) before a look at the literature on how children cope with different question types (Section 3.10.4). Section 3.10.5 finishes off the literature on survey methods with children by coming back to the important issues of prior experience surveys with this age group.

Section 3.11 introduces issues that still appear to exist when carrying out surveys with adults and looks at the similarities between conducting research with children and older adults. Section 3.12 introduces some pre-existing guidelines of survey design with children followed by a summary of the chapter and conclusions including the key contributions coded.

3.1 Prior Experience

When describing a population for a design study, evaluation, or experiment it is commonplace to provide information about the prior experience of the population in their use of a technology or in carrying out specific tasks (Lee, 1986; Shiue, 2003). This is necessary to design for skill transfer across different interfaces, to provide insights into how the subjects understand metaphors, and to balance participant groups in between subject or within subject studies. In the context of an interaction design process, such information can also be used to profile users, develop personas, and eventually inform design decisions.

Within the HCI community there is a tendency to use low cost methods to gather information about experience such as quick short questionnaires asking participants for dichotomous yes/no responses to questions such as *'have you used a computer before?'*. Reporting the time a device, or application, has been used for is another common idea with many surveys using simple Likert-type scales that ask participants to grade their usage on a scale (Inkpen, Ho-Ching, Kuederle, Scott, & Shoemaker, 1999; Jansen, Bos, Vet, Huibers, & Hiemstra, 2010; McCarthy, Sasse, & Riegelsberger, 2004).

More rigorous methods of gathering prior experience do exist (Bunz, 2001; Czaja et al., 2006; Miller, Stanney, & Wooten, 1997; Panero, Lane, & Napier, 1997) but typically these methods are often not used in HCI as researchers are concerned with the overheads, such as time, costs, and the effects on the reliability of participant responses due to factors such as boredom and satisficing, encountered when carrying out long questionnaires and surveys. As a result, in HCI, we end up with researchers discussing their results using weak justifications for their insights and contributions and thus undermining the quality of their research.

It would be wrong to suggest that prior experience is always gathered badly. It may be the case that a good rigourous method has been used, but that this has not been reported with sufficient rigour or detail to allow its replication (Fu, Xia, & He, 2010; Mattila, Väätänen, Box, & Vtt, 2006; Van Nimwegen, Van Oostendorp, & Tabachneck-Schijf, 2004). This poor reporting means that research cannot be replicated and thus leaves the HCI research community reduced.

In order to improve the reporting of prior experience it is important to fully understand the important concepts of survey methodology, first so these can be applied generally, and secondly so they can be applied to children as this user group is the focus of the work in this thesis.

3.2 Introduction to Survey Methods

Fink (2003) defines a survey as *"a system for collecting information from or about people to describe, compare, or explain their knowledge, attitudes, and behavior"*. In short, it is a data collection technique that is used to gather information from, and about, individuals.

The earliest type of survey known to have been conducted is the census, the first of which can be traced back to the Babylonian civilisation as early as 3800BC (Missiakoulis, 2010). More recently surveys have been carried out to help understand specific social problems, an early example being the Charles Booth's survey into life and labour in London in the late 19th century (Groves et al., 2009). This was followed by a growing need to gather people's opinions; spurred on by journalists and market researchers who were interested in the views of the typical 'man on the street'. Today, survey methodology and the use of surveys has become multidisciplinary within the scientific field with examples predominantly being found in areas such as psychology (Sudman, Bradburn, & Schwarz, 1996; Gullone & King, 1992), health (Ware, Kosinski, & Keller, 1996; Chan, Orlando, Ghosh-Dastidar, Duan, & Sherbourne, 2004), sociology (Finch, 1987; Maynard & Schaeffer, 2000) and mathematics (Bethlehem & Keller, 1987; Konovsky, Jaster, & McDonald, 1989). Survey methodology does not solely belong to the scientific community; vast amounts of work in this area are carried out by governments who produce survey reports into the popularity of policies, opinions of potential voters and needs of certain communities for example. There are also professional organisations that carry out independent market research for companies, and opinion polls that are used by the media.

Creating and administering a survey may seem simple in theory, ask some questions, then analyse the answers received and use the results. In practice, the creation of a successful survey takes a lot of time and careful planning. Mitchell and Jolley

(2010) identify three objectives that must be met in order to conduct a successful survey:

- Know your research hypothesis before you create the survey in order to know exactly what you want to measure.
- Ensure your survey is able to accurately measure the feelings, opinions, or behaviours that you wish to measure.
- The results produced must be generalizable to a certain population.

This section of the thesis uses literature to understand and explore the important concepts of survey methods that will be used later in the thesis to aid in the creation of child friendly surveys to elicit the self-report of technology use to understand the prior experience of children.

3.3 Survey Instruments

There are many different methods for conducting survey research with these methods falling into one of the two categories of survey instrument; the written survey (questionnaires) where responses are written down by the participant, and interviews, where the questions are verbally given to the participants who then provide their responses orally (Markopoulos, Read, MacFarlane, & Hoysniemi, 2008; Mitchell & Jolley, 2010). Psychological tests and telephone interviews are two such methods but are not relevant to the work in this thesis; for more information on these please refer to Appendix 8, in the next sections methods relevant to this work are further explored.

3.3.1 Questionnaires

Questionnaires are used to gather written information. The most frequently used method of carrying out a questionnaire is by self-administration. A self-administered questionnaire is read and completed by its participants without the involvement of an administrator. Traditionally, research into this type of survey has tended to focus on the use of postal questionnaires (Adamson, Ben-Shlomo, Chaturvedi, & Donovan, 2003; Mallen, Peat, Thomas, & Croft, 2005; Blais, 2009) where the cost of administering the questionnaire to a large number of participants is very low when compared with methods where an administrator is involved. However, costs still exist and therefore self-administered postal (or more likely these days email) surveys are not seen as appropriate for the work in this thesis. Several schools have agreed to participate in this work which negates the need to survey children by post as any questionnaires created can be delivered to a large number of children at their schools requiring no postage costs.

Self-administered questionnaires are considered to be invaluable when a large number of participants is required and where control over the sample of a population is not deemed to be too important. When considering the use of these with children, one of the major drawbacks to this technique is the lack of an administrator to aide in the completion of the questionnaire supporting Vygotsky's child development theory, discussed in chapter 2, where a more knowledgeable other (MKO) is available, and required, to assist when a person is unsure. Respondents are being asked to answer questions that have a certain meaning and purpose to the researcher and research study which may differ to the perceptions of the respondent of what the question is asking (Jenkins & Dillman, 1997). Without an administrator being there to interact with the respondent this type of problem is hard to identify and impossible to correct meaning that the answers given by some respondents could actually be to a different question than what the question was meant to ask (Mitchell & Jolley, 2010).

The alternative to self-administered questionnaires are investigator-administered questionnaires which are completed by respondents under the supervision of an administrator, or investigator, who may, or may not, be the individual who designed the questionnaire. As previously highlighted, the major advantage of this method is the presence of an administrator (or MKO) who is available to clarify any points in which a respondent may be confused or unsure. The presence of an administrator can also act as an encouragement to make respondents complete the questionnaires and therefore has been found to increase response rate (Mitchell & Jolley, 2010). A negative aspect to this type of questionnaire is the potential effect the presence of the administrator could have on the responses of respondents. The administrator could inadvertently cause the respondent to feel less anonymous and therefore provide less honest responses, or the administrator could possibly give unintentional facial expressions that sway a participant to answer in a certain way.

3.3.2 Interviews

The main difference between interviews and questionnaires is that interviews allow direct discussion to take place between an interviewer and participant (interviewee). Perhaps the biggest advantage to this technique over questionnaire surveys is that participants are able to provide detailed and rich responses that would often be lost, or incredibly stifled in a questionnaire (Lazar, Feng, & Hochheiser, 2010). How rich and deep these responses can actually be often depends on how structured the interview is (see Appendix 8).

Perhaps the biggest disadvantage of using interviews is the time it takes to administer them (Lazar et al., 2010). Interviews only allow one participant to be interviewed at a time and the process of turning interviewers notes and recordings into responses to specific questions can take many hours for each hour of interview (Robson, 2002). The personal nature in carrying out interviews can also lead to interviewer bias whereby the interviewer, whether intentionally or not, influences the response given (Mitchell & Jolley, 2010). This can be further exacerbated by participants wanting to impress, or nor upset, the interviewer leading them to give answers they think the interviewer wants to hear rather than telling the truth (De Leeuw, 1992).

3.4 Populations and Samples

In survey research, a population is the entire group of people that one would aim to survey. Whether this be every person in the UK, or simply every child in a class, the population includes every single person belonging to the group that the survey is looking at. Due to sheer size or difficulty in accessing the whole group, it is extremely difficult, and often impossible, to survey an entire population (de Vaus, 1994; Langridge & Hagger-Johnson, 2009).

A sample can be thought of as a group of people chosen to represent the population that it is aimed to survey. The purpose of surveying a sample of the population is that this smaller group will provide an accurate representation of the entire group. A representative sample should contain people with the same characteristics as the population to be studied as a whole. These characteristics could be in the form of demographic information, habits, and computer experience to name but a few. Oppenheim (2005) highlights that often in survey research, the size and demographic information of a population may be unknown as, for example, we may want to interview all people who own a computer at home in the UK. We have no way of knowing how many people own one, the demographic makeup of these people is also unknown, and the location of owners is not known – so choosing a sample that is representative can be problematic. In this case, strict probabilistic sampling cannot be carried out.

There are many different sampling methods such as random, snowball, and convenience sampling which can be employed in survey research. More information on these can be found in Appendix 8. The work in this thesis involves the creation of a set of surveys for use by the research community. It will be the job of the researchers who adopt this survey set to decide how their sample is chosen. The studies conducted within this thesis will likely use a non-probability sampling technique such as convenience sampling where the choice of children will often come down to the school that is involved in a particular research study.

Non-probability sampling is used when the use of probability sampling techniques are not possible or are unnecessary (de Vaus, 1994). Within HCI, Lazar et al (2010) note that there is a long history of using surveys without probability samples and this is considered to be just as valid due to the lack of data-sets of populations. HCI researchers often have to find users, collect the data, and analyse it themselves which is often not the case in other disciplines. In the preliminary stages of research it is often acceptable to use non-random samples for example when designing and pre-testing questionnaires. Other areas where probability sampling is deemed unnecessary, that are relevant to this thesis, include:

- Scale development.
- Obtaining ideas about the range of responses given.
- Exploratory research looking at patterns in responses.
- Hypothesis generating surveys.

(de Vaus, 1994)

3.5 Variables

In its simplest form, a variable is simply something that varies. Within survey research this variable is something that we wish to measure or has an effect on what we wish to measure. One of the key starting points in creating a survey, and considered to be one of the most important factors in creating a successfully survey is knowing exactly what we want to measure, exactly what variable we wish to measure, and what variable might affect it (Oppenheim, 2005). The reports of technology use and prior experience, as are the focus of this thesis, may often be used as independent variables (see Appendix 8) which is why it is so important to make sure these are done as accurately as possible to enable inferences and assumptions to be made to support a hypothesis or confirm a result.

Confounding variables are particularly important as they can affect the results of a survey unintentionally. If a survey was looking at children’s concentration within different lessons at school then the time of day might be a confound variable as the results may show that children are more attentive in, say, Geography than Maths, but if Geography is the first lesson in the morning, and Maths is last lesson of the day then the result may be because the children are more tired at the end of the day, rather than because they find Geography more appealing. A key issue in survey design is minimising, and if possible, eliminating confound variables by a process of exclusion, keeping them constant, or randomisation (Oppenheim, 2005).

3.6 Question Types

3.6.1 Open-ended Questions

Open-ended questions allow participants to answer questions in their own words using as much or as little information as they see fit. Researchers who advocate the use of this type of question highlight the spontaneity from this type of question giving clues as to the most salient information that is in a respondents mind at the time (Foddy, 2001; Oppenheim, 2005). They allow for unexpected answers that are not possible within closed questions and can be a measure of the knowledge of respondents, together with their feelings on a particular topic (Fowler Jr, 1995; Foddy, 2001). Sometimes participants may have different reasons for giving the same answer to a question which again will be lost in a closed question (Mitchell & Jolley, 2010).

Open-ended questions also have their downsides: Participants can often find them hard to answer and therefore are more likely to skip these types of questions (Mitchell & Jolley, 2010; Oppenheim, 2005). Many people have difficulties in putting their thoughts and ideas down on paper; this advocates the use of this type of question more in interviews than questionnaires (de Vaus, 1994). Within interviews, these questions can cause problems with interviewer bias as respondents are more likely to satisfice when probed for more information and explanations into their answers. Probing also opens up the potential to turn open questions into closed questions if done poorly (Foddy, 2001). Perhaps the most important issue with open-ended questions for researchers is the coding of the data. The sheer volume and variety of answers that can be recorded and the associated time and complexity of coding these questions is well documented (Groves et al., 2009; Lazar et al., 2010; Oppenheim, 2005; Foddy, 2001; Fowler Jr, 1995).

3.6.2 Closed Questions

Closed questions can only be used in surveys where all possible answers are known in advance and therefore can be presented as the response choices (Rogers, Sharp, & Preece, 2011). The main advantages to using this type of question is that for the researcher they are much easier to code than open questions and for the participant they are much easier to answer (de Vaus, 1994; Oppenheim, 2005) as they require no writing, often only the ticking of a box or circling of a word, and answers in interviews are limited to the options given. This simplicity allows for more questions to be asked within a time period which is advantageous as it can reduce the cost of a survey or make it appear to offer more value for money. Drawbacks to closed questions often stem from the need to limit users to a small number of predefined choices (Lazar et al., 2010). Not all closed questions have this problem as questions asking for information such as the sex of the participant or yes/no questions only need to provide a few set responses. If the option set is not complete the options given will often push the participant to give an alternative answer introducing bias into a survey. The answer that is selected may be different to that given by the respondent if the question was asked in an open format, potentially forcing them to choose a response they did not want to give (Oppenheim, 2005). A way to partially combat this is by introducing an opt out option such as *'other'* or *'don't know'* allowing the participant to choose this response when the options presented are not acceptable (de Vaus, 1994; Rogers et al., 2011).

3.7 Pretesting

Pretesting, or piloting as it is alternately known, is the only way to evaluate surveys in advance to identify problems with the survey or with the questions being asked (Presser et al., 2004). It is not simply a case of pretesting each question, the questionnaire as a whole must also be evaluated (de Vaus, 1994). There are different opinions as to the number of respondents required to carry out a successful pretest with Fowler (1995) advocating between 15 and 35 and Sudman (1976) advocating between 20 and 50 although Presser (2004) does highlight the fact there is no scientific evidence to support these numbers. Where pretesting with typical respondents it not possible, Rogers et al (2011) recommend getting colleagues and peers to complete and analyse the survey as they may find at least some of the problems that could be encountered.

Although respondents are used in pretesting it is often the evaluations done by the interviewers or administrators, during pretesting, that provide the most information. This includes the unearthing of practical problems in administering the survey and considerations about the length of time it takes participants to complete (Fowler Jr, 1995). What a researcher expects to happen in a survey, or how a respondent might interpret a question, is likely to differ from what happens in reality (Lazar et al., 2010) and therefore even in questionnaire pretesting it is recommended that an administrator sits with the participants while they repeat the survey (Langridge & Hagger-Johnson, 2009). De Vaus (1994) identifies three stages in the pretesting process:

- Question development.
- Survey development.
- Polishing the pilot test.

Question development concerns issues such as establishing how to correctly phrase each question, ensuring that respondents accurately interpret the questions, and that, in closed questions, the range of responses is sufficient. *Survey development* involves analysing the responses received together with comments from the administrator to make improvements. *Polishing the pilot test* delivers the final revision of all the questions, the reordering of the questions if required and, with respect to questionnaires, the final layout of the survey.

3.8 Validity

Within a scientific study, validity is when a study accurately measures what it has set out to measure. Within survey research, it is the extent to which a measure relates to the underlying construct is trying to measure (Groves et al., 2009). Validity is often looked at in two ways, external and internal. External validity is the extent that the results of a study are generalisable to a group, or groups, other than the sample that participated in the study. Internal validity refers to the rigor in which the study has been developed and conducted. De Vaus states that there "*is no ideal way of determining the validity of a measure*" (de Vaus, 1994) but goes on to discuss the three main methods in which to accomplish it:

- Criterion validity
- Content validity
- Construct validity

Reliability, which will be discussed in more detail later in this section, is also a necessity to insure validity, although it is well documented as not being sufficient in itself (Langridge & Hagger-Johnson, 2009; Oppenheim, 2005).

3.8.1 Content Validity

In its simplest terms, content validity is the verification that a measure actually measures what it is intended to do so. If a test was designed to measure science but all the questions were related to biology then the test would not have content validity as it neglected both chemistry and physics.

To measure content validity it is necessary to have the questions of a survey judged by experts in the field to ensure that it covers all aspects of the construct that is being measured and does not contain questions that are repeated or unnecessary. By using experts content validity is quite subjective in that is relies on their opinions.

However, it is deemed necessary as it ensures important questions have not been missed (Langridge & Hagger-Johnson, 2009).

3.8.2 Criterion Validity

Criterion validity is measured by comparing how well a test correlates with another test, measuring the same construct, which has already been proven to be valid. This is useful if another measure does in fact exist. However, if it does, criterion validity asks the question of why the new measure is being created. Often a test is created as no test exists to measure the construct in which case criterion validity cannot be used. If an existing method does exist it is important to ensure that it is itself valid as a test could be rejected or altered unnecessarily due to the method it has been measured against being invalid and therefore the results produced are different (de Vaus, 1994).

3.8.3 Construct Validity

Construct validity, in its essence, is the measure of observable or physical traits that supposedly reflect the underlying, theoretical, construct. It is the extent to which what is to be measured is actually measured. A crude example of this could be if we are measuring a person’s weight we would use scales and not something else such as a tape measure as it is accepted that scales are an accurate way of measuring weight whereas a tape measure is not; by knowing a person’s height we cannot say how much they weigh.

To ensure that a piece of research has construct validity, Carmines and Zeller (1979) identify three stages:

- The theoretical construct must be defined.
- The empirical relationship between the construct and the measure must be examined.
- The result must then be analysed to show how it clarifies the validity of the construct being tested.

3.9 Reliability

One of the underlying themes within the literature so far in this thesis has been to improve reliability. Whether this be in understanding the problems in doing research with children, or in understanding the nuances of survey methodology, the end goal is to do things correctly whilst trying to minimise any problems that could be caused by the survey, the participants, or the administrator. All of the advantages and disadvantages of using specific techniques, reports of problems encountered (and their solutions), and literature on how we can reduce errors and biases help provide a route to a more reliable survey.

It is interesting how the stability of responses is regarded as a good measure of reliability (Groves et al., 2009), by looking at the consistency of responses between two questions asking basically the same question and yet redundancy in a questionnaire is seen as negative (de Vaus, 1994) being something that can frustrate participants and provide little benefit in the analysis of results. One of the easiest and most effective ways of gathering reliable responses is to use questions that have been proven reliable in other tests. If the participants or context of these questions are different to those of the survey being developed, they may be less reliable and need adapting in some way but they are a least a good starting point. An effective measure of reliability is the test-retest method where that same questions are asked to the same participants over a period of time and the results are compared to see if they are consistent (Langridge & Hagger-Johnson, 2009; de Vaus, 1994). Pilot testing is perhaps the best way of improving the reliability of a survey (as discussed previously) but it is noted that where scientific tests can be performed to help confirm it then that can only be a good thing.

3.10 Using Survey Methods with Children

Survey research has traditionally been carried out with adults even when researchers are trying to gather the opinions and behaviours of children. Although methodological knowledge on how to conduct surveys with children is scarce, the belief that proxy reporting is no longer good enough is growing and that knowledge has indicated that wherever possible this data should be collected directly from the children themselves (Borgers et al., 2000). Early research by Tizard (1986) highlighted that often children are able to provide more reliable information about themselves than adults who are close to them such as their parents and teachers.

Fortunately within CCI, surveys are used with children - predominantly to gather requirements for design or in the evaluation of software and technologies (Read &

MacFarlane, 2006). Child friendly research methods in these areas have been created or adapted from traditional adult methods, but the creation of child friendly survey methods is scarce. That is not to say pockets of research in this area do not exist, in 1999 Hanna, Risden, Czerwinski, and Alexander (1999) introduced a simple visual analogue scale (VAS) asking children to rate specific attributes of a piece of software which was further adapted and expanded by Read and MacFarlane (2002) who created the Fun Toolkit which is a suite of survey tools to measure the experience of children carrying out a specific task. This suite included:

- The Smileyometer – a VAS scale.
- The Fun Sorter – for ranking preference between items.
- The Again-Again table – to capture engagement by seeing if a child would like to carry out an activity again.

Building from these examples, the following subsections explore the literature around the use of survey methods with children starting off with an introduction to two validated question methods that were co-designed by the author of this thesis. Section 3.10.2 introduces the literature around how children answer questions focusing on the question-answer process and the impact of a child's cognitive development on this process. Section 3.10.3 introduces the concept of Satisficing Theory and its importance in understanding the question-answer process in relation to children and its impact on reliability. Section 3.10.4 reviews the literature on the use of different question types with children before Section 3.10.5 finishes off this section by looking at survey methods with children in relation to prior experience.

3.10.1 Thumbs-Up Scale and Frequency of Use Scale

The Thumbs-Up Scale (TUS) and Frequency of Use Scale (FUS) were co-created by the author of this thesis with Dr. Akiyo Kano to assist children in the answering of questions regarding their computer experience (Kano, Horton, & Read, 2010).

The TUS is a visual analogue scale that is designed to measure a child's perception of their skill in completing a particular task (see figure 3.1).

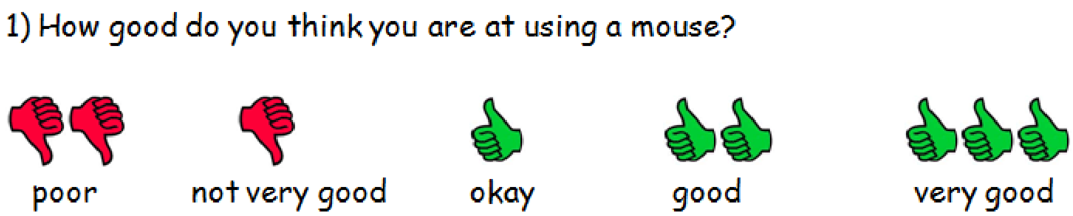


Figure 3.1: Example of the Thumbs-Up Scale (TUS)

This scale was validated using a word cloud scale measuring children's perceived skill in typing producing a high correlation (r=.892) between the two scales.

The FUS, as its name states, is a Likert style scale designed to measure frequency of use. In line with suggestions by Bell (2007) for designing questionnaires for children, the response choices in the FUS scale were limited to 4 options (see figure 3.2).

7) How often do you use a computer at home?

never	once a week	few times a week	everyday

Figure 3.2: Example of the Frequency of Use Scale (TUS)

This scale was designed to be suitable to apply to any task that is carried out by children and although the example above is looking at frequency on a weekly scale, the measures could be altered to daily, monthly or yearly tasks. This scale was validated using a cloud diagram containing the numbers 0-8 where the numbers represented the number of days in a week. The number 8 was added as an option to see if children would use it to imply very frequently. The values were coded as:

- 0 = never
- 1 – 2 = once a week
- 3 – 5 = a few times a week
- 6 – 8 = everyday

The results of the two scales produced a high correlation (r=.744) showing that both new scales produce a similar accuracy to the use of cloud diagrams.

3.10.2 How Children Answer Questions

A survey, in a simplistic description, is a question and answer method to elicit responses. To understand how children answer questions, the question-answer process must first be understood. The process consists of four stages (Breakwell, Lammond, & Fife-Schaw, 2000; Tourangeau & Rasinski, 1988):

- Understanding the question
- Retrieving the information from memory
- Making a judgement about what information is needed
- Communicating the response

Each of the stages involves specific cognitive functions such as speech, understanding, information retrieval and information processing which develop within children as they grow up. Research with adults has shown how they can have problems with difficult questions and questions where information has to be retrieved from memory. Therefore with children these problems must be magnified and have a larger impact (Borgers et al., 2000).

Extensive work by Borgers, Hox and colleagues (Borgers, Hox, & Sikkel, 2004; Borgers et al., 2000; E. De Leeuw, Borgers, & Smits, 2004) has considered surveys and children in the context of the cognitive development of children and the affect this has on their ability to respond in surveys. Their research concludes that children can be interviewed from as young as 4 years old although it is difficult. Relevant to this thesis, they acknowledge than in the sensori-motor stage of Piaget's stages of child development (Piaget, 1952) although the age gap between 4 and 7 year olds is large, they are limited in their comprehension and verbal memory, which are both extremely important to the first two stages of the question-answer process. They emphasize the importance of the wording of questions at this stage and the need to keep questions very simple and clear. Children in this stage are also very suggestible, keen to please, and often afraid to say something foolish or say something that they think may be incorrect to an adult – this has implications on their ability with stages three and four of the question-answer process. Borgers et al. (2000) discuss how literal children of this age can be; as an example - when asking children where they might have banged their leg you might expect a response like *'on my knee'* but this question would be just as likely to get a response of *'in the kitchen'* as this is literally where the incident occurred. Children of this age also have a short attention span, a major effect of which is the problem of satisficing (discussed in more detail in the next section) especially when children become disengaged or uninterested (Borgers et al., 2004; Borgers et al., 2000; De Leeuw et al., 2004).

During the concrete operations stage (aged 8 to 11) children still suffer from many of the problems encountered by younger children such as short attention spans. They are still very literal and require the precise wording of questions in a language they understand, which may not be exactly the same language used with the younger children. Children of this age struggle with negatively worded questions (Van Laerhoven, Van Der Zaag-Loonen, & Derkx, 2004), an example of which might be *"Do you find it difficult to use the keyboard?"*, and contrary to general survey practice the recommendation is to not use them with this group (Borgers et al., 2000).

3.10.3 Satisficing Theory

Satisficing theory (Krosnick, 1991) elaborates on the question-answer process in helping to identify causes of reliability problems when using children as participants. When a participant thoughtfully completes all four stages of the question-answer process they are said to have used an optimising strategy (Bell, 2007); providing the optimal answers to the questions they were asked. If they miss out one of the stages, they apply another superficial reason for deciding their answer, which may appear acceptable but is often a case of choosing a random answer, or the easiest to remember out of a selection for example; this is called satisficing. Borgers et al (2000) introduce the three main dimensions to satisficing theory:

- The motivation of the child
- The difficulty of the question
- The cognitive abilities of the child (discussed in the previous section)

The motivation of the child is paramount to the reliability of responses by a child. If the child is bored or not interested in the survey then the responses, or non responses, will make it unreliable (Vaillancourt, 1973). Children tend to use the easiest route possible to create an answer that is satisfactory to them, the less effort the better, meaning the question quality becomes even more important with this group (Bell, 2007).

Question difficulty is well documented as a cause of reliability issues even with adults. The harder the question is for a respondent to understand, the greater load it puts on memory and the less reliable the answers might be. Poorly worded or poorly constructed questions can confuse children easily (Vaillancourt, 1973). Children are known to struggle with retrospective questions (Bell, 2007) and the longer ago an event occurred, the harder it is for a child to recall it reliably. Children are much better with questions that are salient or about experiences that are more recent (De Leeuw et al., 2004).

3.10.4 Question Types

Bell's guide to questionnaires with children (Bell, 2007) advocates the use of yes/no questions where possible as these are easy to answer; this contradicts Breakwell et al's (2000) view that children tend to say yes to a question irrespective of what they really think. This is perhaps a simplistic view though as children are unlikely to answer yes if you ask them if they are the opposite sex for example, or if they are being asked questions about possessions they do not have. The *yes* issue is perhaps more of a problem in opinion questions where children are known to say they like something even if this may not be the case.

Scott et al (1995) found good results when using graphical representations with children, which is supported by the positive VAS contributions to children's surveys previously discussed. However, Van Laerhoven et al's (2004) research comparing Likert and VAS scales with children, found that children preferred Likert scales and found them easier to complete, although the correlation of the results between the two scales was very strong. They also found a greater level of non-response in VAS scales. When using scales, Bell (2007) states that completely labelled scales produce better results with children than partially labelled ones and that it is better to use verbal (word) scales than numeric ones.

Bell (2007) also provides guidance when using fixed response options with children. This guidance includes trying to avoid using over 3 or 4 options as this places a greater cognitive load on the child and also mandates that the survey designer should ensure that the responses are clearly distinct as children find it hard to recognise differences in responses with subtle differences. Bell notes that in questionnaires it is often the earlier options that are picked first due to children not reading all the responses, and in interviews it is the latter options as these are the one freshest in their minds. She recommends positioning the answers that are thought to be most likely in the positions that are usually less chosen as a method to counteract this.

Finally, free-recall questions used in interviews have been highlighted as useful with children although caution must be taken as the more specific the questions become, the less reliable the responses (Read & MacFarlane, 2006). These questions also come with the issues associated with coding qualitative data.

3.10.5 Prior Experience and Children

Children are often asked about their prior use of technology in design and evaluation studies. It is a common belief that a child's exposure to technology as a whole, or to technologies that are specifically related to a study, will have an effect on what those children expect from these technologies, how they interact with them, how well they can accomplish specific tasks, and how quickly they learn. With children this exposure can differ greatly *between* age ranges (Kano et al., 2010), with the experiences of a 5 year old differing greatly to that of a 10 year old, but also *across* age ranges as access to technology and a child's development can cause wide differences across children of the same age. Differences also exist across cultural groups and across geographical boundaries.

Questionnaires are frequently used to find out answers such as, what general technologies a child has experienced, whether a specific technology was owned by the child or their family (Kerawalla & Crook, 2002), in what ways children have interacted with a specific technology, and how long on average they might spend using a technology over a certain period of time (Mumtaz, 2001). These questions are often asked badly or lack detail. However, the findings from these questions are often used by researchers to justify decisions in studies, back up findings, or influence study design.

As an example, in a study examining children's understanding of interactive tabletops in India, Jamil et al. (2012) made assumptions about the touch techniques used by the children based on the children having recorded that they had little exposure to multi-touch technologies. The prior experience information they reported was based on the children's use of computers at school, they did not question computer use or ownership at home, nor any prior experience with mobile or tablet devices. It was also not recorded whether they asked the children about their exposure to multi-touch technologies.

In using questionnaires with children the researcher must first ensure the child completely understands the concepts presented as it is often not possible to ask the respondents to clarify their answers (Scott, 2000). Markopoulos et al. (2008) highlight that difficulties often encountered in using questionnaires with children, include having confidence that children understand the question being asked and include the problems in eliciting accurate answers from children. As previously discussed in this section, the reliability of children's responses has also been brought into question with issues such as satisficing, the use of inappropriate language (Borgers & Hox, 2001) and evaluator bias (Borgers et al., 2004) being just some of the factors that can have a profound effect on the answers given by children.

3.11 Similarities in Adult Survey Research

Section 3.10 of this literature review looked at using survey methods with children highlighting many of the issues that can occur when surveying this unique user group. However, these issues often are not only seen in survey studies with children as some of the issues still exist when conducting surveys with adults, and others have been found to reappear again in older adults.

The majority of guidance on creating and administering a good survey has been created by researchers carrying out research with adult participants and therefore the guidance provided is, perhaps unintentionally, aimed at this user group and is not designed to take into account the nuances of administering surveys to children. Within this chapter, various survey techniques have been introduced such as the use of open-ended questions in Section 3.5.1 where the problems participants have finding them hard to answer have been identified (de Vaus, 1994; Mitchell & Jolley, 2010; Oppenheim, 2005), or in Section 3.6 where pretesting is introduced as a method of identifying problems with a survey in advance (Presser et al., 2004) to improve aspects such as the wording of questions. These issues and methods of improving surveys were not designed with children in mind, they identify problems that adults have when carrying out surveys which therefore will also need to be addressed when carrying out survey research with children. McFadden et al. (2005) note in work carried out to create a framework for conceptualising response behaviour that adults are still likely to provide inaccurate or erroneous answers for reasons such as the need to please or impress the interviewer, to make themselves look good, or to hasten the conclusion of a survey. All of these have been identified, as would be expected, in survey research with children and often in generic research with children. McFadden et al. (2005) also discuss problems with cognitively complex questions leading to non-response, or artificially ‘safe’ answers which is in line with Vaillancourt's (1973) views on non-response, and the cognitive load complex questions can put on children.

It is the literature looking at research into survey methods with older adults where similarities with children really begin to emerge. As people age, it is known that their cognitive, and motor skills decline (Worden, Walker, Bharat, & Hudson, 1997; Colsher & Wallace, 1989) which can affect the learning of new information (Reddy, Blackler, Mahar, & Popovic, 2010) and their ability to perform many tasks (Salthouse, 1991). This decline is a mirror to the cognitive and motor skill growth, identified in the theories by Piaget (1952) and Vygotsky (1978), that can be seen throughout childhood. It is not surprising therefore, that issues that affect children - who have not developed the abilities to perform certain tasks - can resurface in older people who are losing these same abilities. Again, similarly to children who develop at different rates, the decline of abilities in older adults does not follow a uniform pattern with large differences in the ages, and rates, that adults decline cognitively, physically, or both. It is worth noting that not all skills diminish with old age. In their work on intelligence Backman et al (2001) state that knowledge learned from prior learning and experience, such as vocabulary, can actually improve with age and it is more likely to be fluid intelligence such as abstract reasoning and problem solving that declines.

Research by Rodgers and Herzog (1992) looking into the problems and procedures of collecting data from the oldest old (people over the age of 85) identifies many underlying similarities to collecting data from children. Fatigue effects in the elderly have been identified as a cause of high non-response rates, along with decreased levels of motivation (Colsher & Wallace, 1989) and decreased attention levels (Reddy et al., 2010) leading to a recommendation that interviews should be kept to a minimum length and when appropriate divided up and administered at different times. This is in line with the work by Markopoulos and Bekker (2003) stating that children are still developing their ability to concentrate and therefore research studies with children should be short. Motivation is a key element of Krosnick's (1996) satisficing theory without which children will not answer questions properly. Krosnick’s theory also identifies question difficultly and cognitive abilities (Borgers et al., 2000) as key components to children being able to go through the question-answer process optimally. This would suggest that older adults are also likely to use satisficing techniques to answer questions less reliably. A study by Jobe and Mingay (1990) on designing questionnaires for the elderly found comprehension problems to be particularly common, often due to interpretation problems with the question wording. Goodman et al (2003) attribute a lack of question response to question complexity and the use of unfamiliar jargon, in a survey of older adults’ use of computers, an issue that could potentially occur within the prior research being carried out in this thesis.

Other recommendations in the work by Rodgers and Herzog (1992) that draw parallels with child research include the use of specialised surveys, for example, using large fonts that are easier to read, and simpler wording to that of questions used in research with younger adults. The use of simpler words and fewer choices when developing scale questions is in line with Bell's (2007) recommendations for creating child friendly scales. Earlier work by the same authors (Herzog, Andrews, & Rodgers, 1981) showed that older respondents were more likely to choose extreme scale positions, an effect similar to that found by Read (2007) when looking at children using the VAS Smiley-o-meter as part of the Fun Toolkit.

Many similarities exist between survey research with children and the elderly but this does not mean that understanding elderly users will fully prepare a researcher for working with children. There are also many differences. Colsher and Wallace (1989) note that older adults are more likely to refuse to participate in surveys which is contradictory to the view that child are taught to participate in activities and are used to doing what they are asked (Read & MacFarlane, 2006). Some studies have found response accuracy to increase within older adults, particularly in recalling information from memory without the need for abstract thinking or problem solving (Herzog & Dielman, 1985; Traugott & Katosh, 1979) which would not be the case with children getting younger. Conducting successful surveys with children does require knowledge and experience that can only be gained through literature specifically about this age group and also from conducting this type of research. Guidance can be gained from adult based literature and experience, particularly with older adults, as a good place to begin when creating a survey for children but cannot be used as a substitute for the child, rather only as an accompaniment.

3.12 Existing Guidelines

Whilst methodological research on the use of survey methods with children is still scarce, Read and Fine (2005) produced a set of nine 'approaches' to assist in conducting surveys with children that were later tweaked and turned into a set of nine guidelines (Read & MacFarlane, 2006). One aim of this thesis is to provide a set of guidelines to assist in improving the reliability and validity of children's responses of technology use and it is envisaged that these guidelines will provide some generic guidance on creating surveys for children. Therefore it is appropriate to acknowledge these existing guidelines and use them, where appropriate, to support the creation of the guidelines proposed in this thesis.

Below are the guidelines as written in Read and MacFarlane's paper:- Using the fun toolkit and other survey methods to gather opinions in child computer interaction (Read & MacFarlane, 2006):

1. ***Keep it short:*** *Whatever the children are asked to do, make it fit their time span. This will reduce the effect of satisficing by keeping their motivation high. For young children, five minutes spent in a written survey is generally long enough, more time can be given, as the children get older.*
2. ***Pilot the language:*** *In a survey using written language, children will take short cuts if they cannot read the questions. Teachers can be useful in checking to see if the words used in the survey make sense, they may point out where words may mean something different to children. Avoid ambiguity by piloting with sample children.*
3. ***Provide assistance for non / poor readers:*** *Even with the language checked, there will be some children who may understand the words but not the*

questions. Try to read out written questions if possible, doing this for all the children (as some will not admit to not understanding the questions).

4. ***Limit the writing:*** *Children often do not write what they want to say, as they cannot spell the words they want, cannot find the words for things they want to say, or cannot form the letters for the words that they have in mind. Children can be helped by encouraging the drawing of pictures, the use of images and by providing essential words for them to copy.*

5. ***Use appropriate tools and methods:*** *Reduce the effects of suggestibility and satisficing by using special methods. The Fun Toolkit provides tools to assist children in discriminating between rival products. In interviews, use visual props to help articulate ideas. If interviewing, consider taping the discussion so that the amount of 'suggesting' can be examined later.*

6. ***Make it fun:*** *Introduce glue, scissors, sticky tape or coloured pencils to make the experience fun for the children. If at all possible print questions in colour and supply thank you certificates when the children have finished participating*

7. ***Expect the unexpected:*** *Have a back up plan. If an entire project depends on the results of a survey with children it may well fail! Triangulate where possible ideas include observations and post hoc reports from researchers and children..*

8. ***Don't take it too seriously:*** *One of the great pitfalls in research and development work is to read too much into data. The information gained from a single group of children in a single place is not likely to be especially generalisable. Avoid the temptation to apply statistical tests to children's responses, rather look for trends and outliers! It has been noted that in some instances, children's responses are not very stable over time [33] so it may be that all that can be elicited from a survey is a general feel for a product or a concept.*

9. ***Be nice:*** *As outlined earlier, interviewer effects are significant. To get the most from children, interviewers and researchers need to earn the right to*

talk to them. This may require several visits and may require an investment of time to learn about their culture and their concerns.

3.13 Summary and Conclusions

The aim of this chapter was to introduce prior experience as a concept and to clarify that, to improve the reliability of prior experience research, there is a need to develop a greater understanding of survey methodology and to use literature to highlight the important points that need to be considered in designing valid and reliable surveys. This study provided points to be incorporated into the survey guidelines being developed.

The initial stage was to look at the different survey techniques available with a view to deciding on the best method to be used in the creation of surveys to gather children's self-report of technology use. As previously discussed, the aim of these surveys is to provide researchers with a set of tools to gather reliable background data about the participants in their studies that can be used to make assumptions and clarifications about their findings. The resulting surveys and guidelines are there to assist researchers, not to add extra burden to their studies by, for example, taking up vast amounts of time in administration and coding. It is to that end that questionnaires are going to be the focus of this thesis. The added burden of the time it takes to carry out a set of interviews, transcribe the data, and then code the data is too large to be added to a study where this, although is vitally important, is not the main purpose of the research and therefore not an appropriate tool for this task. Evidence shows that the majority of studies that report on the collection of prior experience and usage data use questionnaires as the collection method as they are quicker and, with the right type of questions, easier to code. The question then becomes which type of questionnaires to choose?

One choice here is whether an administrator should be present when children complete a questionnaire. Having an administrator present does add a time burden when carrying out questionnaires as less can be done at the same time, it also presents the possibility of researcher bias creeping into the results, although not to the extent that can occur in interviews. A well trained and prepared administrator should be capable of keeping any biases to a minimum whilst providing support and clarification to children that is often essential to ensure they fully understand the construct that each question is trying to measure. An administrator can also provide encouragement in the completion of the questionnaire thus reducing the amount of non-response. With children, the plus points of having an administrator present outweigh the potential issues and added burden associated and can also allow observational data to be gathered by the administrator to be used where appropriate. It also supports Vygotsky’s theory of the use of a more knowledgeable other. The use of investigator-administered questionnaires is therefore suggested as the best method of collecting this sort of data from children and will be the method used within the work of this thesis.

Populations, samples, and sampling strategies are an interesting area within this research. On the one hand, sampling will be required in the testing of the questionnaires being created so needs to be considered, but on the other hand is more important, and more relevant, to a researcher using these tools. Any researcher using the tools from this thesis will have his or her own agenda and within this will decide on the sample of children to use in their study without any requirement from the tools themselves. This is because the tools are assistive to the main study and not the focus of it. Guidance can be given in sampling techniques but the sample is ultimately down to the researcher and the study they are conducting.

The use of open-ended questions will be kept to a minimum in the creation of a questionnaire set to further reduce coding time for researchers, and also to reduce the writing load on children completing the questionnaires. A variety of closed question types and scales will make up the majority of questions in any questionnaire created and all questions will be designed taking into account the good practice and advice identified in this chapter for creating successful surveys with children.

Pre-testing has been shown to be essential when creating any new questionnaires and will therefore be employed to refine the questionnaire set focussing on improving the validity of the questions, and the reliability of the answers received.

The key insights gained from this chapter towards the guidelines are presented below. These insights are predominantly in the area of survey design, and survey design with children, some of which may overlap or cover similar issues that are identified at different points in the chapter. At this stage these similarities are included below, meaning some insights may appear to be duplicates. Again the code

LR (literature review) is used here as these insights have been identified from good practice within existing literature.

LR3.1 **Sampling –** ensure the sample is representative of the population to be studied by using a valid sampling technique to ensure generalisations are possible and accurate. Also ensure the sample is of a sufficient size to minimize and sampling errors.

LR3.2 **Confound variables** – it is important to minimise the effects of confounding variables that could be unintentionally having an effect on what is supposed to be being measured. It may be possible to eliminate then entirely through exclusion and good study design.

LR3.3 **Open-ended questions** – use open-ended questions sparingly with children as this reduces any issues of writing ability and reduces the time it will take to complete the survey. If they are required then keep the required response to a minimum, this will also make them easier to code later.

LR3.4 **Closed questions** – are the best choice if the full response set is known. They are quick to answer for the children and easier to code for the researcher.

LR3.5 **Pretesting** – is essential when creating a new survey to identify any problems with it in advance. 20 – 25 children is considered to be the minimum number of participants to carry out a successful pilot. Feedback from administrators is equally important here and if possible using two administrators is preferable; one to conduct, and one to observe the survey.

LR3.6 **Validity** – ensure that each question, and the survey as a whole are measure the construct they are supposed to. Experts can also be used to validate a survey, and comparisons with other surveys measuring the same constructs.

LR3.7 **Reliability** – good survey design and pretesting are ways to increase the reliability of a survey. Responses can be compared across questions asking the same question, proven questions from other tests, and test-retest comparisons can be done to help improve the reliability of a survey.

LR3.8 **Visual analogue scales –** are often used when surveying children and child friendly scales created in CCI have been shown to produce valid and reliable results.

LR3.9 **Simplicity –** questions must be made as simple and easy as possible for children to understand. Simple wording in their own language is key to maximising the chance of children giving an optimal answer. Avoid negatively worded questions, double barrelled questions and keep the length of the question to a minimum.

LR3.10 **Suggestibility –** children are very suggestible, they are keen to please and often worried about saying something that could be wrong or sound stupid. Building up a relationship with the child can help reduce this, as well as good training to reduce unintentional verbal or physical prompts.

LR3.11 **Children are very literal –** ensure that children understand exactly what a question is trying to ask. Pretesting the wording and meaning of questions with teachers and children is a good way of dealing with this.

LR3.12 **Short attention span –** children have short attention spans so it is important to keep surveys as short as possible whilst still getting the data required.

LR3.13 **Question type –** nominal questions such as yes/no questions are the easiest for them to answer. Children have little problem with well written VAS and Likert scale questions and the results between the two have a high correlation.

LR3.14 **Fixed response questions –** ideally responses should be kept to 3 or 4 responses that are clearly distinct. This is not the case for some checkbox style questions as these are more like a set of nominal questions combined.

The guidelines by Read and Fine (2005) will be consulted later in the thesis when the new guidelines are being created - it is not necessary at this point to add them again at this point as they are written in full previously within this chapter.

4 CHAPTER FOUR: RESEARCH APPROACH

4.1 Introduction

The aim of the research presented in this thesis is to design tools and derive guidelines for use by the CCI community, to improve the validity and reliability of children's self-report of technology use. The aim of this chapter is to outline the approach taken in conducting this research together with an overview of the research methods used.

The chapter is presented in three sections. Section 4.2 outlines the overall research design and provides a timeline schematic diagram that shows how the research was carried out. Section 4.3 outlines the key research approaches used, these being grounded theory and user centred research, and Section 4.4 then highlights some of the methods used in the key stages of the research. The concluding section (4.5) reiterates the research aims and objectives and then outlines the experimental and exploratory work that follows in the remaining chapters of the thesis.

4.2 The Stages of the Research

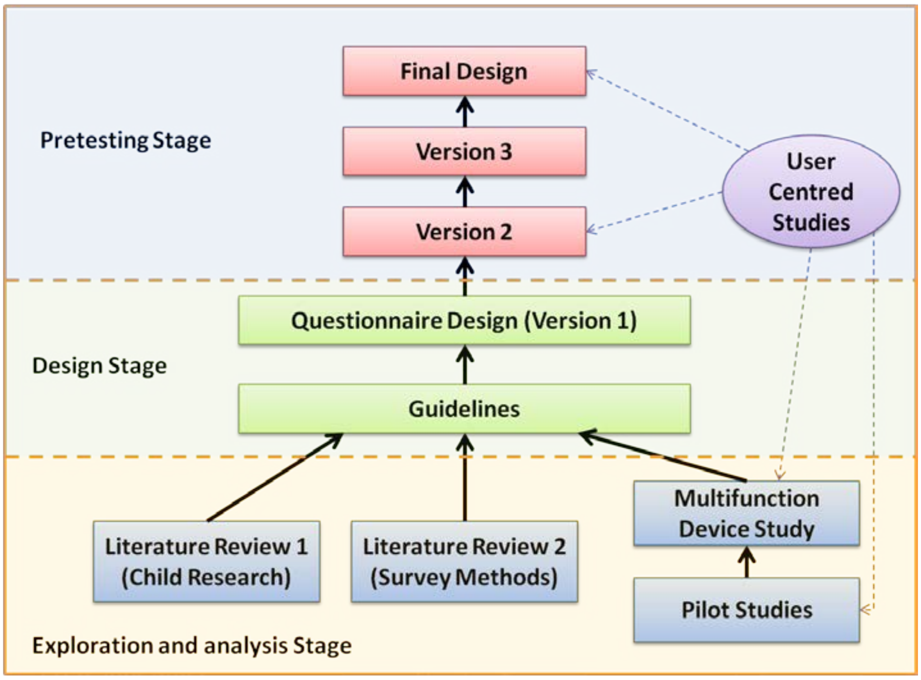


Figure 4.1: Diagram of the research design

The research was intended to be iterative but also to have clear boundaries between different processes, as there was a need to generate results and create tools. Figure

4.1 presents a graphical representation of the three stages of the research design – the stages are further described in the following three subsections.

4.2.1 Exploration and Analysis Stage

Stage one consists of the exploration and analysis stage where a review of the literature into research with children was conducted followed by a review of the literature surrounding generic survey methodology coupled with literature specifically around the use of survey methodologies with children. Alongside this review of the literature, a series of pilot studies were carried out using a grounded theory approach to identify problems in conducting surveys (focussing on questionnaires) with children using a user-centred design approach that continued throughout the studies presented in the thesis. This grounded approach led to the discovery of a specific problem relating to the multifunctional nature of some technologies, which gave reasons to perform a major study to understand this in more detail.

The main points that came out of the activities in this stage were then used in the creation of three sets of guidelines that can be used both to provide researchers working with children guidance in the three areas covered but are also necessary for the investigation of surveys with children which is the work of stage 2. The guidelines presented cover the three aspects of:

- Research with children
- Conducting surveys with children
- Children's self report of technology use

The *research with children* guidelines predominantly come from the merging and collating of good practice identified within chapter 2, although these have been mixed, where appropriate, with good practice identified within chapter 3 and the pre-existing guidelines in the work by Read and Fine (2005). The *surveys with children* guidelines are a mix of existing good practice identified within the literature in chapter 3 combined with a set of new guidelines identified from the studies carried out in chapter 5. On occasion the existing literature has been merged with study guidelines, and existing guidelines, to create a more complete guideline. The *self* *report of technology use* guidelines are new guidelines that have been created as a result of the work carried out in study chapters 5 and 6.

4.2.2 Design Stage

The second stage (design) was intended to create a set of generic questionnaires that could be used by the research community to gather reliable and valid data of children's technology use. This stage used the three sets of guidelines that were generated in Stage 1 of the research together with the knowledge gained by the researcher, during a long experience of doing research with children, and brought this together to create the three initial questionnaires.

4.2.3 Pretesting Stage

The final stage of the work was concerned with improving and testing the surveys. This stage followed De Vaus's (1994) three iterations of creating and pretesting surveys (identified in chapter 3) again using user-centred design studies but also using an expert design study to assess the language used with school teachers.

4.3 A User-centred Grounded Theory Approach

Developing new survey instruments can be done in several ways. The approach taken in this work was to work in a participative way with children and to couple experimental studies with understanding from the literature, to derive a valid suite of instruments. Core to the methods chosen was the belief that the extensive experience of the researcher, in carrying out research with children, would contribute tacit understanding to the work. This belief needed to be tested and validated – hence the approach taken needed to check assumptions, test ideas and unearth unknown aspects.

Two core approaches were to use a grounded approach and a user centred approach. The grounded approach was to derive theory and meaning, the user centred approach was deemed necessary to ensure a functional product.

4.3.1 Grounded Theory

Grounded theory was developed by the sociologists Glaser and Strauss (1967) at the University of California. It involves the creation of theories through the analysis of data rather than the traditional approach of creating theories through the use of literature. During this process several rounds of data collection are often necessary in order for theories to fully emerge (Myers, 1997).

The pilot studies presented in chapter 5, and the subsequent study into multi-functional devices in chapter 6, were created using this grounded approach. (Lingard, Albert, and Levinson (2008) state that a grounded approach involves iterative study design where the analysis of one study is used to inform the next cycle of data collection. This is no different to the studies set out here.

The initial pilot study was created to gather insights into the technologies that children had within their homes and schools. There was no specific hypothesis at this stage other than to look at the data collected and identify issues that warranted further study. The three major questions at this stage were:

- Whether children randomly select technologies.
- The reliability of their answers.
- Issues regarding the ownership of technology.

Subsequent studies were then designed in an attempt to answer these questions. To answer the question of whether the children were randomly selecting technologies from the list, the decision was taken to introduce impossible options. It was expected that the introduction of technologies that children could not possibly own would suitably address this question. More detailed instructions were also provided in this study to ensure the children fully understood the question being asked and to enable ownership to also be studied. The findings proved that children do not randomly select answers and further supported the view that the problem was more likely to be caused due to problems in the language used in either the questions or response options. This study also showed that with sufficient instruction children can understands the concept of ownership.

Study 3 was designed to test the reliability of children’s responses, the final issue not yet considered from the pilot study. The decision was made to conduct a test-retest study on the children by asking them to complete two questionnaires a week apart that asked the same questions. It was also decided that two different questionnaire techniques would be used, one written, and one pictoral. The results of this study suggested children were not capable of reliably responding to the question presented as the results from the two studies were significantly different. Observational data leaned towards this problem being due to the different question types rather than the children’s responses as problems were identified in the use of images within the pictoral questionnaire. It was therefore decided that the use of images in questionnaires should also be studied further. The problems of reliability had also not been suitably addressed in this study and would require further analysis.

To address reliability further the decision was taken to compare the responses given by children to responses given by their parents to the same question. Study 4 was therefore designed to look at technology that children had within their homes. The parents were asked to provide further information such as whether the child had access to a piece of technology and who owned it. The results of this study proved that children could reliably report the technologies they had within their homes. Analysis using the responses of the additional questions given to the parents showed that children could distinguish between items present within the house that they did not use or have access to, further supporting the findings that children understand the concept of ownership. This study also highlighted problems that children had in their understanding and perceptions of certain devices, and more importantly devices that were intentionally multifunctional or had extra functionality in addition to the device’s main purpose.

The final study in this section was designed to further study the issue of image use that was identified in study 3. Study 3 identified that the use of images to represent technology are not always understood by children in the context they are meant. This was mainly due to the fact that some technology images were considered to be generic whereas others were considered to represent a specific branded device. It was therefore decided in study 5 that children’s drawings of technology might provide insights into this by identifying the key components of different technologies as seen by a child. The results of this study did little to support the use of images to represent technology although in part this was due to the drawing ability of the children. It did however raise the issue of children drawing similar images for devices with similar features, or devices that had the functionality of the device they were asked to draw, without actually being that device. These findings gave further support to the need to study multifunctional devices in more detail and therefore the findings from studies 4 and 5 led to the work presented in chapter 6.

Two key questions were identified to help further understand why children might have problems understanding multifunctional devices. The decision was taken to base this study around common tasks that technology was used to carry out rather than on specific pieces of technology themselves. The key questions were:

- Which devices are most commonly used to complete each task?
- Is the task in question the primary function of the most commonly used device?

Eight tasks commonly carried out using technologies were selected and split into three thematic groups that represented the different relationships expected in task usage amongst children (as shown in section 6.2.2). The main findings to come out of this study indicated that multifunctional devices are often used to carry out tasks where specific devices are available to complete the task. The use of multifunctional devices increased in older children, a finding that was heavily due to the uptake in mobile phone usage. This highlights the requirement to ask children about task usage as well as device usage to better understand prior experience.

The studies that were run using this grounded theory approach identified 19 potential guidelines that would contribute to the eventual guidelines created in chapter 7.

Grounded theory was also employed in the development of themes (thematic analysis) to determine appropriate questions for the initial questionnaires. In this thematic analysis computer experience was considered to be a core research area and themes were drawn from literature in this area.

4.3.2 User Centred Design

All studies conducted within chapter 5, and in the later testing chapters, involve children who are the user group that the work of this thesis focuses on. The research of the thesis contributes a theoretical and a practical component. The practical component, a set of surveys that can be used with children, is a product for children and the development of products for children indicates a user centred approach. The inclusion of users within studies allows designers and evaluators to interact with the end users of a product, system or task allowing them to discover potential problems and issues that 'real' people may come across. It also allows researchers to gain a better understanding of the needs and wants of the users and enables them to gather ideas that may not become apparent using proxy users or relying solely on the opinions and judgements of the research team. Within HCI, early work in this areas was carried out in the mid 1980's by Gould and Lewis (1985), and, Norman and Draper (1986) who stressed the importance of an early focus on users, iterative design processes and continuous testing with users. The term given to this user focussed research was user-centred design (UCD). The work in this thesis is focused on children and their abilities to reliably self report technology so it was essential that children were used in the grounded theory approach implemented. Finding problems that affect children who are older, or younger, than the target age range may be irrelevant or misleading compared with the problems that actually affect children in the target age range. Using adults would have potentially been worse as all child related issues may have potentially been missed.

This user-centred approach was followed through to the study in chapter 6 looking at the effect multifunctional technology was having on children's self-report of technology use. Again at this stage it was important to see the effects on a sample of children spanning the target age range in order to identify any differences that occur within this group. This would not be possible without using at UCD technique. User centred testing was also a feature in the latter stages of the work with children pretesting the surveys.

4.4 Methods Used

Choices were made in interpretation and analysis that will have affected the results of the work. Specifically, choices made within the literature review, choices made in deriving guidelines and choices made in designing the surveys all will have impacted on the results.

4.4.1 Literature Review

The literature review in chapter 2 focused on carrying out research with children and introduced the field of child computer interaction (CCI). The literature on children was mainly limited to that associated with children aged 5 to 11. In chapter 3, survey methodology was the main focus, introducing the important concepts, mainly in the context of questionnaires and based on survey design for adults. More specific literature on conducting surveys with children was then introduced together with a look at the similarities between the problems encountered conducting surveys with adults and with children focusing on the similarities between older aged adults and children due mainly to the cognitive and physical shortcomings of both groups. Further literature on feature creep is introduced in chapter 6 and computer experience literature is used in the creation of the initial questionnaire set in chapter 8.

Searches were done on key terms using Google Scholar and digital libraries. Some research also looked at educational sources.

4.4.2 Creation of the Guidelines

The guidelines were created using the contributions identified in the literature chapters (2 and 3) and the study chapters (5 and 6). It is important to use both literature and studies to identify both problems and good practice that can be used in the creation of a set of guidelines. Often contributions can be found using both methods that support one another although there will always be some that will only appear using one technique. Guidelines may already exist which are relevant or complementary when creating a new set and these should be identified in the literature and can make a good basis for the design of a new set.

In categorising the guidelines, the researcher chose to initially separate guidelines across three titles, with these being hierarchical. A top category was that these were guidelines for doing research with children, beneath that, a level was for guidelines for doing surveys with children and then the last category was for doing research with children in the specific instances of gathering technology use. Some contributions were placed into two separate categories where they crossed the boundary between the two although their separate importance in both had to be recognized.

Once all contributions were categorised into these initial three subsets, thematic analysis was used to both merge and better describe contributions based on common identifiers. Common contributions were either merged to form more detailed guidelines, or duplication was removed where two or more contributions could be covered by the wording of just one. A final pass of all contributions was made and where necessary some were removed where they did not fit in with the proposed guidelines.

4.5 Creation and Pretesting of the Questionnaires

The creation and pretesting of the survey set followed De Vaus's (1994) three stages of pretesting a new questionnaire:

- Question development
- Survey development
- Polishing the pilot test

Question development was performed using a mix of the guidelines described in chapter 7 and by identifying questions and constructs that are present in similar questionnaires within literature. The need for each question chosen was justified and each question was then written in a language that was deemed appropriate for children. Each questionnaire created needed to have appropriate tasks and technologies assigned to it in order to be ready for pretesting. Studies 7 and 8 were an iterative cycle of testing the language used within the questionnaires, once with children themselves, and once with teachers who have a extensive experience of working with the target age range. Study 7 also sought to address the construct validity and reliability of each question as is essential in questionnaire design.

Survey development and the polishing of the pilot test were carried out in study 9 where a large scale pilot study was run using children of all ages within the target age range (in line with the UCD approach adopted). This allowed the responses received to be analysed in conjunction with comments from the administrator in order to produce the final questionnaire set. The questionnaire set then needed to have the task and technology specifics removed to return it to its generic state.

A user guide was then written to accompany the generic questionnaire set to assist in its use by researchers who may be unfamiliar with it.

4.6 Conclusions

This chapter has presented an overview of the research presented within this thesis and the research methods that were used at different stages.

The major methods employed include:

- Grounded theory
- User-centred design
- Merging of qualitative data sets
- Pretesting methods of questionnaire design

The concluding section (4.5) reiterates the research aims and objectives and then outlines the experimental and exploratory work that follows in the remaining chapters of the thesis.

5 CHAPTER FIVE: IDENTIFYING THE PROBLEMS

5.1 Introduction

The use of survey methods with children within the HCI domain is common place and they are often used at the beginning of studies to support the study method and findings by identifying children's prior use or exposure to technologies. The literature review identified issues across several different subject areas of using survey methods with children and highlighted the fact there is little research into the effects this could have on the accuracy and validity of the self-reporting in this context.

This chapter presents the exploratory studies aimed at identifying the main issues faced when using survey methods to elicit children's self-report of technology use. Studies within this chapter have been published at several academic conferences (Horton & Read, 2008; Horton, Read, & Sim, 2011; Horton & Read, 2012) and provide the foundation for later work within the thesis.

5.1.1 Contributions

The findings from the studies in this section contribute towards RC3 (data and understanding of technology use), and, together with the findings from the literature sections and the following chapter, contribute significantly towards RC2 (three sets of guidelines).

5.1.2 Structure

The structure of the remainder of this chapter is as follows: Section 5.2 reports on the pilot questionnaire to identify the initial problems to be studied. Section 5.3 investigates the random selection of technology found during the pilot study. Section 5.4 presents a comparison of two different questionnaire techniques, written and pictoral, looking at the reliability across the techniques and problems encountered by the children. Section 5.5 looks at the reliability of children's responses by comparing them with those of their parents. Section 5.6 looks at the use of children's drawing as representations of technology and the feasibility of using these. The findings and results from the studies are then summed up in section 5.7 with the key contributions coded.

5.2 STUDY 1 – Pilot Questionnaire

The pilot questionnaire was created to gather insights into technologies that children reported to having within their home and separately within their schools. There was no specific hypothesis at this point other than to analyse the results with observational information that was recorded whilst the study was taking place.

5.2.1 Participants

The study consisted of 43 children from two classes at the same UK primary school. To identify any age disparities in this study the classes selected were from different key stages (KS) of the UK National Curriculum. 23 children aged between 6 and 7 years took part from a Year 2 (KS1) class and 20 children aged between 9 and 10 years took part from a Year 5 (KS2) class.

All the children within these classes were given the option of participating in the study and were informed they could stop participation at any time.

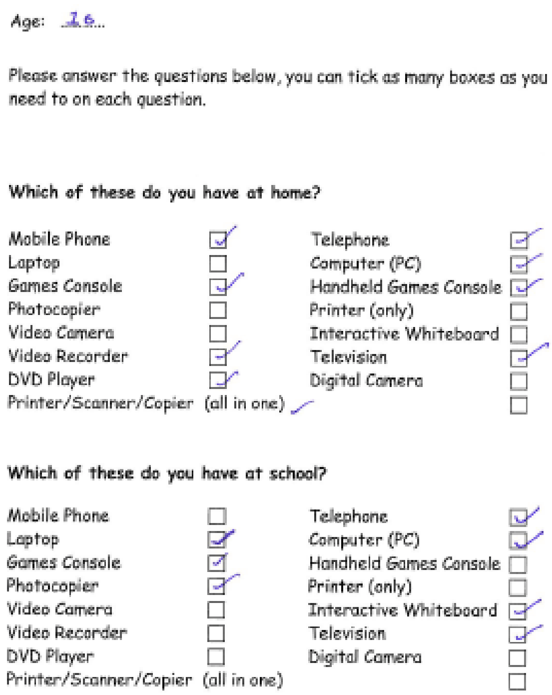
5.2.2 Questionnaire Design & Method

This study was carried out during a research day held at the primary school who took part in this study as part of a set of research studies carried by different researchers at the same time. The study took place in the small school library where there was space for up to 3 children to complete the questionnaires at the same time whilst not sitting at the same table. The children were collected from their classrooms in groups of two or three and were given 10 minutes to complete the task.

The pilot questionnaire contained three questions (see figure 5.1). The first question was an open ended question to capture the age of the participant. No other personal data was collected from the children as it was not required for the analysis of this data. A record of the year group was kept for the two groups in case a child failed to provide this information.

The second and third questions were almost identical multiple choice questions where the children were asked to select which technologies they had in their homes and which technologies they had in their schools from a predefined list of 15 technologies. The list of technologies was presented in a two columned list with tick boxes after each technology. These two questions were presented on different sides of the same sheet of paper to reduce the chance of children copying their answers from one question to the other. The questions were also presented in a random order as a counterbalance.

The initial list of technologies was created from experience of working with schools and finding out what technologies they commonly contained. This was combined with a selection of the most popular technology devices that were intended for home use.


Age: 16

Please answer the questions below, you can tick as many boxes as you need to on each question.

Which of these do you have at home?

Mobile Phone	☑	Telephone	☑
Laptop	☐	Computer (PC)	☑
Games Console	☑	Handheld Games Console	☑
Photocopier	☐	Printer (only)	☐
Video Camera	☐	Interactive Whiteboard	☐
Video Recorder	☑	Television	☑
DVD Player	☑	Digital Camera	☐
Printer/Scanner/Copier (all in one) ✓			☐

Which of these do you have at school?

Mobile Phone	☐	Telephone	☑
Laptop	☑	Computer (PC)	☑
Games Console	☑	Handheld Games Console	☐
Photocopier	☑	Printer (only)	☐
Video Camera	☐	Interactive Whiteboard	☑
Video Recorder	☐	Television	☑
DVD Player	☐	Digital Camera	☐
Printer/Scanner/Copier (all in one)			☐

Figure 5.1: Example of completed questionnaire from study 1

5.2.3 Results

Table 5.1 presents the total number of instances where a child stated they had a technology either within their home or within their school. The results of the two groups have been left separate with group 1 being the Year 2 (KS1) class and group 2 being the Year 5 (KS2) class.

Table 5.1: Pilot Questionnaire Results

	Group 1		Group 2	
	Home	School	Home	School
Mobile Phone	20	20	18	1
Laptop	16	22	9	19
Games Console	11	7	19	16
Photocopier	11	17	4	18
Video Camera	15	14	12	15
Video Recorder	13	1	12	8
DVD Player	22	5	18	14
Printer/Copier/Scanner	3	2	7	6
Home Telephone	16	19	17	19
Computer (PC)	14	12	12	19
Handheld Console	11	0	17	4
Printer	13	18	9	17
Interactive Whiteboard	6	20	2	19
Television	21	17	18	18
Digital Camera	14	10	16	18

Further interesting findings identified in the completed questionnaires include:

- Two children reported to having all the technologies from the list in their homes. No children reported having all the technologies at their school.
- A proportion of children reported to having unexpected items at their homes such as Interactive Whiteboards.
- The differences between what different children stated to having within the school, considering the children were all from the same school, provide some interesting discussion.

The result and findings are discussed in the next section with observations from the children completing the questionnaires added to help inform the discussion.

5.2.4 Discussion

Both questions in this study provide interesting data and observations. As both groups of children attended the same primary school, a comparison can be made of the responses to the question asking which technologies they have in their school.

5.2.4.1 Technologies within the Home

Without talking to parents or visiting each child's house individually it is impossible to state how accurate the data gathered is so a further study will be necessary to assess how close parents and their children's answers are to the question of what technologies they have within their homes. The following discussion provides evidence that the information collected in this study is not 100% accurate and highlights further issues that will need to be addressed.

As discussed earlier in this section certain items within the technology list were added as they can be found within the majority of UK primary schools. It is less likely that these items would be found within subjects' houses although it is acknowledged that is it possible. Eight of the children reported to having interactive whiteboards within their homes whilst fifteen reported that they had photocopiers at home.

There are several plausible explanations for these findings that will need further study. Firstly it is possible that the child simply misunderstood the question or had problems reading the words but still completed the questionnaire without asking for clarification. A further criticism to the work of Piaget is regarding the lack of importance he placed on language, again a criticism of the demands he placed on children within his tasks. Do the children actually understand what is being asked of them, or just appear to when in fact they do not (Wood, 1998). Secondly it may be a case that the child 'thinks' that he or she has the item within their home but in fact does not. This would most likely occur when a child didn't fully understand what a device was, an example being the interactive whiteboard. A child may have a whiteboard at home that is written on similarly to their interactive whiteboard at school, the difference being the whiteboard at home may have no interactivity. To the child, these devices could be perceived to be the same. Finally it is possible that the item does exist within the child's home and that the answer given is perfectly valid. Notably most reports of less likely items within the home came from the younger children which strengthens the opinion that it is less likely the answers given were valid.

Further to this, two of the children reported to having every piece of technology within their home (they ticked every box). Again this could be due to the children actually having every piece of technology. A more likely explanation is that the child 'wanted to look good' or did not take the questionnaire seriously. It was noted that both these children did not tick every box for the question relating to the technologies they have in their school.

5.2.4.2 Technologies within School

The most interesting results when looking at the question on technologies at school come from a comparison between the two year groups bringing into question the reliability of this style of question.

For the majority of technologies in this question the results are similar across the two groups indicating that in general the results are accurate and reliable. However, there are a small number of technologies where the results differ significantly. The most notable of these is that 87% of the children in group 1 stated they had mobile phones at school whereas only 5% of the children in group 2 answered the same way thus showing that if this question had only been asked to one of the groups then the result would have been different.

Notes taken when observing the children complete the questionnaire highlighted an interesting question that could help to explain the instances where the results differed between the two groups, that being what exactly does the term 'at school' mean? There were several instances where children made reference to the fact their teachers have mobile phones at work. Whilst these devices are not intended for use at school, they have been seen by the children within the school premises and therefore could be considered by some children to be a device that they had at school. Another example of this was that the after school club at the school has a games console that is situated and stored on school property. The teachers at the school confirmed the school did not have a games console of its own and did not have access to the console owned by the after school club. It appears there is an issue of ownership with this question as some children appear to have difficulties in differentiating between personal possessions that can be in a location, but do not actually belong in that location, and also the ownership of a device that is situated in a location used by multiple occupants or organizations but is only usable by one. This in line with Piaget's (1952) view, supported by Borgers et al. (2000), that children at the sensori-motor stage (Year 2 children) are still very literal, at trait that that follows them to the concrete operations stage but reduces the older children get.

5.2.5 Conclusions

The results of this initial study highlighted some interesting issues that required further study including:

- Whether children randomly select technologies.
- The reliability of their answers.
- Issues regarding the ownership of technology.

5.3 STUDY 2 – Investigating the Random Selection of Technologies

The findings from study 1 highlighted an issue with children reporting having technologies at home that are not usually found within the home. The aim of study is to further study whether this issue was occurring by the children not completing the questionnaire properly. The introduction of technologies into the questionnaire that would not appear within the house will provide evidence of whether children are completing the questionnaire correctly or simply just ticking boxes. The hypothesis is that children will not select technologies that are impossible to have within the house and that the underlying issue lies with their understanding of the devices being asked about.

5.3.1 Participants

This study consisted of 28 children from a Year 5 (KS2) class at a UK primary school. The children who participated in this study were aged 8 and 9, and were a different set of children to those who took part in study 1.

All the children within the class were given the option of participating in the study and were informed they could stop participation at any time.

5.3.2 Questionnaire Design & Method

This study was carried out in the classroom of the children participating. The classroom contained a ‘quiet corner’ where there was a large table present along with a carpet, and a selection of books for the children to read. The children were taken two at a time from their normal lesson and placed at each end of the large table so as to keep them as far away from each other as was possible. The children were given 10 minutes to complete the questionnaire.

The questionnaire contained two questions. The first question was an open ended question to capture the age of the participant. No other personal data was collected from the children as it was not required for the analysis of this data.

The second question was a multiple choice question asking the children to select, using tick boxes, which of the 15 items in the list they had in their house and were owned by the child them self. Of the 15 items, 9 were items which could commonly be found in a house, 4 were items that would not be found in the house (traffic lights, submarine, ATM machine, space shuttle), the final two were the interactive whiteboard and the photocopier that would not normally be found in the house but were the main reason for conducting this study and therefore included also.

The children were given more detailed instructions to reduce the effect of confusion within the questionnaire. This included being informed that none of the items on the questionnaire were allowed to be toys or models, they had to be the ‘real thing’. The children were also asked to only choose items within their house that they owned and could not include items owned by their parents, siblings, or general household items that did not really belong to anyone. Although not the focus of this study, the inclusion of general household items such as a fridge and a washing machine allow the concept of ownership to be analysed from the results also.

5.3.3 Results

Table 5.2 presents the full results from this study showing the items chosen by each child (represented by a 1) and the total number of times each item was chosen. The minimize the table size, the name of each item was abbreviated using the following codes: computer (PC), traffic lights (TL), printer (PR), games console (GC), submarine (SU), interactive whiteboard (IW), photocopier (PH), ATM machine

(AT), DVD played (DV), Fridge (FR), washing machine (WM), bed (BE), television (TV), space shuttle (SS) and mobile phone (MP).

Table 5.2: Study 2 Questionnaire Results

Child	PC	TL	PR	GC	SU	IW	PH	AT	DV	FR	WM	BE	TV	SS	MP
1	0	0	0	1	0	0	0	0	1	0	0	1	1	0	1
2	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0
3	1	0	0	1	0	0	0	0	1	0	0	1	1	0	0
4	0	0	0	1	0	0	1	0	1	0	0	1	1	0	1
5	0	0	0	1	0	0	0	0	1	0	0	1	1	0	0
6	0	0	0	1	0	0	0	0	1	0	0	1	1	0	1
7	0	0	0	1	0	0	0	0	1	0	0	1	1	0	1
8	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1
9	0	0	0	1	0	0	0	0	1	0	0	1	1	0	1
10	1	0	1	1	0	0	0	0	1	0	0	1	1	0	1
11	1	0	0	0	0	0	0	0	1	0	0	1	1	0	1
12	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0
13	1	0	0	1	0	0	0	0	1	1	0	1	1	0	1
14	1	0	1	1	0	0	0	0	1	0	0	1	1	0	1
15	1	0	1	1	0	0	0	0	1	0	0	1	1	0	0
16	1	0	0	1	0	0	0	0	1	0	0	1	1	0	1
17	1	0	1	1	0	0	0	0	1	0	0	1	1	0	0
18	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0
19	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0
20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
21	0	0	1	1	0	0	0	0	0	0	0	1	0	0	1
22	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0
23	0	0	0	1	0	0	0	0	1	0	0	1	1	0	0
24	0	0	0	1	0	0	0	0	1	0	0	1	0	0	1
25	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
26	1	0	0	1	0	0	0	0	1	0	0	1	0	0	1
27	1	0	0	1	0	0	0	0	1	0	0	1	1	0	1
28	1	0	1	1	0	0	0	0	0	0	0	1	1	0	1
Total	**12**	**0**	**7**	**24**	**0**	**0**	**1**	**0**	**20**	**1**	**0**	**27**	**20**	**0**	**17**

None of the children in study 2 chose any of the items they could not possibly have had in their houses. No children selected that they owned an interactive whiteboard or a fridge with only one child (4%) selecting a washing machine and a different child selecting they owned a photocopier.

5.3.4 Discussion

The hypothesis that children will not select technologies that are impossible to have within the house appears to be valid from the results as no child selected the traffic light, ATM machine, submarine or space shuttle. This confirms the assumption that children will not deliberately select unrealistic answers and therefore the problem lies with a child's understanding of the item within the question or the understanding of the question itself. It is interesting to note that the issue with interactive whiteboards did not surface as no child selected the interactive whiteboard and only one child selected the photocopier.

The fact that there was only one occurrence of a child selecting they owned a washing machine and no occurrences of any children selecting they owned a fridge shows that children do understand the concept of ownership as these devices will exist in the majority, if not all, households but they will not be owned by the child. If children are informed about the ownership of devices before a study is run they are quite capable of distinguishing between these devices and other devices that should not be included in their decisions. By providing the extra information, the problem of children giving literal answers is removed as they are able to fully understand what the question is trying to ask, a result that supports the argument of Piaget's critics that simplifying the question for a child can remove problems that Piaget claimed children of this age group have (Wood, 1998).

The results for items that it is reasonable to expect some children to own yielded no unpredictable or surprising patterns although it does appear that one child does not own a bed which is highly unlikely. This again could be a result of this child taking a different view of ownership to the other children in that whilst they sleep in the bed it is not really seen as a personal possession and more as a household object.

5.3.5 Conclusions

Study 2 has addressed the issues found in the pilot study and has shown that children do not appear to randomly select technology as when presented with options they could not possibly select as a valid answer no responses were recorded. This issue is caused due to problems understanding certain technologies and potential problems in differentiating some technologies from items that look similar but are in fact different (such as a whiteboard and an interactive whiteboard).

By carefully wording the instructions at the beginning of a study and also providing adequate instructions it is possible to increase the validity of the answers given. An example from this study being the apparent understanding of ownership as a concept with the children being clearly able to identify the difference between items they own and items owned by others.

There are always going to be occasions where a child misunderstands terms in a questionnaire or has a different view than other children on concepts such as ownership and it is the job of the research team to minimize these occurrences. Creating a questionnaire that can be understood and completed as intended by all participants, whether adult or child, is all but impossible and therefore it is never going to be possible (or extremely improbable) to create a child proof questionnaire that produces totally accurate results. This study has identified some simple steps to minimise the issues found in the pilot questionnaire and why these issues occurred.

The next stage is to look at the reliability issues still outstanding from the pilot study. Study 3 and Study 4 will attempt to do this by looking at the reliability of children's responses by looking at the use of two different questionnaire techniques and also by comparing responses given by children to responses to the same question given to their parents.

5.4 STUDY 3 – A Comparison of Different Questionnaire Techniques

The previous studies have helped identify issues that can cause questionnaire results to be unreliable. Solutions have been found to minimize these issues but the underlying issue of whether children can provide reliable answers has not been considered. The purpose of this study is to look at two different questionnaire techniques, pictoral and written, to see if the results of using the two methods are comparable, and identify problems that could cause either of the methods to be less reliable. With language being an important factor in questionnaire design with children there has been a tendency to introduce images into questionnaires to minimize reading effects. This is often through the visual representations of scales (as discussed in chapter 3) and the use of images to represent objects or tasks. It is hypothesized that the results of the two questionnaires will be similar and that the use of pictures will make the completion of the questionnaires easier.

5.4.1 Participants

This study consisted of 19 children from a Year 3 (lower KS2) class at a UK primary school. The children who participated in this study were aged 6 and 7, and were a different set of children to those who took part in the previous two studies.

All the children within the class were given the option of participating in the study and were informed they could stop participation at any time.

5.4.2 Questionnaire Design & Method

Due to the nature of this study, it was carried out in two different locations. The initial study was carried out within the ChiCI research laboratory at the university which has been specifically designed to look more like a children's classroom than a research laboratory. This work was carried out at research event with other researchers carrying out research with the children throughout the day. Two tables in close proximity were set up so that two children could complete the study at the same time. The children were given a copy of each pictoral questionnaire (school and home) with a set of technology pictures for each. They were also given scissors, glue and sticky tape to complete the task. The children were given 20 minutes in total to complete the study. The follow on study was carried out at the children's school. Space was provided in the school's staff room for the children to complete the study in groups of two or three. The children were sat at different tables and given 10 minutes to complete the task.

Both questionnaires contained four questions. The first two questions were open ended question to capture the first name and age of the participants. It was deemed appropriate to record the first name of the children as this would enable the two questionnaires completed by the same child to be analysed against each other. To ensure there were no issues with children having the same name in the class the children were asked to record the initial of their surname if this was the case so that each child could clearly be identified. No other personal data was collected from the children and the name of the school was omitted from any paperwork related to the data to help protect the anonymity of the children involved in the study.

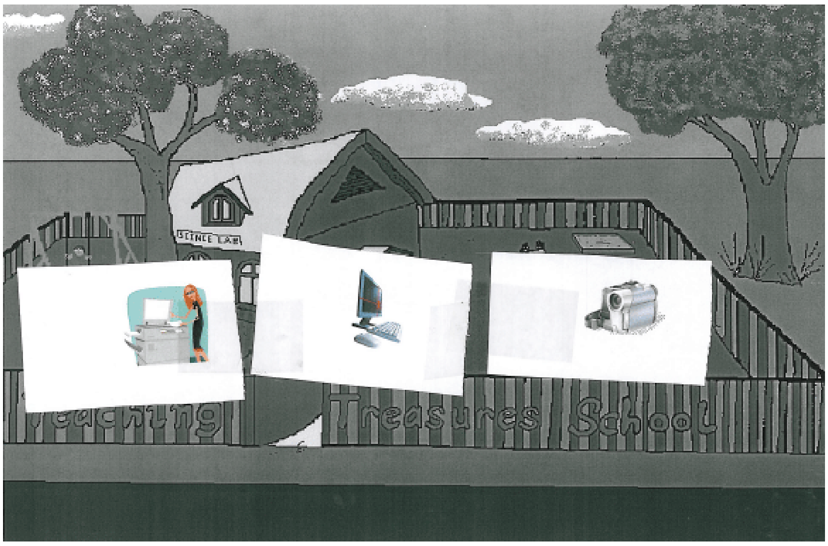


Figure 5.2: Example of a completed pictoral school questionnaire

The first questionnaire given to the children was pictoral for the final two questions and asked the children to stick pictures of technologies they had at school (see figure 5.2) on a picture of a school followed by a question asking them to stick pictures of technologies they had at home on the picture of the house. A week later the same children were given a written version of the same questionnaire that used the same question and the same list of technologies (the original technology list from study 1) only in this instance they were asked to tick the technologies in the list that they had in their schools in question three and their homes in question four.

5.4.3 Results

The results from the questionnaires have been analysed and can be seen in table 5.3. The table is split into the results from the question about technologies in the school and then technologies at home. These results have then been further split to show the number of technologies chosen by each child in each of the questionnaires and how many times the same technology was chosen by the same child across the two questionnaires.

The final column for each question presents a fractional value to illustrate how many technologies appeared in each child's results for both questionnaires against how many unique technologies they chose for that location across the two questionnaires. An example of this would be if a child had a percentage score of 7/15 for the school question they would have identified 7 technologies on both questionnaires for this question. However, they identified a total of 15 individual technologies for this question across the two questionnaires showing that 8 technologies they chose only appeared in the results of one of the questionnaires and not the other.

Table 5.3: Study 3 Questionnaire Results

	School				Home			
Child	**Only Pictoral**	**Pictoral & Written**	**Only Written**	**Total**	**Only Pictoral**	**Pictoral & Written**	**Only Written**	**Total**
1	4	0	4	0/8	0	7	8	7/15
2	2	1	5	1/8	1	5	4	5/10
3	3	1	6	1/10	1	2	4	2/7
4	2	3	8	3/13	1	3	8	3/12
5	0	2	6	2/8	4	0	5	0/9
6	2	8	0	8/10	4	5	3	5/12
7	2	7	2	7/11	1	4	2	4/7
8	2	3	3	3/8	2	2	5	2/9
9	2	4	5	4/11	1	6	4	6/11
10	8	0	2	0/10	7	1	2	1/10
11	2	7	2	7/11	4	5	2	5/11
12	1	9	1	9/11	0	10	3	10/13
13	1	7	4	7/12	6	6	2	6/14
14	3	8	3	8/14	1	14	0	14/15
15	2	1	6	1/9	2	2	6	2/10
16	4	7	1	7/12	7	5	3	5/15
17	4	1	4	1/9	0	11	4	11/15
18	2	10	2	10/14	1	14	0	14/15
19	6	7	0	7/13	6	9	0	9/15

In both the home and school results, 58% of the children had less than half the technologies they stated to overall in each location on both questionnaires. The 58% did not consist of the exactly the same children between the two questions and for the majority of these children their results were significantly lower than a half. None of the children in the study produced the same results for either of the locations across the two questionnaires.

5.4.4 Discussion

This study was carried out to compare the use of pictoral and written questionnaires and identify any problems with either technique. The most significant result found, and one that heavily rejects the hypothesis, is that over 50% of the children, for both the home and the school question, produced a fractional value that was less than ½.

This value tells us that less than half of the technologies each of this set of children stated as having their schools or homes actually appears in their results for both of the questionnaires. It is further noted that the majority of these had much lower values such as 0/10, 1/10, 0/8 and 1/9 to highlight but a few. This in short shows that the majority of children who took part in this study gave answers that were very different to the same questions in questionnaires that were administered just one week apart.

This alone brings into question the validity of children's responses as either of these questionnaires would have produced results in a study that look perfectly valid but could have had different implications as supporting evidence or in corroborating findings due to the major difference in responses. An example of this could be that using one technique the majority of children report they have a computer at home where as using the other they do not. This could be significant if carrying out a study where prior use or knowledge of a computer is important to the research design and justifications for the results.

Another finding that also highlights this issue is that not one single child, for either of the questions, had matching answers across the two questionnaires. Looking at this as a comparison of the same question asked twice to the same person, none of the 38 questions resulted in exactly the same answer. If this is the case then once again how can the results from either questionnaire be valid.

Listening to the children who completed the pictoral questionnaire it was clear to see that a certain amount of picture matching was taking place. This is where a picture is chosen, or not chosen, due to the specific brand or type of technology that is shown of the picture rather than thinking of the picture as a generic representation of the technology in question. An example of this is that the image used to represent games consoles was a collection of an Xbox, PS2 and Nintendo Wii console. If a child had a games console but it was not one of these then they might not choose they had one because theirs is not shown in the picture. Supporting evidence in this instance was seen in that some children cut out the Nintendo Wii and glued that to the picture of their house and threw away the Xbox and PS2.

The use of pictoral representations in scales and question types was not studied here as it is clear from literature that these are known to be valid and reliable for use with children. The problem this study highlights is the use of images as a representation of a generic type of technology. Without the words to inform the children that these are supposed to be generic, the children appear to make the decision on whether it is a generic representation on a technology by technology basis. There was no evidence either within the results obtained from the children, or in the observations of the children completing the questionnaires, that they had any problems completing the written questionnaires. The findings from Study 2 will have helped reduce issues highlighted with written questionnaires in Study 1 but it is acknowledged that a small number of children could still have had problems that were not identified.

It is acknowledged that changing the order that the questionnaires were administered may have had an effect on the results obtained although it is unlikely to affect the observational findings discussed within this section. The problem of picture matching appears to be the major factor in the results obtained and it is expected this issue would have been recorded in the observational data whether the pictoral questionnaire was completed first or second.

5.4.5 Conclusions

This study has highlighted some serious issues with the validity of questionnaire answers given by children from the varying results. The use of different questionnaire styles has been shown to have an effect on the result and therefore a further study into the reliability of responses is still required.

The use of pictures whilst supported in literature, particularly with younger children, does seem problematic with technology as children appear able to identify generic representations of certain technologies but not all, individual games consoles been seen as separate items is a good example of this. A way around this problem may be using children to create representations of the generic technologies instead of branded photographic examples.

The results from this study do not reject the use of images as a whole, particularly not in question design such as visual scales, but highlight issues that can occur when using images to represent technology. The hypothesis that the two different questionnaire techniques would be similar was proved incorrect. The qualitative data evidenced that using images of technology devices within questionnaires caused added problems for the children. This was unexpected as it was anticipated that the introduction of images instead of words would make the questionnaire simpler to complete.

5.5 STUDY 4 – Comparison of Child Responses to their Parents

Study 3 provided little evidence of children being able to reliably complete questionnaires. Due to the problems with images in the pictoral questionnaire the reliability of responses could not properly be analysed and instead the study was more useful in identifying the problems of using images. Another way of testing reliability is by comparing a child's results with that of someone else who in theory should provide identical results and looking at the similarities between the two sets of answers. To this end, the purpose of this study is to investigate children's responses to technologies they have within their home by comparing them with the responses given by their parents to the same question. The hypothesis at this stage is that the results will vary significantly although not by the same amount as seen in study 3.

5.5.1 Participants

Initially this study was sent out to 90 parents at a local primary school with children across the age range of 6 to 10 years old. Only 13 were returned, one of which had to be disregarded due to insufficient information about the participant (discussed in section 3.5.4). It was decided that 12 participants was not sufficient so the study was sent out to another 60 parents at a different primary school. 12 responses were received giving a total of 24 families (parent and child) participating in this study from two local primary schools. None of the children or parents involved had previously taken part in any related research.

All the children were given the option of whether to participate in the study even though their parents had already completed their questionnaire.

5.5.2 Questionnaire Design & Method

The questionnaires sent out to the parents were completed within their own homes and therefore the setup of how they completed the questionnaire cannot be ascertained. The completed questionnaires were then taken to the relevant primary school where, in both cases, the head teacher of the primary school identified the relevant children whose parents had completed the questionnaire. These children were then brought to the staff room two at a time to complete the corresponding questionnaire. In both locations the children were sat at separate tables and given 10 minutes to complete the task.

The questionnaires given to the parents differed slightly from the questionnaires given to the children. The parent questionnaire (see figure 5.3) contained three open ended identification questions to start where the name of the parent, child, and school year of the child were recorded. This was to enable the identification of their child in order for them to be given the corresponding questionnaire. The next question was presented in tabular form where the parent had to select which technologies they had within their homes, who owned the technology, and whether the child was allowed to use it. By asking about ownership and use also it would also allow a comparison of whether the child’s answers were more accurate to the technologies they have in their homes or the technologies they are able to use. The technology list used for this question was again the original pre-defined list of 15 technologies. As a way of refining/updating this technology list, the parents were also given two open ended questions in which they were asked to state any technologies they felt should be added, or removed from the list.

Technology Questionnaire

Name: ……………………………………………………………………

Child: ……………………………………………………………………

Child's School Class: …………………………………………………

Please choose which of these technologies you have at home, who owns the technology *(mum, dad, brother, sister, child, shared)*, and whether your child is allowed to use it.

Item	Have in the home	Owned by	Child can use
Example: TV	✓	*shared*	✓
Mobile Phone			
Laptop			
Games Console			
Photocopier			
Video Camera			
Video Recorder			
DVD Player			
Printer/Copier/Scanner			
Home Telephone			
Computer (PC)			
Handheld Console			
Printer			
Interactive Whiteboard			
Television			
Digital Camera			

Are there any technologies you feel should not be included in the table above, and why?

Are there any technologies you feel are missing from the table above, and why?

Figure 5.3: Study 4 parent questionnaire

The child questionnaire consisted of two open ended questions to record the child's name and age and also a closed question asking for their gender. No other personal data was collected from the children and the name of the school was omitted from any paperwork related to the data to help protect the anonymity of the children, and parents, involved in the study. The children were then asked to choose which technologies they had at home from the same list of 15 technologies given to their parents. This question was again presented in a table where the child had to tick the boxes next to the technology they had.

5.5.3 Results

As highlighted in section 5.5.1, out of 150 questionnaires sent out to parents there were only 25 returned, one of which had to be disregarded due to insufficient information about the participant. Therefore the response rate from parents was only 16%.

The results in table 5.4 show that when comparing the children's responses on what technologies they have in their home with the response of their parents (CP) there is an 80% match with 71% of the children having a match of 80% or above. When comparing the children's responses against the responses given by the parents stating which of the technologies the children have access to (CA) the match is reduced to an average of 74%. The findings suggest that children are capable of accurately identifying technologies they have in their homes that they do not have access to or simply do not use which again supports the finding in study 2 that children do understand the concept of ownership. It is worth noting that on two of the occasions where the results of CP and CA have the same percentage match, the responses given were actually different (e.g: in the CP answer it was the response to the printer that was different whereas in the CA answer it was the games console). This difference although worth highlighting was not analysed further.

Table 5.4: The accuracy between the Child/Parent (CP) and Child/Access (CA) responses

Child	CP (%)	CA (%)
1	86.67	86.67
2	66.67	66.67
3	100	100
4	93.33	53.33
5	80	80
6	86.67	80
7	80	66.67
8	80	60
9	60	46.67
10	86.67	73.33
11	93.33	80
12	93.33	93.33
13	93.33	80
14	80	86.67
15	46.67	73.33
16	73.33	66.67
17	66.67	73.33
18	86.67	46.67
19	80	80
20	86.67	86.67
21	80	80
22	86.67	93.33
23	60	53.33
24	73.33	73.33
	80.00	**74.17**

Table 5.5 shows a comparison of the results that would have been gathered by asking the parents and the children as two separate results which technologies they have within their homes. Four of the technologies produced identical results between the two samples with 80% of the technologies having a difference of three or less. The three items that showed a larger difference in responses were the video recorder, computer (PC), and printer. These devices are discussed further in section 3.5.4.

Table 5.5: The response differences between the child and parents as separate groups to the question of which items they have within their homes.

Item	Children	Parents
Mobile Phone	22	22
Laptop	24	24
Games Console	22	22
Photocopier	13	11
Video Camera	18	16
Video Recorder	17	8
DVD Player	24	23
Printer/Copier/Scanner	16	17
Home Telephone	22	19
Computer (PC)	17	12
Handheld Console	20	19
Printer	18	13
Interactive Whiteboard	1	0
Television	24	24
Digital Camera	22	20

5.5.4 Discussion

The results shown in table 5.4 and table 5.5 provides evidence that children are capable of reporting the technologies they have within their homes accurately which is not in line with the hypothesis for this study. The results given by the children had an 80% inter-coder reliability match overall to those given by their parents which shows that children can complete questionnaires reliably as within inter-code reliability testing a score of 0.80 (80%) or above is considered acceptable and is greater than the 0.70 (70%) that is considered appropriate in exploratory studies (Lombard, Snyder-Duch, & Bracken, 2005). The more interesting findings in this study come from a qualitative analysis of both the parent and child versions of the questionnaire.

The disappointing parental response rate of 15% was expected. The parents received their questionnaires from the school and were provided with a prepaid envelope to return them completed (although they were given the option to return them to school) and it is well known in literature that the response rate for postal surveys is low.

The results shown in table 5.5 begin to identify items that are becoming the norm in households that contain children. The children and adults who took part in this study reported to all having laptops and televisions within their homes. Almost all houses contain games consoles, DVD players, mobile and home telephones, some variation of printing device and a digital camera. This sort of data is useful as it identifies common technologies the majority of children will be introduced to and have knowledge of. Care must be taken not to mix this knowledge of technology with the experience a child has had using the technology as, for example, having a laptop in the house does in no way imply that a child has ever used it. The validity of a whole study could be brought into question by a researcher misinterpreting the difference between having access to a technology and the experience of using it. There is also a risk with this sort of demographic information that it does not fit an entire population. The demographics may only be true of children in a single town in a single country. However, they could be true for a whole city, state, country or several different countries. What a child has access to in the UK or US house will be different to that of a child living in poverty in a third world country.

The video recorder, printer and computer (PC) were the three devices where the results between parents and the children had a greater difference (see in table 5) and further investigation has come up with some interesting possibilities as to why.

The video recorder (VCR) is a device for playing and recording video tapes. Whilst this technology is still in use it has been overtaken by technologies such as DVD, Blu-ray and digital recorders and players. The decline of the VCR coincided with invention of the DVD in the late 1990's and its wide uptake in the early 2000's. Current pre high school children (aged 12 and below) will not have been born until after the year 2000 which could be a reason why there appears to be confusion as to what this device actually is. One child in the study stated he had a video recorder on his iPod (this was written on the questionnaire where the tick should have been placed in the box). We as researchers know that it is impossible to put a video cassette into an iPod and play it. However, the iPod is capable of recording and playing digital content so as far as a child is concerned this device could quite conceivably be classed as a video recorder.

The printer was another device with differing results. It is worth again noting at this point that the multifunctional printer/copier/scanner and also a photocopier were present on the questionnaire as separate items to the common printer. There were instances in the results, both with the children and parents, where all three of these items had been selected. This is more evident with the children's results but does highlight a possible problem with technologies that have multiple functions. It is quite plausible that some of the families have all three devices but it is more likely that in most cases a family will have a multifunctional device that is capable of printing, scanning and photocopying. This presents a child with a dilemma when completing a questionnaire as to whether they should state they have all these devices as technically they do or whether they should just select the multifunctional device from the list and ignore the other two if they do not have a device that specifically carries out the one task. As noted previously, this was also an issue for the parents of the children and therefore an issue that would also need considering when asking similar questions to adults although this is not within the scope of this thesis.

The difference found in the PC results is a little different in that there is no clear reason as to what the cause of this might be. The most likely explanation is one that supports the findings from study 1 and study 2 where the understanding of the technology wording appears to be an issue. It is likely that the children read the technology 'computer (PC)' as simply 'computer' in which case a laptop may then fit into this bracket. Within the school system the term 'computer' is often used to refer to both desktop and laptop computers and therefore it is likely some children may not have understood the acronym PC as a distinction for the desktop computer. Also the physical distinction between the devices is narrowing with many people now using laptop computers as portable desktop machines. The desktop computer came to prominence in the 1980's and 1990's and at that time was referred to as a personal computer or PC for short. During this time, the laptop computer was a high end device with a clear distinction from a desktop machine so it is unlikely parents would have the same problem identifying the term *'computer (PC)'* as much as a child.

Similarly to the findings in study 2, there has been a shift in the understanding of different technologies within the home. Children in study 1 appeared to struggle to understand what an interactive whiteboard was with several stating they had them in the home. This current group appeared to understand these devices completely. This is probably due the time between the studies and the UK government policy requiring all school classrooms to contain interactive whiteboards that has been in place during this gap. The reverse of this is the decline in the understanding of what a video recorder is over the same period.

The range of technologies that children have within their homes is changing all the time. What is interesting and potentially important for a researcher is the point at which a certain technology is no longer considered to be important. There is strong evidence to suggest mobile devices such as Android Tablets and iPods should be included in a list of technologies that children could have at home and this view was supported by comments made by the parents in the study who were asked about the technology list and what should and should not be included. The responses to these questions also brought up the question whether the video recorder should be removed. Is there any advantage in knowing whether a child knows how to use the out of date functionally of this device?

More and more devices, particularly mobile devices such as mobile phones and tablet/touch devices (including Android Tablets, iPods and iPads) are being created with more and more functionality. It is not implausible for a mobile device to be a phone, digital camera, video camera, video player, music player, sound recorder, games console, television or even classed as a mini PC with functionality such as basic word processing, spreadsheets and photo editing all available on these devices through programs and apps. This poses a dilemma for those seeking to discover the extent of, and the expertise in, technology use in the home. Should a child be stating they have say a mobile phone or should they be able to tick they have several technologies even if they are built in to just one device.

An interesting side note to this study was that there appeared to be at least 6 instances across the 24 responses from the parents where the parent had failed to complete the questionnaire. One parent who filled in the whole questionnaire neglected to fill in their name or the name of their child so the child questionnaire could not be carried out. Three separate parents stated they did not have certain technologies in the house, but then stated that the children had access to these technologies in the house, whilst also stating which members of the household owned the devices in question. One parent commented that iPods and iPads should be removed from the technology list (these items are not actually in the list that was used) when asked the question of what should be removed. The same family also said that iPods and iPads should be added to the questionnaire in the next question. Whilst this does not directly affect the children in this study it does highlight how easy it can be for adults to make simple mistakes when completing questionnaires meaning researchers must be even more careful and vigilant when designing surveys for children and analyzing their results.

5.5.5 Conclusions

This study has shown the accuracy in children's responses to technologies they have within their households and their ability to recognize technologies that are in these spaces that they may not actually use or even have access to.

The more interesting findings come from the discussion where the constant changing and enhancements to technology is affecting children's knowledge, understanding and perceptions of certain devices. Multifunctional devices and the addition of more and more features to devices that originally had only one function appears to cause confusion for children (and adults).

Surveys for children may need to concentrate on the functionalities of products, or task instead of technology; thus, a future survey may need to look more like this:

- Do you have a mobile phone ?
    - Do you take photos with this device?
    - Do you make phone calls with this device?
    - Do you make videos with this device?
    - Do you watch videos with this device?
    - Do you play music on this device?
    - Do you play games on this device?
- Do you have a laptop ?
    - Do you take photos with this device?
    - Do you make phone calls with this device?
    - Do you make videos with this device?
    - Do you watch videos on this device?
    - Do you play music on this device?

- Do you play games on this device?

You could end up asking the same questions for devices that were originally created for completely different purposes but now offer similar functionality. In reality a laptop is likely to be used for more traditional computer related activities such as word processing on top of this as this becomes increasing more difficult on devices with smaller screens and therefore less likely, although not impossible.

It appears that in the quest for more reliable responses we need to ask more questions. With additional questions being put in front of children and parents there will be more risk of improper completion, more guesswork, and less reliability. This will then lead to questions being asked about the extent to which the use of the device is important and questions about the experience of the function perhaps being more important than the experience of the device. This is without taking into account the time each device or function is used and also the frequency. The true issue may be finding the point where the amount of questions starts to have a negative effect on the survey process.

5.6 STUDY 5 – Use of Children's Drawings to Represent Technology

Realising that photographic images of technologies might not be always understood in the correct context by children (evidenced in study 3 and from conversations with children) it would be interesting to see how children drew representations of technologies in order to find out what the identifying features of different technologies are, for instance, to a child is a keypad of a phone the key aspect, is the mouse on a computer the key aspect. This study was carried out to collect a sample of children's drawings of technologies and to evaluate these drawings as to their understandability.

5.6.1 Participants

This research was carried by children from a local primary school using two classes from different Key Stage (KS) levels of the National Curriculum. 20 children aged 6 from a year 2 (KS1) class and 23 children aged 9 and 10 from a year 5 (KS2) class. These children were different to the children used in all the previous studies. These classes were chosen as they represent children at the top and bottom of the age range that the work in this thesis is aimed at. It was unfortunate that, on the day of the study, none of the Year 2 children (Year 2 is children aged 6 and 7 years old) that participated in this study were actually 7 years old.

All children within the class were given the option to take part in the study and the children were told they could stop participating in the research at any time.

5.6.2 Questionnaire Design & Method

The study was carried out in the IDPCC lab at the university. The children who participated in this study had carried out other unrelated research within this laboratory previously and also throughout this day and therefore were comfortable with the research surroundings. Two children completed the study at the same time and were sat at different ends of a large desk. One child from Year 5 completed the study on their own although a member of the school's staff was present in the room (the staff member was instructed not to communicate with the child during the study). The children were given 15 minutes in which to complete the task.

The children were given two sheets of paper with 18 boxes on (see figure 5.4). 15 of these boxes had the name of a technology in them and they were instructed to draw that technology within the box. The other boxes were available if a child made an error so they could draw the technology again.

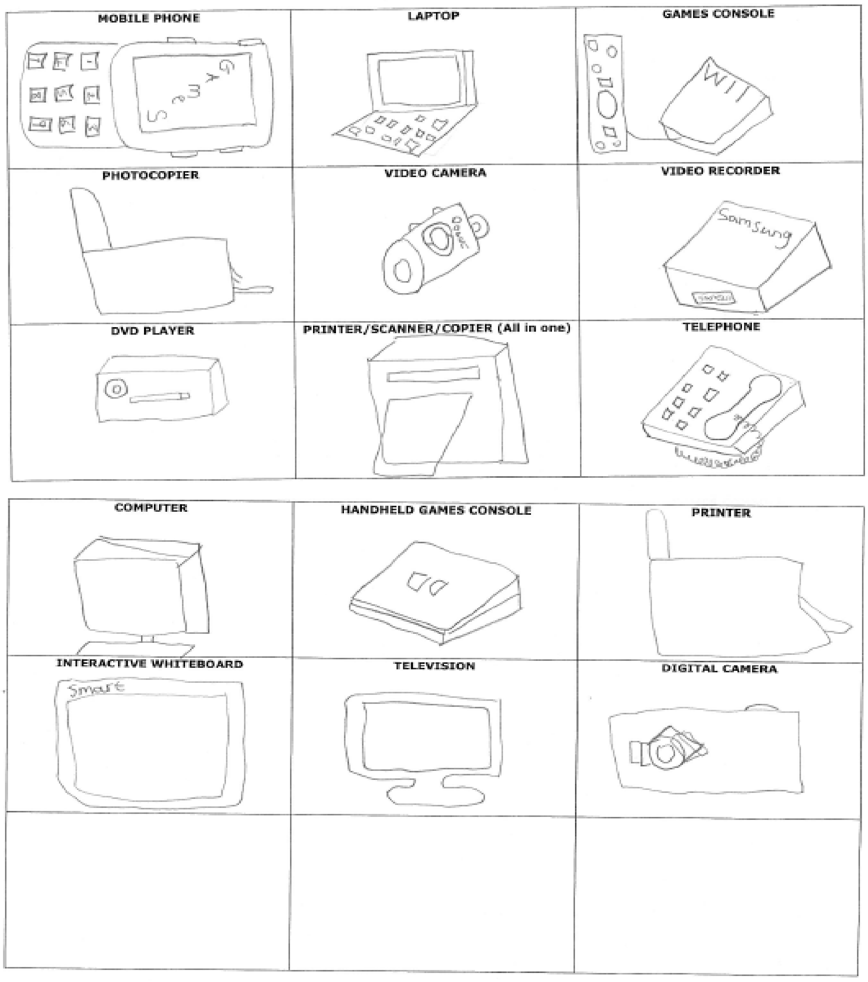


Figure 5.4: An example of a completed set of child drawings

5.6.3 Results

The results from the two age groups can be seen in table 5.6 and table 5.7. Each drawing was analysed and placed into one of four categories:

- Clear – easy to tell what the child was drawing
- Possible – possible tell what the child was trying to draw
- Unclear – not able relate the drawing to the technology being drawn
- Nothing – The box was left empty

Table 5.6: The results from the Year 2 children.

Child	Age	Clear	Possible	Unclear	Nothing
1	6	3	5	2	5
2	6	2	5	7	0
3	6	3	2	6	1
4	6	0	6	9	0
5	6	1	4	8	2
6	6	2	6	7	0
7	6	2	8	4	1
8	6	4	6	5	0
9	6	0	2	4	7
10	6	1	4	6	4
11	6	1	5	7	1
12	6	0	2	12	1
13	6	5	1	1	8
14	6	1	5	8	1
15	6	1	3	10	1
16	6	3	8	4	0
17	6	3	5	6	1
18	6	3	5	4	3
19	6	1	9	5	0
20	6	1	8	4	2

Table 5.7: The results from the Year 5 children

Child	Age	Clear	Possible	Unclear	Nothing
21	9	7	3	5	0
22	9	6	6	3	0
23	9	9	1	5	0
24	10	8	6	1	0
25	9	6	6	3	0
26	9	3	8	4	0
27	9	2	7	5	1
28	10	4	9	2	0
29	9	9	5	1	0
30	9	2	4	9	0
31	9	6	5	4	0
32	9	4	6	4	0
33	9	2	5	8	0
34	10	6	7	2	0
35	9	2	8	5	0
36	9	5	7	3	0
37	10	7	6	2	0
38	9	1	10	2	2
39	9	2	10	3	0
40	9	2	2	11	0
41	9	6	6	0	3
42	9	2	7	6	0
43	9	3	7	5	0

The main result visible from this study shows that younger children produced more unclear pictures and less clear pictures than the older group. The younger group also provided a greater number of empty boxes where they had not drawn the technology.

5.6.4 Discussion

Comparing the results of the two groups highlights the difficulty of analysing the results produced by the children in Year 2. In general the results for these children showed a lot more of the pictures categorised as unclear whereas a lot less of the pictures we categorised as clear. This was expected as firstly it is more likely that the younger children have had less experience of the technologies and therefore do not draw them as accurately if at all, secondly, because in general children of 6 have not developed the same level of drawing skills as children of 9 and 10. This is further supported by the fact that in general the younger children left far more boxes empty than the older children.

From examining the actual drawings it was possible to draw some conclusions. Firstly, many children drew video cameras that looked more like digital cameras. This could be due to the fact they were unclear as to exactly what a video camera is, or because many digital cameras do have the facility to record small amounts of video so therefore can be used as a video camera. This again brings up the issue of multifunctional devices that was found in study 4 which appears to be having a big effect on children's responses and understanding of technology.

A large proportion of children simply drew a box for the interactive whiteboard which could lend support to the claim in study 1 that children might mistake a normal whiteboard at home for an interactive one. It is noted that causes such as drawing ability could have a lot to do with this. It is interesting to highlight that there was an interactive whiteboard present in the room where the children were drawing.

Some children drew similar pictures for mobile phones and house phones which was not originally anticipated although not a surprise as many cordless home telephones now look similar to mobile phones with some families in the UK opting not to have home telephones due to using their mobile phones as both. They also drew DVD players and video recorders very similarly in most cases which is easy to understand as these technologies do have a similar look in the real world.

Children do not appear to be very good at drawing technologies such as printers and photocopiers which could be due to less exposure to these items but also due to the box like shapes of some of these, particularly photocopiers where most of the design would have to be the close up details like the control panels and paper trays. The best drawn pictures on the whole were mobile phones, laptops, televisions and handheld games consoles.

Some children wrote on their drawings, such as DVD on the DVD player, or Wii on the games console. Whilst this did help to identify what they had drawn the writing was not taken into consideration if the drawing was still unclear by itself.

One child did get confused with the task and tried to write their telephone number in the box that asked for a telephone.

5.6.5 Conclusions

The results from this study have provided little help in highlighting the differences in what children think a piece of technology looks like, to what it actually looks like. This appears to bed due to the drawing abilities of the children. As expected better results were gathered from the older children but this does not necessarily mean they understood the technologies better it simply shows that older children are better at drawing.

Interesting observations were made of what the children actually drew which could make a difference to the images that should be used when constructing a pictoral questionnaire. These include similarities between mobile and home telephones and also DVD players and video recorders. The occurrence of issues related to devices with additional functionality presented itself again and is becoming a common factor in problems found using technology in questionnaires with children.

5.7 CONCLUSIONS

The work in this chapter presented exploratory studies aimed at identifying the main issues faced when using survey methods to elicit children's self report of technology use.

Study 1 identified 3 key issues that needed to be addressed, these being:

- Whether children randomly select technology?
- The reliability of children's responses.
- Whether ownership posed an issue when reporting technology.

5.7.1 Whether Children Randomly Select Technology?

The results of study 2 identified that when children are presented with technology options that are not valid they do not choose these options. This shows that the problems identified in study 1, where the children selected technologies that would not normally be found in the house, is not due to them completing the questionnaire by picking random answers. This problem occurs when the children do not fully understand what a specific technology is, either by not understanding the wording of the name of the technology, not knowing what the technology is, or by confusing the technology with something that looks, or acts in a similar fashion. It was evident over the length of time between all the studies that the understanding of some technologies increased as they became more mainstream and embedded in children's lives with the opposite occurring with older technologies becoming less understood due to them being superseded by newer and improved technologies and therefore less likely to have been exposed to the child.

When creating questionnaires with children it may be necessary to provide an option where they can select they are unsure of a technology or do not know what it is in order to reduce invalid responses. In support of Vygotsky's (1978) theory, the use of a facilitator, or MKO, is another way in which the reliability could be increased in this case as this person could ensure that each child fully understood what each technology was whilst not helping them actually answer the question. This could be done with children completing the questionnaires in groups as to not provide the same overheads associated with interviews rather than questionnaires.

5.7.2 The Reliability of Children's Responses

The results from study 4 provided compelling evidence that the responses given by children are accurately measured by how close they were to those given by their parents. This gives credence to the fact prior experience of technology can be gathered reliably by children and supports the notion that children can be used as subjects in studies using questionnaires. Study 3 highlighted problems associated with the use of pictoral questionnaires as a different technique for administering a questionnaire to children. This is not in respect to visual questions styles such as visual scales but relates to children's perceptions of what the image is portraying. There appear to be differences between technologies, with images of some being seen as a generic representation, whilst others relate to specific products. This causes real problems in justifying the use of technology images if, for example, an image of an iPhone is seen as an iPhone and not a generic mobile phone whilst at the same time an image of a Samsung 3D LED TV is seen as an image for televisions in general.

5.7.3 Whether Ownership Posed an Issue when Reporting Technology

Whilst ownership did appear to be an issue in study 1, simply providing detailed instruction, either written or verbal, removed this problem as evidenced in study 2 which added credence to the assumption that children of a young age are susceptible to questions with a literal meaning (Borgers et al., 2000) and the view that simplifying question by providing added support can alleviate this problem. This was also supported in the findings of study 4 where the children's responses were closer to those of their parents when items they did not own or use were taken into account. Therefore, it can be concluded that children are capable of understanding the construct of ownership and can differentiate between items they own, items that are present in a specific location but not owned by themselves, and shared items within households that they may interact with or use, but not actually own.

5.7.4 Further Issues

As a follow on to study 4 involving images, study 5, looked at children's drawings of technologies and provided strong evidence that children's drawings of technologies were not of a sufficient quality to be used as graphical representations of technology. As predicted the quality of images analysed was lower in the younger children. This study did show how children believe some technology to be very similar in appearance which could account for issues understanding the differences between the technologies themselves, further supporting the view that images are not a good method for representing technologies with children.

The drawing of wrong devices due to the multifunctional nature of some technologies (like the digital camera being drawn instead of the video recorder) supported the major issue to come out of study 4 which was that of enhancements and added functionality affecting children's knowledge, understanding, and perceptions of technology. Many technologies are adding more and more features/functions that are the primary functions of other technologies and this appears to be confusing children which brings up the question of whether task is more important than technology. This issue of multifunctional devices will therefore be the focus of the next chapter of this thesis.

It was evident in the running of all the studies presented in this chapter that having a facilitator present was beneficial to the children. Simple clarification questions such as "Where do I write my answer?" and "Do I tick more than one box?" could be answered quickly allowing children to concentrate on completing the task rather than worrying about whether they were doing it correctly. An explanation of certain words was required on occasion, again ensuring that the children fully understood what was being asked and were certain of the meaning of specific words and specific technologies. This again supports the opinion that a facilitator should be present in all research with children and follows the social developmental theories of Vygotsky (1978). The facilitator was able to remove anxiety from the children when the need arose by removing any unnecessary confusion or worry with simple explanations. On occasions, particularly with the younger children, questions, or parts of questions, could be read out when reading ability was an issue. It was not that the children did not understand the questions, it was that the children were not capable of reading the words, even though when spoken they knew exactly what they meant.

5.7.5 Chapter Contributions

The contributions presented here have been derived from the studies presented in this chapter:

SC5.1 **Device perception –** devices may exist that to children look similar which could be perceived as being the device in question, an example being the whiteboard and the interactive whiteboard. Researchers must be aware of this issue and provide further information for clarification if required.

SC5.2 **Impossible choices –** children will not choose responses that are impossible to be true if they understand the question. Occurrences where results can be questioned this way are likely due to a lack of understanding in response options, a problem that will need to be addressed.

SC5.3 **Ownership –** given sufficient information at the beginning of a survey, children are capable of understanding the concept of ownership and can differentiate between items that are present in a particular location and items in that location they may own, or have access to.

SC5.4 **Instructions –** the careful wording of instructions at the beginning of a survey can clear up potential ambiguities such as ownership. If a child has a full understanding of the purpose of a survey then they are more likely to give reliable results.

SC5.5 **Representation of technology** – using images of products to represent technologies causes problems for children. Representing a games console with a PS3 for example is not sufficient as some children may have a different console and therefore not see the PS3 as relevant to them even though it is being used as a representation. Children are more able to understand the written meaning games console than to make assumptions about the meaning of an image.

SC5.6 **Reliability of self report –** children in general are capable of reliably reporting about technology if there are no ambiguities in the questions (such as in SC5.5).

SC5.7 **Knowledge ≠ usage –** knowledge of a piece of technology does not imply that a child is capable of using it or has any understanding of how it works.

SC5.8 **Multifunctional devices –** children can have problems classifying a multifunctional device under one label if in their opinion it is the primary device for carrying out other tasks that may be asked within a survey. For example, they may be unsure where to classify a multifunctional printer as just this, or also as a scanner, printer, or photocopier as it is capable of carrying out all these functions.

SC5.9 **Terminology –** it is important to use appropriate terminology for technology as words that are common for a researcher may be unheard of by children as devices may now be known by a different name. Both children and teachers can help alleviate such problems.

SC5.10 **Children's representation of technology –** the drawing ability of children within the age range of this work is very varied with the drawing ability of younger children a particular problem. Older children can provider clearer representations although often provide similar drawings for different technologies.

SC5.11 **Similar devices –** children can have issues differentiating devices that look similar supporting the argument to use written words rather than graphic representations of technology. To a child, a video player and

DVD player may be considered the same device as both are capable of showing movies and are similar in appearance.

SC5.12 **Appropriate technologies –** as well as using the correct terminology for devices, reliability problems can occur when using technologies that are unfamiliar to children (such as legacy technologies that have not been in production since the children were born). It is easy for researchers to forget how long it is since a device was common place and it may be that young children will never encounter devices we consider to be well known.

SC5.13 **Use of a facilitator –** the presence of a trained facilitator in the administration of a survey can increase reliability as they are able to clarify any questions and constructs that are unclear to a child and can provide assistance in understanding the language.

6 CHAPTER SIX: FEATURE CREEP AND BLOAT

One of the major issues to surface during the studies in chapter 5 is that of the increase in multi-functional devices in the marketplace and the effects that it is having on the knowledge, understanding, and perceptions that children have of technology. The aim of this chapter is to investigate the use of multi-functional devices by children and to determine the implications that this has for surveying children about their prior experiences of using or interacting with technology.

In recent years the added functionality that has continued to appear in smart phones has led to these devices taking over from other, single use, traditional devices like cameras and clocks. A recent study by the UK mobile phone provider O2 reports that 54% of adult users now use their phone instead of an alarm clock, 46% have dispensed with their watches, 39% use their phone rather than a camera and 11% use phone instead of a PC (O2, 2012). A simple search on the internet, for information about the sale of smartphones, provides countless news stories on how the global sales of smartphones have overtaken those of technologies such as PCs, laptops and digital cameras. Media commentary is also common blaming smartphones for the demise, or impending demise, of technologies such as the MP3 player, digital camera, satellite navigation system, and even the landline telephone (Bloomberg, 2010).

The current trend in the design and manufacture of portable devices such as the smartphone and tablet computer has been to increase the functions these devices are capable of physically performing and to provide applications to utilise this functionality to perform even more tasks. This, coupled with increased processing power, memory, battery life and graphical capabilities, is allowing users to abandon of many devices that they once considered essential in favour of this ‘Swiss army knife’ device, a single device fulfilling all their needs (Jones & Marsden, 2006).

Of course this is not the first time this has happened. In the 1970s a device called a word processor was invented as a digital replacement for the typewriter and electronic typewriter. This word processor incorporated a digital display, basic text editing functionality, and disk, or tape, storage. It then wasn’t long before the multi-functional desktop computer arrived which allowed users to use software to carry out many other tasks but included a now software version of a ‘word processor’ that allowed the desktop computer to carry out the same tasks as the stand alone word processor.

The modern word processor would be currently described, not as a device nor even as a piece of software only capable of basic text editing. Today a word processing package allows advanced text editing, the use of tables, graphs, shapes, images (including image editing), website creation and many more features. A study by Hsi and Potts (Hsi & Potts, 2000) highlighted the increase of functions in Microsoft Word from 311 in Word 2.0 to 955 in Word 97. A spreadsheet released by Microsoft identifying location changes of functions between Word 2003 and Word 2007 had 1264 functions listed on it.

All of this expansion, of software and hardware capabilities has many implications for HCI. One area, where understanding what product is used for what task, is in the understanding of prior experience with technology. Often in HCI there is a need to ascertain the prior experience or knowledge of study participants especially where that could have an effect on study design or on results. The ever changing nature of technology and the multi-functionality that is creeping into devices is destroying assumptions that could once be made surrounding experience from the use of a device or carrying out of a task. Now more than ever there is a need to understand and address these use changes and this multi device multi task landscape to ensure prior experience is correctly reported to maintain the integrity of work within the field.

Whilst this is a concern for all the HCI community, it is a more pressing concern for the Child Computer Interaction (CCI) community. With children there are additional variables that come into play such as their ability to carry out tasks, their access to technology, and their different social structures – each of these variables can further complicate this issue.

6.1 Feature Creep

Creeping Featurism is a term originally introduced to talk about the extra features being added to software (McGrenere & Moore, 2000), a practice of technology manufacturers aiming to get an edge over their competitors by making consumers feel they are getting value for money (McGrenere, 2002). The phrase was quickly linked with the term ‘bloatware’ and gained negative connotations where the increase in features did not outweigh the impact on resources or the increased complexity of use (Thagard, 1992).

It is interesting that this same creeping featurism has exploded onto the technology scene over the past few years with more and more devices being able to carry out the functions previously carried out by other devices whilst still performing their primary functions. So far, with technology, this feature creep has mainly positioned itself around the mobile phone and tablet markets, and it has predominantly been embraced by manufacturers and greeted with enthusiasm by consumers as the advancement of faster CPUs, better operating systems and smaller components has offset many of the issues associated with bloat. Where one physical device can perform many functions, the user is relieved of the burden of transporting multiple devices. Researchers on the other hand still stress the issues associated with feature creep and feature stress (Chai, 2009; Page, 2009; Biljon, Kotzé, & Renaud, 2008) although this appears to have had little impact on the speed of device and feature development.

Within a single technology, an increase in features raises issues of how to describe a technology when it is capable of carrying out so many tasks. In general, these devices still go by the legacy titles given to them when they predominantly only carried out a single primary task. A mobile or cell phone is such a device. The study by O2 showed that making phone calls is now down to fifth in the most common uses of the smart phone behind using the phone to browse the internet, to engage in social networking, to listen to music, and to participate in games (O2, 2012). Technology is now at a point where one physical device is capable of performing many tasks whilst at the same time many devices are capable of carrying out a single task.

6.2 STUDY 6 - Children’s Growing Adoption of Multi-Functional Devices

This study investigates the use of multi-functional devices by children and considers, against this backdrop, the implications this has on surveying / asking children about their prior experiences of using or interacting with technology. The study also investigates the significant impact the mobile phone appears to have on this transition from single use to multi-use devices for carrying out everyday technology supported tasks. In the research, questionnaires are used to discover the primary piece of technology used to carry out eight predefined tasks, all of which involve the use of technology. Key points to be investigated include:

- Which devices are most commonly used to complete each task?
- Is the task in question the primary function of the most commonly used device?

6.2.1 Participants

This study consisted of 47 children from two classes in the same UK primary school. 22 children aged between 7 and 8 years took part from a Year 3 class (lower KS2) and 25 children aged between 10 and 11 year took part from a year 6 class (higher KS2). Some of children involved in this study may have taken part in previous research within this thesis. However, due to the different nature of this study there will probably be no effect associated with this.

All the children within these classes were given the option of participating in the study and were informed they could stop participation at anytime.

6.2.2 Questionnaire Design and Method

This study was carried out within the IDPCC lab at the university. As with the previous study, the children had worked within this lab before and were accustomed to working with the research group. Children participated in this study in groups of three and four. Space was provided for two children to complete the study at either end of a large table in the middle of the room with a further two spaces available on the desks around the side of the room (with each child facing a different wall). The children were given 10 minutes in which to complete the task.

The aim of this study was to investigate the use of multi-functional devices by children and to determine the implications that this has on surveying children about their prior experiences of using or interacting with technology.

To facilitate this inquiry a set of eight tasks that are commonly carried out using technology was compiled. These tasks were split amongst three categories (A, B, C) predicted as having slightly different usage variations amongst children. The wording of each task was carefully considered to ensure the maximum comprehension of the task to reduce reliability issues with the responses. The wordings have been left in their ‘child friendly’ language throughout this chapter.

A – Tightly Coupled Tasks

Tightly coupled tasks traditionally are closely associated with a primary piece of technology with the task and technology often going hand in hand. The emergence of mobile and multi-functional devices is creating new methods for these tasks to be carried out. The tasks chosen for this category are:

- Listening to music
- Watching videos
- Playing games
- Going on the internet

B – Social/Situated Tasks

Social or situated tasks are those often carried out when the need arises or a moment occurs when a person feels need to carry out the task. They are often unplanned, although by no means always, and predominantly involve more than one person either at the time of the task or after the task has been completed. The tasks chosen for this category are:

- Taking photos
- Talking to friends

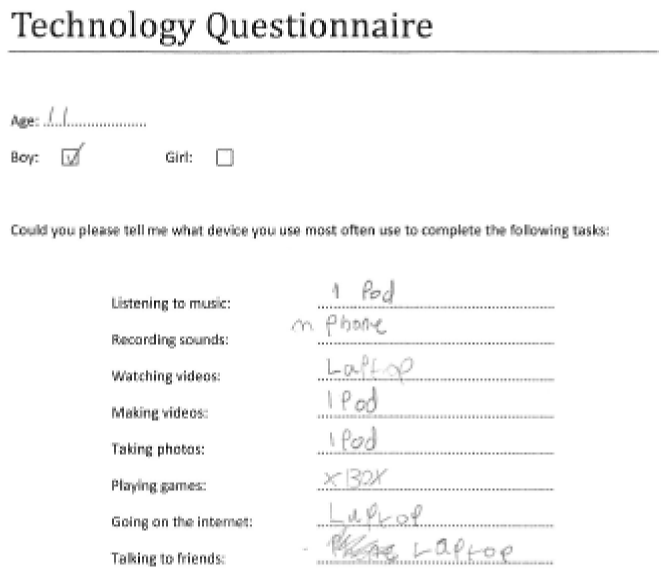
C – Construction Tasks

Construction tasks are often tightly planned and contain an element of skill or instruction to carry out. These tasks are also restricted due to access to technology available to complete them. With younger children these tasks are usually instigated and supervised by an adult and therefore less likely to take place. The tasks chosen for this category are:

- Recording sounds
- Making videos

An open ended questionnaire was designed (see figure 6.1) where the list of eight tasks was presented, not in any specific order, and the child was given space next to the task to write down which technology he or she used the most to carry out each task. Space was also provided on the questionnaire to record their age so that the results between two different age groups could be compared; no other personal data was collected.

The questionnaire instructions stated that only the most used technology for each task should be written and this was also re-emphasized, verbally, at the start of the questionnaire. The children were also asked to differentiate between a mobile phone and a home landline telephone particularly for the 'talking to friends' task as it is this task where the word phone could represent either.


Technology Questionnaire

Age: 11

Boy: ☑ Girl: ☐

Could you please tell me what device you use most often use to complete the following tasks:

Listening to music: i Pod
Recording sounds: m phone
Watching videos: Laptop
Making videos: I Pod
Taking photos: I Pod
Playing games: XBOX
Going on the internet: Laptop
Talking to friends: ~~Phone~~ Laptop

Figure 6.1: Example of completed questionnaire from study 6

6.2.3 Results

This section presents the results from the study. The results of one child from Year 3 were omitted as it was clear that this child had not at all understood the questionnaire having simply repeated the wording for the tasks as the technology used to complete the task. It was later discovered this child had only recently moved to the country and had very limited knowledge of the English language. This reduced the number of Year 3 children to 21. On a few occasions, despite being instructed otherwise, children provided more than one technology for some tasks and therefore a decision was taken to record only the first answer given. Computer and laptop were combined into one category, as were games consoles and handheld consoles. As explained in the previous section, mobile and phone were also treated the same for all tasks other than ‘talking to friends’.

Table 6.1: The most commonly used technology for each task across each age group and combined

TASK	YEAR 3	YEAR 6	COMBINED
Listening to music	Mobile Phone	Mobile Phone	Mobile Phone
Recording sounds	No Answer	Mobile Phone	Mobile Phone
Watching videos	Television	Television	Television
Making videos	No Answer	Mobile Phone	Mobile Phone
Taking photos	Digital Camera / Mobile Phone	Mobile Phone	Mobile Phone
Playing games	Games Console	Games Console	Games Console
Going on the internet	Computer	Computer	Computer
Talking to friends	Home Phone / No answer	Mobile Phone	Mobile Phone

Table 6.1 shows the most commonly used (modal) device used by each group of children, as well as the overall most used device (across both age groups) to carry out each of the eight tasks. In this summary data it is noted that for five out of the eight tasks, the most commonly used device across the combined age groups, and for the year 6 children when counted alone, is the mobile phone.

The charts (figures 6.2 – 6.9) shown in this section show the technologies selected for each task ranked in order of most used technology first with the total for each group shown separately.

6.2.3.1 Tightly Coupled Tasks

The results of the tightly coupled tasks evidence the fact that the use of traditional technologies is still high amongst children with *listening to music* being the only task not most frequently carried out by a device intended predominantly for this function. The uptake in mobile devices does become more apparent in the responses of the older children.

Listening to music

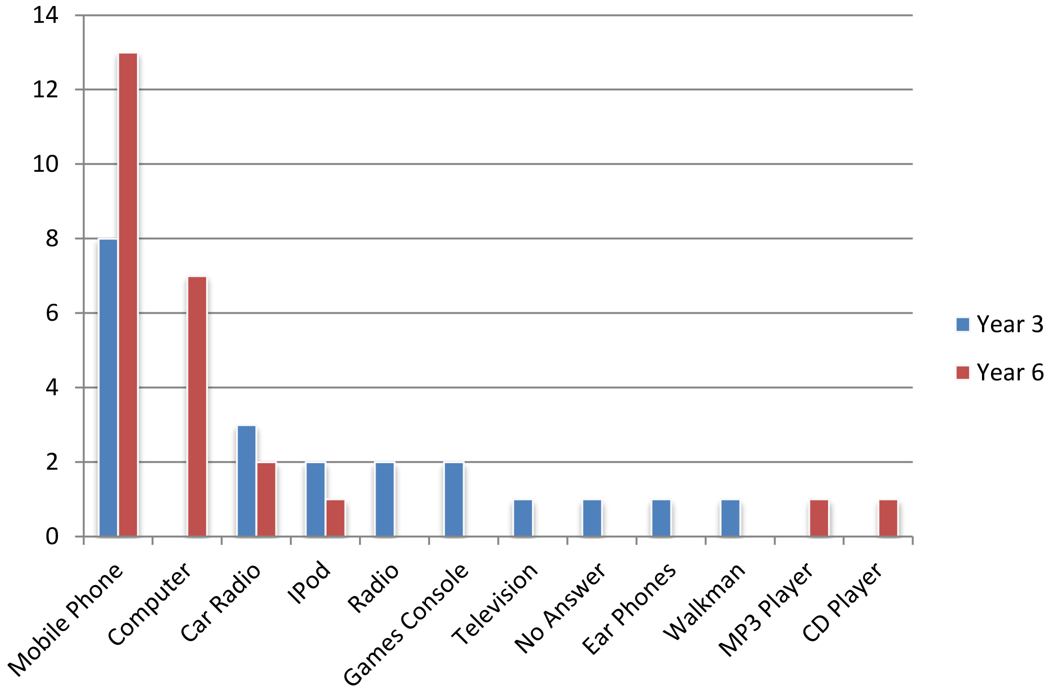


Figure 6.2: The frequency of technologies most commonly used to listen to music

38% of Year 3 children stated they used the mobile phone most with the second most popular device being the car radio at 14%. In Year 6 the most popular device was again the mobile phone with 52% stating they used this device. The computer was the second most popular device for this age group 28%. The combined results show that 46% of the children in the study use a mobile phone to listen to music with the second most popular device being the computer at 15%.

Watching Videos

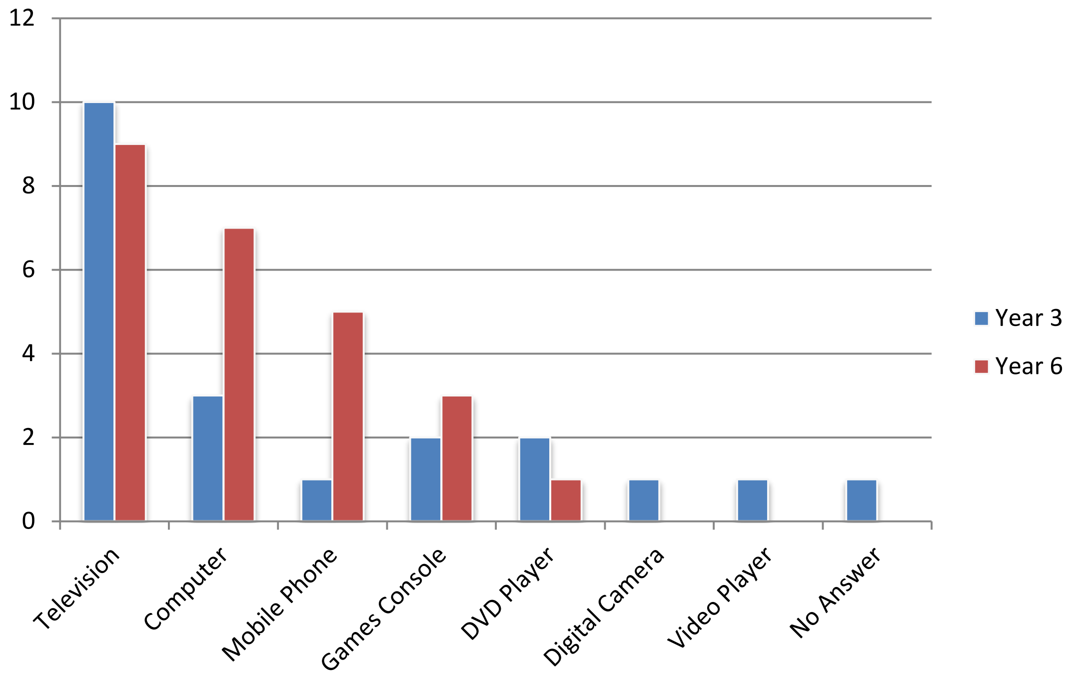


Figure 6.3: The frequency of technologies most commonly used for watching videos

48% of Year 3 children and 36% of Year 6 children use televisions (TV) as their primary way of watching videos. The second most popular technology for both groups was the computer with 15% of Year 3 children and 28% of Year 6 children choosing this device. The combined results show that 41% of all the children use a TV to watch video with a further 22% using a computer.

Playing Games

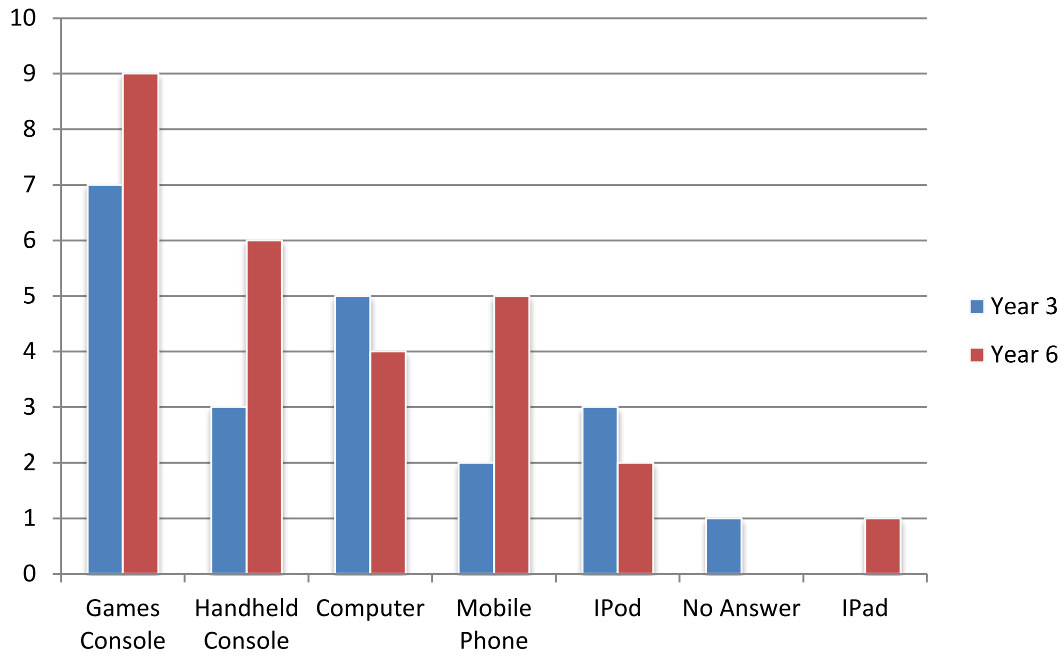


Figure 6.4: The frequency of technologies most commonly used for playing games

The most common device used for playing games by Year 3 was the games console at 33% following by the computer at 24%. Year 6 again used the games console most at 36% with 24% using handheld consoles such as the Nintendo DS. Overall the majority of children used a games console (35%) with 20% using handheld consoles and 20% using computers.

Going on the internet

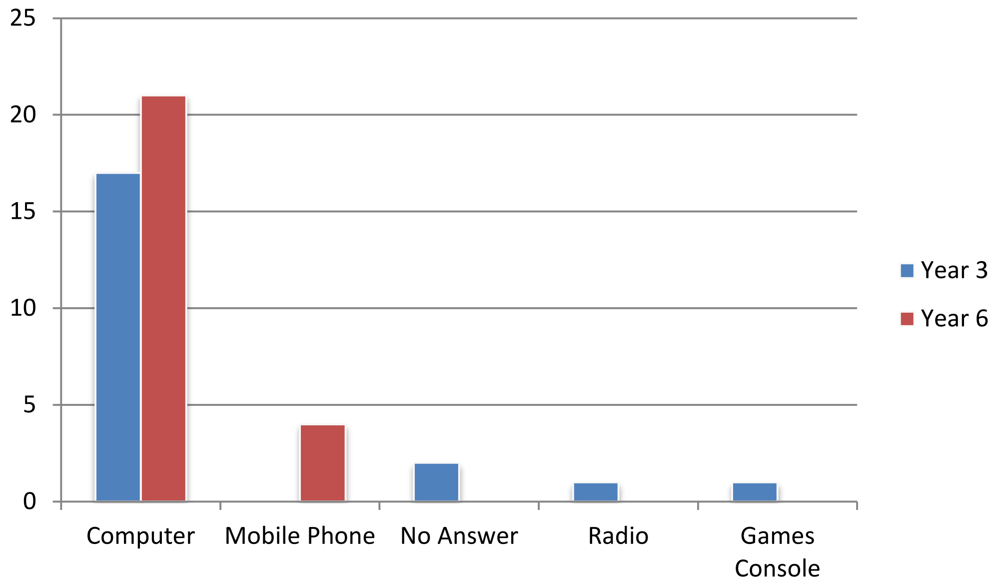


Figure 6.5: The frequency of technologies most commonly used for going on the internet

The most used device for going on the Internet was the computer with 81% of the Year 3 children choosing this device and 84% of the Year 6 children. 10% of the Year 3 children reported they did not use the Internet and the remaining 16% of the Year 6 children stated they used their mobile phones most often. Overall 83% of the children stated they used a computer most often to use the Internet with the next most popular device being the mobile phone chosen by 9%.

6.2.3.2 Social/Situated Tasks

The social/situated tasks overall are carried out using the mobile phone, although for the younger children this device is not the most common for either task. It is the results of the older children that highlight the surge in using this device to carry out these tasks.

Taking Photos

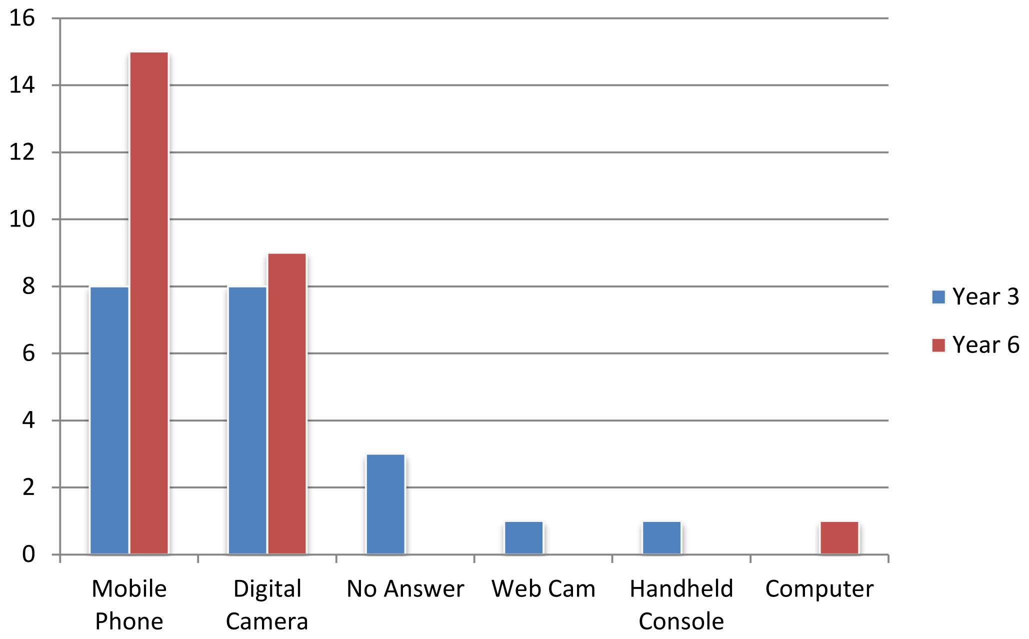


Figure 6.6: The frequency of technologies most commonly used for taking photographs

With Year 3 there was an even split for the most popular devices to take photos. 38% choose mobiles phones with the same number choosing digital cameras. In Year 6 these were again the most popular devices although mobile phones came out on top with 60% of the children using them compared with 36% using digital cameras. Overall mobiles phones were used the most to take photos being used by 50% of the children compared to 37% using digital cameras.

Talking to Friends

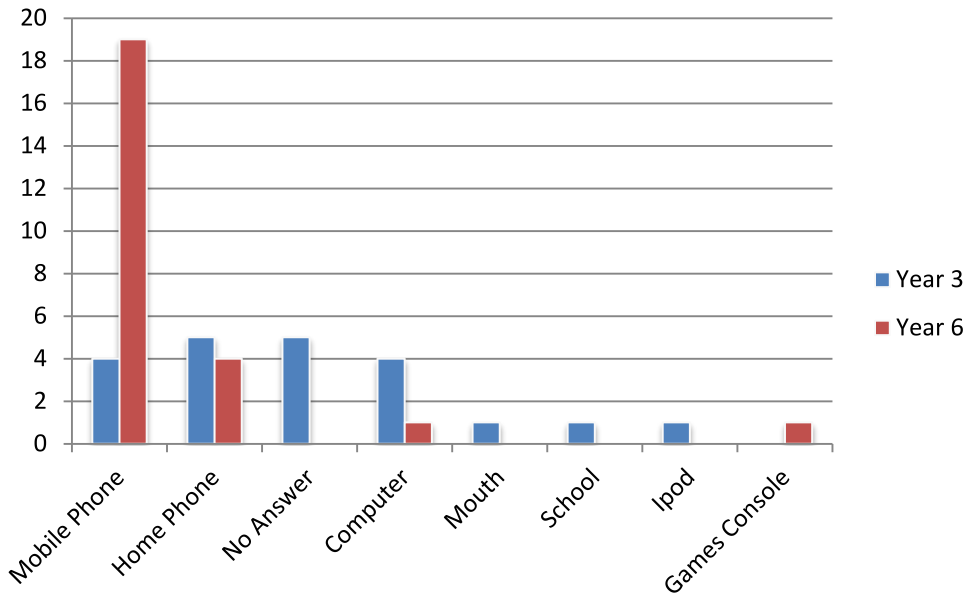


Figure 6.7: The frequency of technologies most commonly used for talking to friends

The top 4 responses given by children in Year 3 for the task of talking to friends received similar scores with 24% of the children stating they use the home telephone most often and 24% stating they do not use technology to talk to their friends. 19% of Year 3 children reported using a mobile phone with a further 19% using a computer. In Year 6 the mobile phone is the most used device with 76% stating they use this the most with a further 16% using the home telephone. Overall the mobile (50%) and home phone (20%) are the most popular technologies that the children used to talk to their friends.

6.2.3.3 Construction Tasks

The construction tasks are carried out significantly less by the Year 3 children than the Year 6 children with, for the younger children, 'no answer' being the top, or joint top, selection for these two tasks. The mobile phone is the most popular device used to carry out the tasks by the children in Year 6.

Recording Sounds

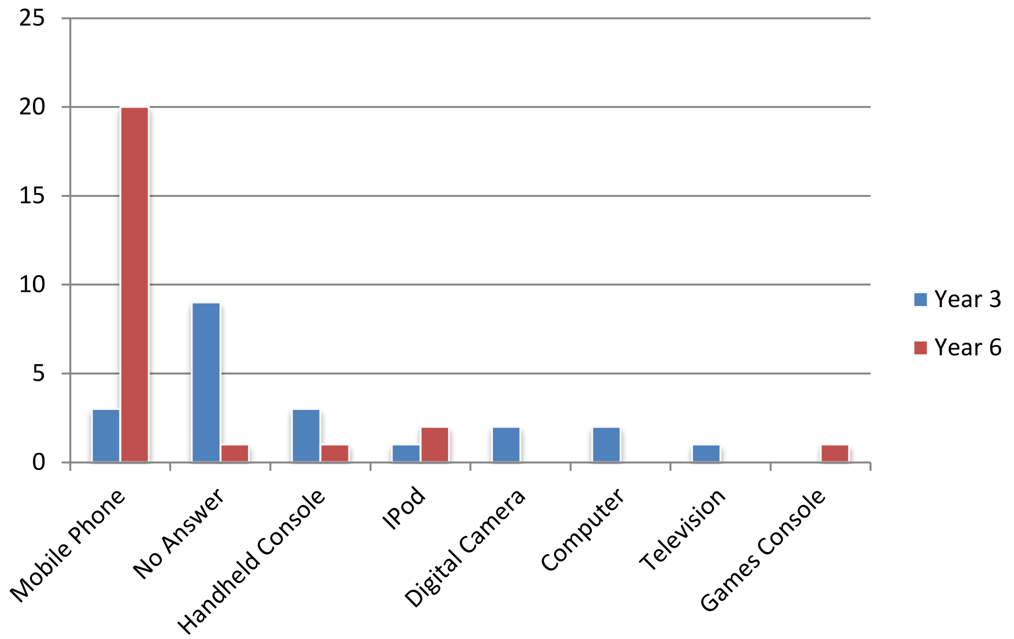


Figure 6.8: The frequency of technologies most commonly used for recording sounds

43% of Year 3 children gave no answer to this question meaning they did not carry out this activity. The next most popular answers were the mobile phone and handheld games console which were used by 14% each. In year 6 only one child stated they did not do this activity while the most common devices being the mobile phone used by 80% and the iPod used by 8%. Overall the mobile phone was used by 50% of all the participants to carry out this activity with 22% stating that they do not do it and therefore did not choose a device.

Making videos

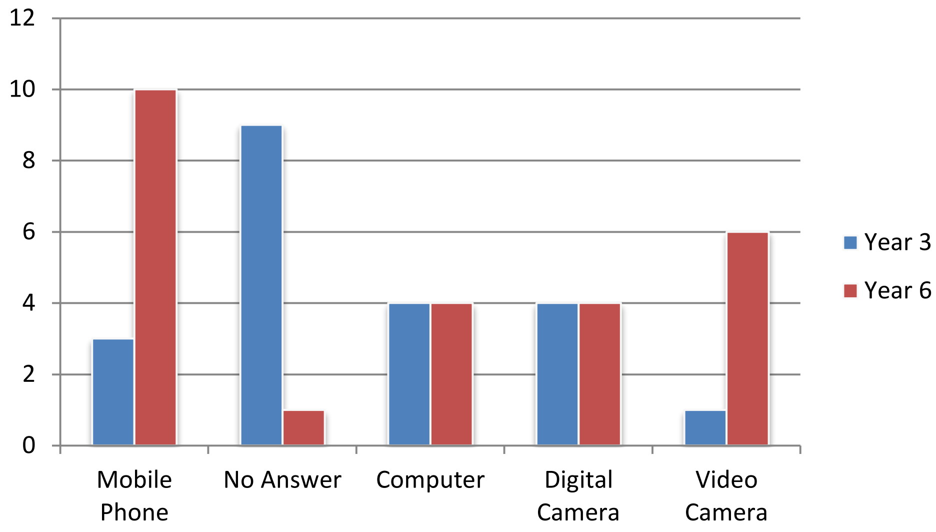


Figure 6.9: The frequency of technologies most commonly used for recording sounds

Similar to recording sounds, 43% of the Year 3 children stated they did not carry out this task; the most common devices used were the computer and digital camera with 19% of the children using each. 40% of the Year 6 children used their computers and 24% used video cameras to make videos. The most popular device used by the whole group of children was the mobile phone used by 28%. 22% of the children stated they do not make videos with 17% saying they do with video cameras and 17% with digital cameras.

6.2.3.4 Multi Use of One Device

The results in table 6.2 show that on average each child in Year 3 completed 2.48 of the 8 tasks with their most commonly used device. This rises to 3.92 tasks in Year 6 giving a combined mean for the total population of 3.26 tasks per most popular device.

Table 6.2: The mean number of tasks completed most often by the most common device

	YEAR 3	YEAR 6	COMBINED
Mean	2.48	3.92	3.26
Std Dev	1.25	1.55	1.58

Further analysis of the means in table 6.2 showed that 61% of the children recorded the mobile phone as being the most frequently used device used when carrying out one of the eight tasks following by 24% who recorded this devices being a computer. This shows that 85% (or 39 out of the 46) children use either a computer or a mobile phone more than any other device to complete the eight tasks.

6.2.4 Discussion

The results of this study provide evidence that the use of a single device to carry out a single task is becoming less and less common in young children. The use and ownership of mobile phones has increased dramatically across the world with the increase in ownership by adults being matched by the increase in ownership by children (Davie, Panting, & Charlton, 2004). Table 6.1 highlights the uptake of the mobile phone in primary school aged children and demonstrates the multiple uses that children are putting these devices to. It is unclear as to whether this will eventually lead to the demise of dedicated devices such as MP3 players or digital cameras as these devices do often provide superior experiences and abilities for their specialized use. However, the clear advantage of carrying around one device instead of many and of having the device at hand when the occasion calls for a particular function is obvious, especially when the quality gains of a specialist device are not required.

The separate results for the two groups highlight an age related uptake in carrying out some of the tasks with the younger children, for example, being less likely to record video or sound than the older children. There is an apparent increase in the number of children owning mobile phones between the two age groups and that increase does appear to coincide with the increase in the use of mobile phones to carry out these tasks.

Figure 6.10 highlights the dominance of the mobile phone and computer for carrying out the tasks in this study and shows how the mobile phone begins to dominate as the preferred device in the older children at the expense of all other technologies although only marginally over the computer and games console.

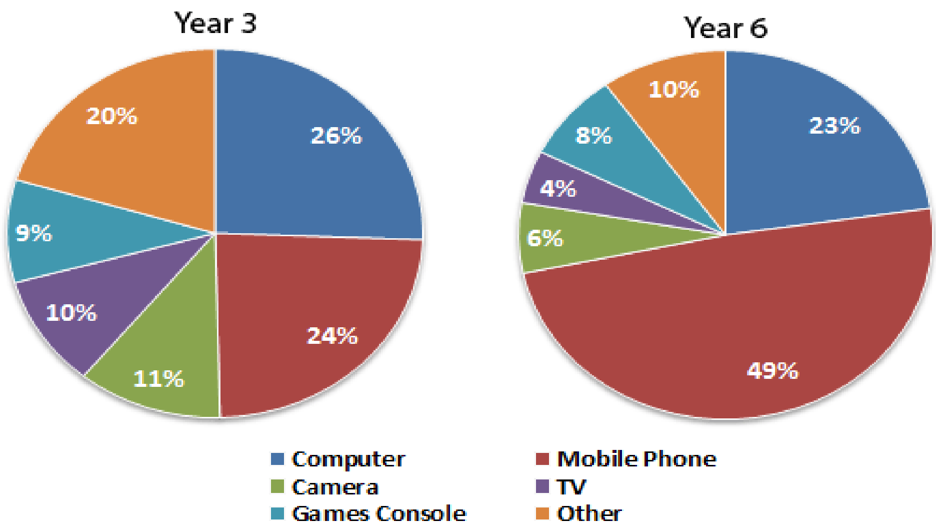


Figure 6.10: growth of mobile phone usage from Year 3 to Year 6

It is easy to see why, if a child is going to have a mobile phone, it would be more convenient to the child, and potentially cheaper for the parents, if this device could also play music, take photos and potentially carry out all the tasks used in this study. The mobile phone was one of only two devices that was recorded by at least one child in one of the groups for all of the eight tasks, the other being the computer.

Grouping the eight tasks into one of three categories did provide us with insights that will be of use to the community when trying to study children's use of technology. Tasks that traditionally involve the use of non-mobile larger technologies such as televisions and games consoles are still predominantly carried out using these devices; *listening to music* was the exception - although this activity has always had a vast array of both mobile and non-mobile technologies associated with it – this only goes some way to explaining the difference. One explanation might be that children in these age groups are not very engaged with music.

The *social/situated tasks* help support the view that younger children are less likely to own or have access to mobile phones and therefore use a wider variety of devices, or in the case of *talking to friends*, methods for carrying out these tasks depended on what is available to them at home or at school. The older children show a clear preference for using the mobile phone to carry out these social activities as it caters to the instant, in the moment, need that these tasks often require.

The *construction task* results support the hypothesis that younger children are less likely to carry out these types of task. The overwhelming choice of the mobile phone being the most used device to carry out these tasks is perhaps less surprising when *recording sounds* as devices to do this are now less common, but was unexpected for *making videos* with better results expected from digital cameras, particularly against the most expensive video camera.

Overall there were 24 distinct, or variations of, technologies reported by the Year 3 children and 22 reported by the year 6 children. It is interesting to note that games consoles and handheld consoles were always referred to by the name of the specific device owned by the child. It was always, *Xbox*, *PS3* or *(Nintendo) DS* rather than a generic term such as games console. This did raise the question of whether these devices should therefore be referred to separately in a survey. This was dismissed as it was apparent that children do understand these generic terms which in turn removes issues such as having to name every possible games console on the market including older ones which would be impractical.

The mobile phone is clearly leading in the multi-functional devices used by children. The mobile phone was selected on 127 occasions in the study as being the most often used technology whereas the iPad, considered by many to be the ubiquitous must have device, was the only representative for multi-use tablet devices but only appeared once. In terms of mobile phones, the study has highlighted that these devices are being used for multiple purposes by children and literature suggests that the actual phone feature is well down on their primary use. This prompts the question as to why the device is still referred to by its legacy title of phone if this is no longer its primary function? Maybe a new name such as a 'texter' or take the name of a legacy device such a digital camera or MP3 player as this could now be its primary use with the phone functionality now just an added benefit.

6.2.4.1 Effects on Prior Experience

The results in this study support the view that the constant change and enhancements being made to technologies is having an effect on children's perceptions and understandings of certain devices, which is in turn causes confusion affecting how accurately children can report technology use. This provides further evidence of the problems that might occur by researchers asking the wrong questions about technology which could lead to validity issues in a piece of research.

Questions such as asking children whether they have taken photos before will not indicate that they have had experience in using a camera. Asking children if they listen to music, or record videos, does not provide researchers with knowledge of what devices they used to do the activities on. Perhaps 5 or 10 years ago fairly concrete assumptions could be made about devices used to carry out certain tasks but this not the case today.

The same can be said of technologies implying task knowledge. Asking a child if they have a mobile phone does not imply that they are adept at using it to phone people or send text messages. Many young children have mobile phones but are not able to use these functions, as they have no credit. They have phones for other purposes such as music, apps and allowing their parents to contact them rather than the other way round.

The study has shown a need to ask many questions to gain a full understanding of children's technology use, such as having access to devices, about usage for particular tasks and about the time spent doing these tasks if researchers want to be able to use prior knowledge as a baseline or to inform studies with children. It is not good enough simply stating that *n%* of the children in this study own a computer as this doesn't really tell us anything, not even that the child actually owns the device, it only really says that they have access to one whether they really use it or not.

6.2.5 Conclusions

The study indicates that multi-purpose devices are very often preferred for a given task over devices whose primary function is to support that task. These trends appear to be more pronounced with older (year 6) children rather than younger ones (year 3). While no conclusive statement can be made on the reasons for this shift, it appears plausible that these results relate to the uptake of mobile phones as children go through primary school. It appears that modern smartphones could be replacing, and negating the need for, more traditional technologies that have been used to carry out specific tasks. The results are not predicting the demise of certain technologies but are highlighting the move away from these technologies for convenience in everyday use.

Rather than inquiring regarding previous usage or ownership of a specific device, studies that survey children regarding their technology use and experience, need to become more nuanced as to the type of technologies used and the purposes they are used for. A simple statement as to whether a child has used a mobile phone, or a computer, or whether they own one, also appears not to be discriminating enough between children's different levels of experiences. A plausible alternative would be to extend this to include specific uses of these devices.

Extending questionnaires to include specific uses of devices goes against the guideline by Read and Fine (2005) that surveys with children should be kept as short as possible. Adding in extra questions about usage will certainly increase the length of a questionnaire which will need to be considered during design. A potential solution would be to follow Rodgers and Herzog's (1992) suggestion, in research with elderly people, that surveys can be split up and administered at different points. The issues of questionnaire length, and the solution proposed, in relation to the work in this thesis is discussed in section 8.1 at the beginning of chapter 8.

6.2.6 Chapter Contributions

The contributions towards the guidelines derived from the work within this chapter are presented here:

SC6.1 **Single use devices –** are becoming less common to carry out single tasks. It is likely that devices are capable of carrying out more than one task, or that the device used to carry out a task is not one that was traditionally created to do so.

SC6.2 **Smart phones –** the uptake in ownership of smart phones dramatically increases during primary school and as a result, more and more tasks traditionally carried out by other devices begin to be carried out on phones by children.

SC6.3 **Device variety -** Younger children (7 – 8 years) are more likely to use a variety of devices to carry out a task, predominantly due to them not having access to a mobile phone.

SC6.4 **Product names -** Games consoles (including handheld), and mobile phones to an extent, are often referred to by their product name rather than a generic term, in line with the fact children may ignore a games console in a survey if it is not the specific product they own.

SC6.5 **Multi-functional devices** - The mobile phone is clearly the leading multi-functional device used by children although it is expected that tablet devices will begin to share this status of the coming years.

SC6.6 **Task v technology –** Assumptions cannot be made about task knowledge simply by knowing a child has experience using a particular device. This is also true in reverse as task knowledge does not imply that a child have knowledge of using a specific technology.

7 CHAPTER SEVEN: GUIDELINES

This chapter uses the good practice identified throughout chapters 2 and 3, the pre-existing guidelines (Read & Fine, 2005) presented in chapter 3, and the guidelines identified in chapters 5 and 6 to produce a complete set of guidelines for creating surveys to elicit children's self-report of technology use. The guidelines are not all specific to this task as they also include guidelines for carrying out research with children, and guidelines for carrying out surveys with children. These are included as they also essential in maximising the validity and reliability of the data collected.

7.1 Categorisation of Guidelines

As previously discussed, it is not just guidelines for children's self-report of technology use that are being created. Generic guidelines for using survey methods with children and carrying out research with children are also included. Here the contributions gathered are split into one of these three categories. Table 7.1 presents a list of all the contributions gathered and splits them into the category that is most appropriate. The guidelines from the literature chapters are labelled using the code LR, the study chapters SC, and the pre-existing guidelines from Read and Fine (2005) are labelled using the code RF.

The three categories are labelled as follows:

1. Research with children
2. Conducting surveys with children
3. Children's self-report of technology use

It is worth noting that some of the contributions from the thesis are categorised in more than one category. Each potential contribution is labelled by the name given at the end of the chapter in which it was defined; please refer to the chapter for further clarification or explanation of the contribution.

Table 7.1: Categorized guideline contributions from chapters 2, 3, 5 and 6

CODE	CURRENT GUIDELINE CONTRIBUTION NAME	CATEGORY
LR2.1	Location of studies	1
LR2.2	Researcher effect	1,2
LR2.3	Perceived preference	2
LR2.4	Language skills	1,2
LR2.5	Study length	1
LR2.6	Inclusion	1
LR2.7	Consent	1
LR2.8	Privacy	1
LR2.9	Confidentiality	1
LR2.10	Vulnerability	1
LR3.1	Sampling	2
LR3.2	Confound variables	2
LR3.3	Open-ended questions	2
LR3.4	Closed questions	2
LR3.5	Pretesting	2
LR3.6	Validity	2
LR3.7	Reliability	2
LR3.8	Visual analogue scales	2
LR3.9	Simplicity	1,2
LR3.10	Suggestibility	1,2
LR3.11	Children are very literal	2
LR3.12	Short attention span	1,2
LR3.13	Question type	2
LR3.14	Fixe response questions	2
RF1	Keep it short	1,2
RF2	Pilot the language	1,2
RF3	Provide assistance for non / poor readers	2
RF4	Limit the writing	2
RF5	Use appropriate tools and methods	1,2
RF6	Make it fun	1
RF7	Expect the unexpected	1
RF8	Don’t take it too seriously	2
RF9	Be nice	1
SC5.1	Device perception	3
SC5.2	Impossible choices	2
SC5.3	Ownership	2

SC5.4	Instructions	2
SC5.5	Representation of technology	3
SC5.6	Reliability of self report	2
SC5.7	Knowledge ≠ usage	3
SC5.8	Multifunctional devices	3
SC5.9	Terminology	2,3
SC5.10	Children's representations of technology	3
SC5.11	Similar devices	3
SC5.12	Appropriate technologies	3
SC5.13	Use of facilitator	2
SC6.1	Single use devices	3
SC6.2	Smart phones	3
SC6.3	Device variety	3
SC6.4	Product names	3
SC6.5	Multifunctional devices	3
SC6.6	Task v technology	3

7.2 Refinement of Contributions

Having collated the contributions, each had to be analysed to see if any refinement was necessary. This refinement was done in three stages, for each of the three categories (1,2,3), the stages being:

- **Removing duplication –** where two or more of the contributions are covering the same concept there is a need to remove the duplication whilst also ensuring that any subtle differences are accounted for where necessary.

- **Merging themes –** where two or more of the contributions cover related concepts, there may be a need to merge them together to create a more extensive guideline that covers the contributions more coherently together.

- **Refinement of the wording –** the wording of the guidelines needs to be well thought out ensuring the important concepts can be clearly understood by the research community.

7.2.1 Category 1 - Research with Children

Contributions LR2.4, LR3.9 and RF2 are based on children's language and refer to the use of appropriate language when conducting a research study. Aspects of the wording of all three will be used to create the new guideline. The specific examples of wording problems shown in LR3.9 will not be added in this category as they relate predominantly to question styles and therefore will be included in the guidelines on surveying children (category 2).

LR2.5, RF1 and LR3.12 all relate to the fact that children have short attention spans and so refer to the need to keep activities short. LR3.12 is based around survey methods so the description from this contribution will not be used in conjunction with LR2.5 and RF1, and instead used in category 2 where this contribution has also been placed.

LR2.2, LR3.10 and RF9 all deal with the relationship between the researcher and child and will therefore be merged into a larger guideline.

The other contributions in this category are considered to be unique.

7.2.2 Category 2 – Conducting Surveys with Children

LR2.2, LR3.10 and parts of LR2.3 deal with the effect the researcher can have on a survey. This effect is dealt with in part in category 1 but the specific implications in survey methods, i.e. in relation to the answering of questions, still need to be addressed.

LR2.4, LR3.9, RF2, SC5.9 and parts of LR2.3 revolve around language issues – these dealt with in part in category 1 but the application to survey methods is specifically mentioned here. The five will be combined with RF3 and SC5.13 which advocate the use of a facilitator to assist in the completion of written questionnaires.

LR3.12 and RF1 support the issues of survey length with children and so relevant parts from both will be merged.

LR3.3, LR3.4, LR3.13 and LR3.14 relate to question styles within surveys, these are backed up by RF4 and will be brought together.

RF5 (use appropriate tools and methods) is being omitted from these guidelines as it is considered to be addressed by a combination of the other guidelines in this section. RF8 (don’t take it too seriously) is also omitted as it is considered that this was a subjective opinion of the researchers who first proposed it and is too concerned with the value to be placed on the results of any user test to be considered an appropriate guideline.

LR3.1, LR3.2, LR3.6 and LR3.7 were also omitted from the guidelines as these were considered to be generic survey guidelines that should be followed when conducting surveys with any population or sample, and not just children.

7.2.3 Category 3 - Children's Self Report of Technology Use

SC5.1 and SC5.11 cover issues revolving around the similarity between different devices and therefore will be merged together.

SC5.8 and SC6.5 both relate to the use of multifunctional devices and therefore will be merged although SC6.5 also supports the prominence of the smart phone which is addressed in SC6.2.

SC5.7 (knowledge ≠ usage) and SC6.6 (task v technology) both cover the same concept and therefore will become one guideline.

SC5.5 and SC5.10 both concern the use of images to represent technology and therefore will be combined.

The wording of all guidelines will be reworked and the titles altered to provide more information about the guideline contents.

7.3 Detailed Guidelines

The final process is to turn both the single contributions and the merged / combined contributions into full guidelines. The wording of all the guidelines will be carefully reworked to ensure they encompass all the relevant information the guideline is trying to portray in a clear and precise format as to be easily understood by the community. The titles of each guideline will also be revised to provide a true, but brief, reflection of the main concept.

7.3.1 Guidelines for Carrying Out Research with Children (RWC)

The following 12 guidelines are designed to assist researchers in carrying out research studies with children.

RWC Guideline 1: Carry out studies in an appropriate location

Studies should be carried out wherever possible in a location that is familiar and comfortable to the child such as their school or home. If it is necessary to use a research laboratory then steps should be taken to make the location more child friendly (examples include: adding colourful pictures, child friendly objects/toys, and seating similar to a school layout). *From LR2.1*

RWC Guideline 2: Keep the length of a study as short as possible and if more time is needed, break it up into smaller chunks. The younger the child, the less time he or she will be able to keep to the task

Children have relatively short attention spans therefore the length of a study should be kept to less than 30 minutes where possible and never be longer than an hour. *From LR2.5, LR3.12 and RF1*

RWC Guideline 3: Ensure that all children in a group are given the opportunity to participate

Children are used to being included in all class activities at school and therefore should be given the opportunity to participate in a piece of research even if their results are not going to be used. Exclusion can cause undue stress on a child and through inclusion this can easily by avoided. *From LR2.6*

RWC Guideline 4: Use spoken and written language that is appropriate to the age and experience of the children

Children use different language to that of adults so the wording used in studies must reflect this. Language should first be checked with teachers and/or tested out with a small group of children. It may be necessary to provide different versions of the same study using different language where the age or ability gap of the children is large. *From LR2.4 and RF2*

RWC Guideline 5: Be aware of the effect of the researcher and ensure that, as far as possible, children are treated well, are not primed, and are empowered to have their own opinions

Children often see researchers as authoritative figures and as a result are often eager to please and easily swayed to provide a specific answer. Building up a relationship with children prior to a study can help eliminate the traditional power balance resulting in children giving a more honest reflection of themselves and their views/opinions. *From LR2.2, LR3.10 and RF9*

RWC Guideline 6: Use appropriate tools and methods

Ensure the tools and methods used in a research study are appropriate for children. Where possible use a method specifically designed and validated for use with children. Adult methods may require alteration to work with children and should be tested on a small group first. *From RF5*

RWC Guideline 7: Ensure informed consent is gained from children (and from adults where appropriate)

Children should be provided with enough information about a study to provide informed consent. It may also be necessary to gain consent from appropriate gatekeepers who should also receive full details of the study. Children should also be informed they can revoke consent at any time. *From LR2.7*

RWC Guideline 8: By removing the possibility of identification, ensure the privacy of all study data

Personal data should only be collected when it is absolutely necessary and the results from a study should not allow children to be personally identifiable. All data should be held in a secure location, used only for the purposes consent was given for, and should be destroyed once a study has concluded. *From LR2.8*

RWC Guideline 9: Inform children about any research confidentiality

Children should be informed about the confidentiality of their participation in a research study and also of any circumstances where it may be required for this confidentiality to be broken. From *LR2.9*

RWC Guideline 10: Ensure all participating researchers are trained and comply with legal requirements

Researchers must comply with any legal requirements that exist when carrying out research with children. Training should be provided in how to interact with children effectively including noticing signs of anxiety or stress and how to deal with this appropriately. *From LR2.8*

RWC Guideline 11: Have additional activities, backups, and contingency plans for all studies: Expect the unexpected

Unexpected events often occur when working with children. Be prepared to alter studies as they are carried out or have a back up plan when things are not working. When working in schools, other activities such as break time, swimming lessons and play rehearsals may take place and researchers must be able to incorporate these unforeseen activities into their studies. *From RF7*

RWC Guideline 12: As much as possible, make the study interesting and fun

If possible, try and make the study interesting to the children and add in elements of fun so the children enjoy the work they are doing. This will help improve their motivation and keep their attention on the task in hand longer. It will also make them more likely to participate in future studies. *From RF6*

7.3.2 Guidelines for Conducting Surveys with Children (SWC)

The following 12 guidelines are designed to assist researchers in conducting surveys with children. Generic guidelines that should be followed when conducting surveys with and population or sample are not included. These guidelines are intended as further guidelines specific to conducting surveys with children.

SWC Guideline 1: Always pretest a survey with children and adult facilitators

Pretesting is essential when creating a new survey to identify any problems in advance. 20 - 25 children is considered to be the minimum number of participants required to carry out a successful pilot of a survey. Feedback from administrators is equally important and if possible two researchers should conduct a pilot study, one to administer it and one to observe. *From LR3.5*

SWC Guideline 2: Limit the use of open-ended questions

Open-ended questions should be used sparingly with children as this reduces issues that may occur due to writing ability and also reduces the time taken to complete a survey. If they are required, try to keep the response required as short as possible. Be mindful that children will often feel the need to fill the space available so leave a gap that indicates the amount of writing that might be needed. *From LR3.3*

SWC Guideline 3: Use visual analogue scales that have been tested with children

Visual analogue scales (VAS) are often used when surveying children. They are known to break up a survey by adding colour and have also been shown to produce valid and reliable results. *From LR3.8*

SWC Guideline 4: Choose appropriate question types that are easy to understand and limit choices as much as possible

Nominal questions such as yes/no questions are the easiest for children to answer. Children also have little problems with likert and VAS scales. Where possible closed questions should be used providing the full response set is known and not too vast. Response sets of 3 or 4 questions are best apart from in selection questions as these are treated more like a group of nominal questions. *From LR3.3, LR3.4, LR3.13 and LR3.14*

SWC Guideline 5: Keep the presentation of the questionnaire short; repeated questions asking the same thing can be safely omitted

Where possible a questionnaire should be kept to one page. Longer questionnaires should be tested to see how long it takes children to complete. Contrary to traditional survey techniques, the use of positive and negative versions of the same question, along with questions asking the same construct, should be kept to a minimum. *From LR3.12 and RF1*

SWC Guideline 6: Provide assistance for poor or non readers

The use of a facilitator will allow children to ask questions and clarify any issues they have when completing a survey. They can also read out the questions and potential answer choices if the need arises. Facilitators should be trained to avoid giving off unintentional verbal and non-verbal prompts that may cause children to choose a specific answer. *From RF3 and SC5.13*

SWC Guideline 7: Test the language used with a teacher and design age appropriate language avoiding adult jargon

Appropriate terminology is essential when conducting a survey with children. Children use different language to adults when asking questions and may use different terminology for the specific constructs and items for example. Testing the language on teachers and children can help reduce and language problems. Try and avoid negative and double barrelled questions. *From LR2.4, LR3.9, RF2, SC5.9 and SC5.13*

SWC Guideline 8: Remove ambiguous response options from questions

Children will not choose answers that are impossible if they understand the response options fully. Providing ambiguous response options can lead to questionable results as children may or may not choose an option due to not understanding it fully. *From SC5.2*

SWC Guideline 9: Ensure the wording of literal questions cannot be interpreted in more than one way

Ensure that children understand exactly what is being asked. Children may interpret a question completely differently to that in which it is intended if the literal meaning if different to the implied meaning. Again pretesting is a good way of addressing this issue. *From LR3.11*

SWC Guideline 10: When asking children about the ownership of items clarify what this means at the start of the survey

Given sufficient information at the begging of a survey and within a question children are capable of understanding the concept of ownership and can differentiate between items that are present in a particular location and items within that location they may own or have access to. *From SC5.3*

SWC Guideline 11: Provide clear written instructions at the start of the survey and in front questions as needed but also explain verbally the important instructions and encourage children to ask if they are unsure, even while they are completing the survey

The careful wording of instructions at the beginning of a questionnaire can clear up potential ambiguities. If a child has a full understanding of the purpose of a survey they are more likely to provide accurate responses. *From SC5.4*

SWC Guideline 12: Provide validated questions and tools to allow children to self report

Do not be afraid to ask children to self report within a survey. Providing questions are simple to understand, with no ambiguities, children can reliably answer questions on topics such as ownership, usage, and preference. *From SC5.6*

7.3.3 Guidelines for Children's Self Report of Technology Use (SRT)

The following 8 guidelines are designed to assist researchers in the specifics of creating surveys to gather children's self report of technology use.

SRT Guideline 1: When considering similar devices ensure that as much information as possible is given to enable children to differentiate between them

Children often experience difficulties differentiating devices that look similar and devices that have similar functionality. Further information may be required where such issues exist so that children fully understand the device in question. *From SC5.1 and SC5.11*

SRT Guideline 2: Avoid using images to represent generic technology, only use for specific technologies

Using images of products to represent generic technologies can cause issues for children as they tend to interpret the image as relating to the specific product, an example being an Xbox being used to represent a games console. Often children who do not own an Xbox will not select they own a games console if this is the picture provided to represent this generic term. Children’s representations of technology are also not appropriate due to their drawing abilities. *From SC5.5 and SC5.10*

SRT Guideline 3: Differentiate in surveys between gathering data about the usage of technologies and about ownership of technologies

A child’s knowledge of a piece of technology does not imply that they are capable of using it or have any understanding of how it works. Assumptions can also not be made about task knowledge due to the use of a specific device, or device knowledge due to the ability to perform a specific task. *From SC5.7 and SC6.6*

SRT Guideline 4: When asking about technologies, ensure that they make sense within the lifespan of the children completing the survey

Reliability problems can occur when technologies children are not used to are included within a survey. It is easy for researchers to forget how long it is since a specific device has been commonplace and it may be the case that young children will never encounter technologies that the researcher considers to be well known. *From SC5.12*

SRT Guideline 5: Check that the survey deals appropriately with multifunctional devices

Children can have problems classifying multifunctional devices under one label, particularly if they perceive the device to primarily carry out other functions than a survey is concerned with. Many devices are now capable of carrying out multiple tasks which can cause problems for children trying to classify a device under a single label. *From SC5.8 and SC6.5*

SRT Guideline 6: Be wary of asking about single use devices

It is becoming less likely that children interact with devices designed to carry out only one function. More often these devices now provide additional functionality and it may be the case that their primary functionality is not what the device was originally intended to do. *From SC6.1*

SRT Guideline 7: Consider the smart phone effect

The uptake in ownership of smart phones dramatically increases during primary school and as a result, more and more tasks traditionally carried out using other devices begin to be carried out primarily on phones instead. A result of this is that younger children are more likely to use a variety of devices to carry out a task than older children due to them not having access to a smart phone. *From SC6.5*

SRT Guideline 8: Be aware of the likelihood of children to use product names to identify devices

Games consoles and mobile phones are often referred to by their product name rather than by a generic term. Other devices such as televisions and computers are not. A pilot study will generally identify the right product names to include. *From SC6.4*

7.4 Conclusions

This chapter has presented 3 sets of guidelines, all of which are important in the creation of any survey to gather children’s self report of technology use. The sets scaffold on each other, it is not intended that the third set, for example, are used without sets 1 and 2. In general research with children, the first set could be used without sets 2 and 3.

Figure 7.1 shows the hierarchy of the guidelines created. The generic guidelines for research with children can be applied to any research with this group. These guidelines **must** be used to underpin the survey research with children guidelines which themselves **must** be used to underpin the specific survey guidelines to elicit children's self report of technology use.

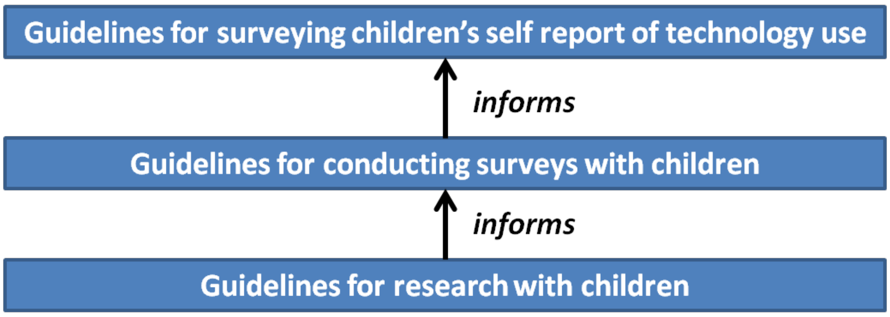


Figure 7.1: The hierarchy of guidelines

These guidelines will be followed in the creation of the surveys that follow on in chapter 8.

8 CHAPTER EIGHT: TECHNOLOGY USE QUESTIONNAIRES

8.1 Introduction

One of the most important factors of doing research with children and carrying out surveys with children is the length of time you can expect a child to concentrate fully on a task. Children have relatively short attention spans and it is advised studies should be kept to around 30 minutes (Hanna et al., 1997). Even with adults, survey length should be kept as short as possible to reduce factors such as non-response (Borgers & Hox, 2001) and satisficing (Krosnick et al., 1996) so with children it is therefore even more important.

The previous chapters have identified a need to survey children about task experience as well as technology experience in order to fully understand technology use in relation to the main study that is being run. This does not include any questions to measure a child's generic technology exposure which may also be important to base any assumptions on. In asking questions related to all three of these areas there is a risk the size of the questionnaire will become unmanageable by children and will certainly not fit with the belief that a questionnaire for children should be kept to one page.

It is therefore proposed that these areas (task experience, technology experience and generic technology experience) are split into three separate questionnaires that can be used separately if appropriate, but can also be combined to gather more substantial data if required. The three questionnaires will be:

- Children's technology use questionnaire (CTUQ)
- Children's task experience questionnaire (CTEQ)
- Children's technology (generic) history questionnaire (CTHQ)

Each questionnaire by itself will be limited in size to one page enabling researchers to carry out the questionnaires at different times if it is deemed necessary to reduce any effects related to the length of doing the survey in one go. To enable the CTUQ and CTEQ to be used separately there will be a question on each relating to the other questionnaire to gather basic information about the other whilst also providing the researchers with a reliability measure, when the questionnaires are carried out together, to check that the related questions are answered in the same way.

Section 8.2 describes potential starting points for the creation of the initial questions to be used and the method that has been deemed most appropriate. Section 8.3 discusses the similar experience survey method of computer experience and provides a set of themes derived from computer experience questionnaires identified within literature giving examples of the types of questions asked. The next three sections discuss the creation of the CTUQ (section 8.4), CTEQ (section 8.5) and CTHQ (section 8.6) questionnaires including explanations as to why each question was chosen, the type of question to be used, and the response options to be provided where appropriate. Each section concludes with an example of the questionnaire put into a specific context. Section 8.7 provides concluding remarks and is followed by a brief introduction to chapter 9.

8.2 Choosing a Starting Point

When creating a new questionnaire, there is no specific starting point for the creation of the question set. Mitchell and Jolley (2010) state that knowing what is to be measured is the first stage of conducting a successful survey. This has been the first stage in terms of the identification of the three questionnaires being required in section 8.1. In terms of populating the surveys with questions, potential starting points include:

- Asking teachers what questions would be appropriate
- Creating a set of questions using knowledge gained from research with children
- Using literature to identify potential questions and themes

Each of these approaches is discussed further in the next three sections.

8.2.1 Teachers

Aside from their parents, the group of adults that spend the most time interacting with children are teachers. Teachers have been specifically trained to work with this unique user group, not only in methods to assist children in learning; but also in other skills such as how to interact with them, how to identify problems or issues and how to motivate them. They also spend large amounts of time with children of different ages from different backgrounds and different cultures.

Through interacting with the children in their school teachers are able to understand the daily language used by children which would be a great asset in the wording of questions within a questionnaire. They also have some knowledge of the level of interaction children have with technology, particularly within school, but also in their home lives by virtue of being observers of their interactions with each other and of the work they produce.

What teachers perhaps lack is the knowledge of survey design and knowledge of HCI as a discipline to create questions that will produce meaningful data for researchers.

8.2.2 Researcher Knowledge

The work carried out in this thesis so far has provided extensive knowledge of conducting research with children, creating questionnaires for children and understanding survey methodology. This gives a unique and well-grounded starting point to begin creating questions that would be appropriate for use within the three questionnaires.

For the author of this thesis, working in the field of Child Computer Interaction for the last decade has resulted in extensive knowledge and experience of carrying out research studies with children, the majority of which have included a questionnaire of some kind. This experience includes honing skills such as appropriate question styles, appropriate language for children of different age groups, creating studies of a length appropriate to the age of the children, and methods of successfully engaging and interacting with children.

On top of this, reviewing and reading academic literature identifies both good and bad practice in both the use of questionnaires and also conducting research with children. It is from this point that the need for the work in this thesis was identified.

8.2.3 Literature

Survey methodologists advocate the use of pre-existing questions written and validated in other questionnaires as a good starting point when creating a new questionnaire (Boynton & Greenhalgh, 2004; Lazar et al., 2010). This, of course, depends on questionnaires existing with questions that measure an appropriately similar construct to be useful. Children's self report of technology is in essence children reporting on their prior experience of interacting with technology or carrying out tasks using technology.

Computer experience (CE) is the most common measure of prior experience when carrying our research in HCI and therefore would appear to be the most appropriate place to seek pre-written questions and thematic areas. Although CE questionnaires are typically based around one specific piece of technology, the computer, they are still prior experience of technology questionnaires and therefore may provide an appropriate starting point in the creation of more generic technology questionnaires.

To that end, thematic analysis of questions used within CE questionnaires will be used in conjunction with extensive experience gained in conducting research with children to create the initial questionnaire set. Although teachers may have provided an equally acceptable starting point they will not be consulted at this point but their unique skills will be employed during the pretesting phase of the work.

8.3 Computer Experience

Computer experience is the most widely used method of gathering information about prior experience of technology within the field of HCI. It is considered one of the most important factors that can have a significant effect on performance within a research experiment (Lee, 1986; Shiue, 2003).

More and more within HCI, the focus is less on traditional computers and more on emerging mobile technologies such as mobile phones and tablet devices. To this end direct use of traditional computer experience questions may not be completely relevant when applied to other technologies (and their tasks) and so a thematic analysis of the main questions within CE is more appropriate. Focussing on the themes rather than on specific question wording removes potential biases that any existing questions may have towards traditional computing devices.

An analysis was therefore performed on computer experience questionnaires within HCI which identified the following themes to be considered within the questionnaire set:

- Frequency of use
- Access and opportunity of use
- Training
- Perceived competency
- Diversity of experience
- Understanding or knowledge

8.3.1 Frequency of Use

Frequency of use is broken down into two specific areas: How often a piece of technology is used over a chosen time frame and for how much total time it is used. It is important to gain an insight into how frequently a child uses a piece of technology as questions such as *have you ever used a mobile phone* could mean the child has only used it once and thus would have very little experience of the device which is not how the answer *yes* might be interpreted in study results. Examples of questions and data gathered within this area of CE include:

- On average, how frequently do you use a computer? (Igbaria, Iivari, & Maragahh, 1995)
- How often a computer is used? (Robertson, Calder, Fung, Jones, & O'Shea, 1995)
- Estimated the amount of time each day a computer was used at work. (Henderson, Deane, Barrelle, & Mahar, 1995)
- Average usage of applications packages. (Gilroy & Desai, 1986)

8.3.2 Access and Opportunity of Use

Access and opportunity of use covers constructs such as ownership of technologies and the locations where participants have access to them. With children this would predominantly be at home or at school with these being the two major locations children spend their time (Jensen & Skov, 2005). Questions in this area within the literature focus upon:

- Whether participants have a computer at home. (Busch, 1995)
- Whether the participants owned a computer. (Robertson et al., 1995)
- Computer availability at school and within the classroom. (Rosen & Weil, 1995)
- Range of locations in which computers have been used. (Todman & Lawrenson, 1992)

8.3.3 Training

Questions related to training predominantly focus on older teenage and adult users but this area could be applied to children by asking them if they interact with pieces of technology with their teachers. This may not be training in the sense of the examples given below. If technologies are being used with a teacher then some amount of training or instruction on the use of the technology will be required from the teacher. Examples from the literature include:

- Have the participants ever done a course requiring the use of a computer. (Jones & Clarke, 1995; Brosnan & Lee, 1998)
- Computer courses completed. (Breakwell et al., 2000)

8.3.4 Perceived Competency

Perceived competency relates to how good the participant thinks they are at using a piece of technology or at carrying out a specific task. This question is most often presented using rating scales where the participants can select the appropriate position according to where they feel they belong on the scale. Examples found in literature include:

- Participants rating their skills on a range of computer tasks. (Geissler & Horridge, 1993)
- Participant’s opinion on whether they can use a computer without any help. (Colley, Gale, & Harris, 1994)
- Participants categorising their level of computer experience using a scale. (Smith, Caputi, Crittenden, Jayasuriya, & Rawstorne, 1999)

8.3.5 Diversity of Experience

Diversity of experience covers both technologies and task related questions. The majority of questions in this area relate to a participant's prior use of technologies and also to the different purposes for which a piece of technology has been used. These cover both specific questions towards a piece of technology, or task, and also generic technology experience. Examples include:

- What computer applications the participants were familiar with. (Robertson et al., 1995)
- The range of purposes the participants had used a computer for. (Todman & Lawrenson, 1992)
- Scale to find out extent of use of specific types of software (e.g. word processor, graphics package). (Szajna & Mackay, 1995)
- Prior computer and technology experience. (Rosen & Weil, 1995)

8.3.6 Understanding or Knowledge

Evaluating understanding or knowledge involves participants providing some kind of evidence that they understand a piece of technology by more than just its name. This may be showing a deeper understanding of a technology or self-reporting their knowledge using scales which is similar to perceived competence. Examples include:

- What do you think computers can be used for? (Roussos, 1992)
- Self-rating of computer knowledge. (Rosen & Weil, 1995)
- Participants understanding of computer terminology. (Levine & Donitsa-schmidt, 1998)

The next three sections describe the three questionnaires that were produced.

8.4 Children's Technology Use Questionnaire (CTUQ)

The purpose of the CTUQ is to provide evidence of a child's experience with a specific piece of technology. It is in essence a prior experience questionnaire focussing on a single piece of technology. As previously stated, the idea behind the full questionnaire set is that it is generic and can be used with any piece of technology. To this end the questions that will appear within the CTUQ questionnaire will be generic but will be presented in the initial version with a piece of technology to show how the questionnaire would look in use. For the purposes of illustration, text entry and the mobile phone is used as an example.

The first question that a questionnaire relating to a specific piece of technology must be whether the child knows what the piece of technology is. This would fall into the category of *understanding or knowledge* to its most basic level. The question proposed therefore is:

Do you know what a *[technology]* is?

This question should be a simple question with a yes or no answer as this type of question is easy to understand and easy to answer for children (Bell, 2007).

The findings of study 2 indicate that children do understand the concept of ownership and the ownership of a piece of technology is a good indicator of whether a child has prior experience of it. Ownership appears under the category *access and opportunity of use* within the themes identified within the literature. The question proposed to cover this is again a yes/no nominal question:

Do you own a *[technology]*?

It may be a case that the child does not own the technology in question but has access to it at home, it could be owned by their parents or a sibling. It is not simply a case of asking if they have the piece of technology at home. Having a piece of technology at home does not tell us if the child uses it and therefore the question would have to incorporate use in order to ensure that the child does use it and that it is not just present within that location. This question again appears under the category of *access and opportunity of use* although it is from a different perspective. The question proposed is the yes/no question of:

Is there a *[technology]* at your house you can use?

The next stage is to understand how often the technology is used by the child. This type of question comes under the category *frequency of use* and rather than being nominal, like the previous questions, the question will require the use of a scale.

Children are known to struggle with retrospective questions (Bell, 2007) as identified in chapter 3 and therefore a small time frame would be preferential to reduce the cognitive load. A week is a relatively small time scale for a child and is therefore proposed, as using something larger like a month or year would involve major cognitive work in reaching an answer. The proposed ordinal question is:

How many days a week do you use a *[technology]* at home?

In order to make this answer type clear to children it is important they are made aware of how to answer the question therefore all scale questions will include short instructions of how to answer the question (e.g. circle your answer). To keep the number of response options smaller within the question, the proposed response options are:

- 0 days
- 1 or 2 days
- 3 or 4 days
- 5 or 6 days
- 7 days

Following on from how often they use a piece of technology it is important to gain some understanding of how good the children think they are at using it. This is in line with the thematic category *perceived competency*. This type of question again should involve the use of a scale. Chapter 3 introduced the thumbs-up scale (Kano et al., 2010) as a validated 5 point VAS scale for use with children where the answers go from positive to negative and therefore this would be an appropriate scale to use. The proposed question is:

How good do you think you are at using a *[technology]*?

The labels proposed for each stage of the thumbs-up scale, from positive to negative, are:

- Very good
- Good

- Okay
- Not very good
- Poor

So far, the questions where location has been a factor have revolved around the home. As noted in section 8.3.2 children spend a large amount of their time at school and therefore it would be appropriate to find out whether they have access to the technology in this location. Care needs to be taken at this point to ensure the children understand that they must be able to use the technology, as simply stating they have a piece of technology at school does not mean they are able to use it or have ever used it. This again falls into the category *access and opportunity of use*. A yes/no question will be sufficient in this case and the proposed question is:

Does your school have *[technology]* you can use in class?

Being able to use a piece of technology in class is useful to know although this does not ascertain whether they are taught to use it. One of the thematic categories identified was *training* and whilst it is unlikely formal training will be given at this age, use of the technology under instruction of their teacher would imply that a certain amount would have been received. The proposed nominal question in this case is:

Do you use it with your teacher in your class?

As identified in chapter 6 and discussed at the beginning of this chapter, the use of technology is not just about the technology itself, but also about the task that is being performed on it. It is important therefore to know whether the children have carried out the major task related to a study using the piece of technology specific to this questionnaire. As a reliability measure this question could also be used on the CTEQ as this is the task centred questionnaire and therefore would still be relevant. It would also allow the questionnaires to be used separately if the focus on a study was just the task, or just the technology, and the greater detail of the other was not required. This question would come under the category *understanding or knowledge* as being able to carry out a task on a piece of technology implies a level of knowledge is required to do this.

The task chosen as the example task to appear in initial examples of the questionnaires is sending a text message. The nominal question proposed is:

Have you ever used your *[technology]* to *[carry out the task]*?

The wording of this question may need to be reworded slightly to ensure it makes sense with the specific task and specific piece of technology that is to be included.

The final stage of this questionnaire would be to further examine a child's *understanding or knowledge* of the technology by asking them to identify further tasks that they have used it for. This will give insights into further skills they may have in using it and also provide the research team with a list of the most common or salient tasks the piece of technology is used for. The responses at this point could be provided in a list but it is unlikely the research team would be able to identify all tasks that a device could be used for, and if it was possible, the list would be too long to present in a question. Allowing the children to give their own answers would allow the children to provide rich data to the research team whilst not restricting the tasks that they could choose from which could occur with a fixed choice question.

It would be advisable to provide the children with a limit to the number of responses they should give. This will take this uncertainty out of the child's mind and reduce stress. Past experience of carrying out questionnaires also suggests this limit will make children provide more than one answer which would be likely if a limit was not given. The proposed open-ended question is:

Can you write down *[n]* things that you use your *[technology]* for:

There may be occasions where the name of certain pieces of technology requires the wording of the questions to be tweaked a little bit and it will be the responsibility of the researcher using the questionnaire to do this when required.

8.4.1 CTUQ version 1

Figure 8.1 shows an example of the first version of the CTUQ where mobile phone is used as the piece of technology and text messaging is used as the task. This can also be viewed in more detail in Appendix 3.

The purpose of this questionnaire is to see how much experience you have had using a mobile phone. Please answer all the questions and ask the person giving you the questionnaire for help if you are unsure of anything.

1. Do you know what a mobile phone is? Yes ☐ No ☐
2. Do you own a mobile phone? Yes ☐ No ☐
3. Is there a mobile phone at your house that you can use? Yes ☐ No ☐
4. How many days a week do you use a mobile phone at home (circle your answer)?

   0 days   1 or 2 days   3 or 4 days   5 or 6 days   7 days

5. How good do you think you are at using a mobile phone (circle your answer)?

   very good   good   okay   not very good   poor

6. Does your school have mobile phones you can use in class? Yes ☐ No ☐
7. Do you use it with your teacher in your class? Yes ☐ No ☐
8. Have you ever used your mobile phone to send a text message?

   Yes ☐ No ☐

9. Can you write down 3 things that you use your mobile phone for?

   ....

   ....

   ....

Figure 8.1: CTUQ version 1

8.5 Children's Task Experience Questionnaire (CTEQ)

The purpose of the CTEQ is to provide evidence of a child's experience carrying out a specific task without putting that task into the context of a specific piece of technology. As seen in the results of study 6 (chapter 6) there may be occasions where the task and technology go hand in hand but this is not always the case especially with multi-use devices Again, as with the CTUQ, the idea behind this questionnaire is that it will be generic and therefore can be applied to any task. As indicated earlier and to keep in line with the initial version of CTUQ, text messaging is the task that has been chosen to present the first version of this questionnaire in a specific context.

Similarly to the previous questionnaire, the first question on the CTEQ should identify whether the children know what the task is. Again with task based questions the wording may require tweaking depending on the task in question. The initial nominal question proposed for this questionnaire is:

Do you know what a *[task]* is?

The next question will need to establish whether the children have ever carried out the task before. The proposed nominal question here is:

Have you ever *[done the task]*?

Frequency of carrying out the task will allow researchers to see how familiar the children are with carrying out the task. Rather than the number of days the user does the task as with the *frequency of use* question used in the CTUQ questionnaire, this question should be based on the of number of times the task is carried out over a specific time period. This question will again require the use of a frequency scale where the numbers within the scale will change depending on the task. Using sending text messages as an example, a child could potentially send over a hundred within a week. Other tasks such as using a word processor might be carried out significantly less so it would not be appropriate to use the same scale. Again the time period being considered should be small to minimise the cognitive load on the children so a week would again be appropriate. The proposed question for use with an appropriate frequency scale is:

How many *[times do you carry out the task]* in a week?

Now we know how often the children carry out the task it is important to understand each child's perception of how good they are at carrying out the task. This fits the category of *perceived competence* identified in the thematic analysis. This question should again be in the form of a scale and therefore the VAS thumbs-up scale with be used. The proposed question is:

How good do you think you are at *[carrying out the task]*?

The proposed labels for the scale from positive to negative are:

- Very good
- Good
- Okay
- Not very good
- Poor

Within CCI, an important aspect of a child carrying out a task is the amount of enjoyment they get out of it. If they enjoy doing it then they are likely to be more engaged with it and therefore, have a better experience, spend longer doing the task and ultimately have a better understanding of how to do the task which will potentially make them explore the technology used more. Again a VAS thumbs up scale is proposed for this question:

How much do you enjoy *[doing the task]*?

The proposed labels for the scale from positive to negative are:

- A lot
- A little bit
- Not bothered
- Not much
- Don't enjoy

To keep in line with the previous questionnaire (CTUQ) a question needs to be asked about carrying out the task using the piece of technology chosen for the CTUQ questionnaire. If a researcher has decided not to use the CTUQ in their study then the technology presented in this question should be the one considered to be the most used technology to complete the task. The question here is therefore the same as question 8 in the CTUQ:

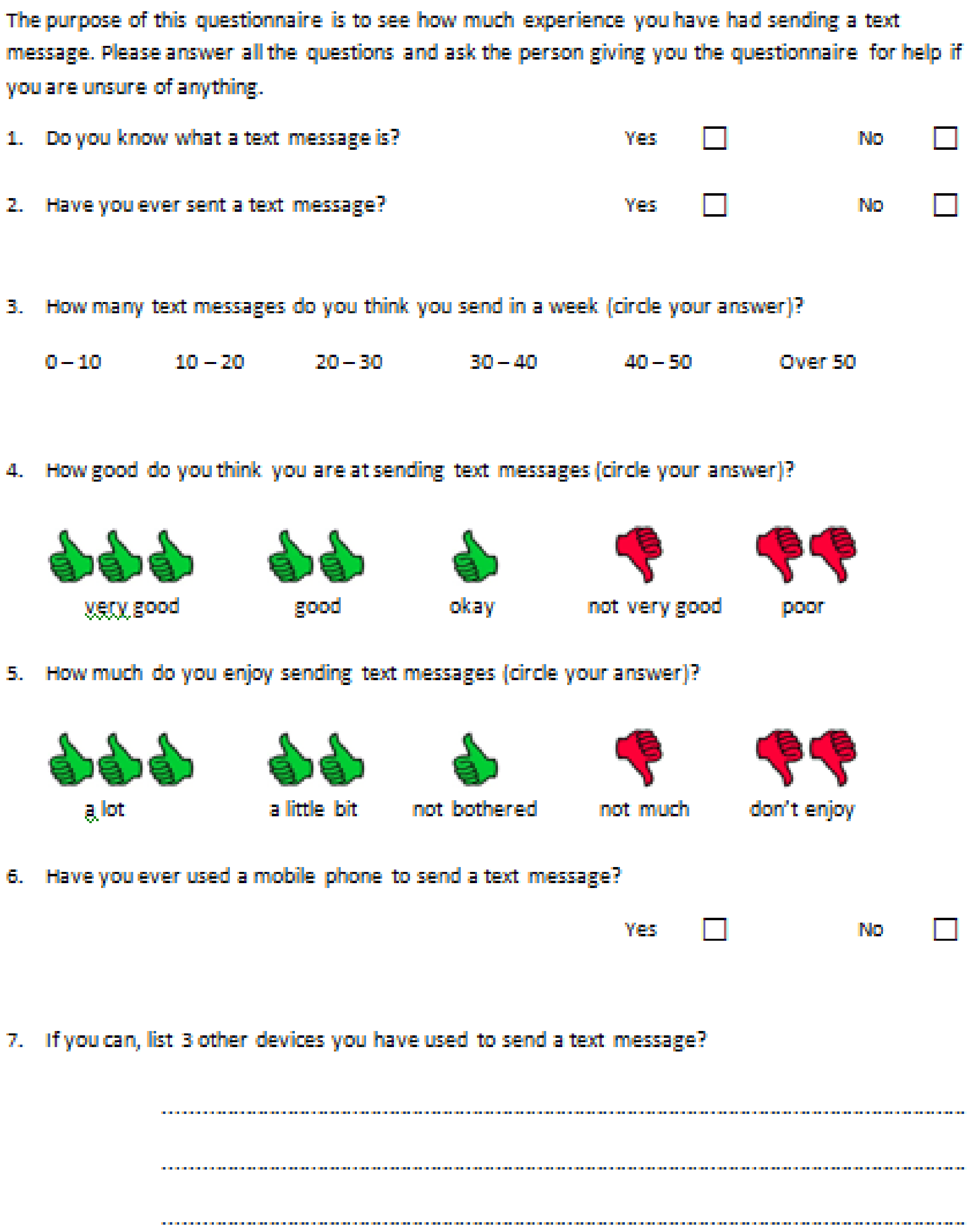
Have you ever used your *[technology]* to *[carry out the task]*?

Chapter 6 identified that tasks do not imply that a specific technology has been used to complete them therefore the proposed final question in this questionnaire is to find out what technologies the children have used to complete the task. It may be the case that children have used multiple devices to complete the task which highlights both a greater knowledge and understanding of carrying out the task and also a greater knowledge of technology devices. This question should therefore be an open-ended question so as not to exclude any devices that could be unintentionally omitted from a fixed response set. Again this open ended question should have a limit to the number of responses required as discussed in section 8.4. The proposed question is:

If you can, list *[n]* other devices you have used to *[carry out the task]*?

8.5.1 CTEQ version 1

Figure 8.2 shows an example of the first version of the CTEQ where text messaging is used as the task and the mobile phone is used as the piece of technology. This can also be viewed in more detail in Appendix 3.



The purpose of this questionnaire is to see how much experience you have had sending a text message. Please answer all the questions and ask the person giving you the questionnaire for help if you are unsure of anything.

1. Do you know what a text message is? Yes ☐ No ☐
2. Have you ever sent a text message? Yes ☐ No ☐
3. How many text messages do you think you send in a week (circle your answer)?

   0 – 10   10 – 20   20 – 30   30 – 40   40 – 50   Over 50

4. How good do you think you are at sending text messages (circle your answer)?

   very good   good   okay   not very good   poor

5. How much do you enjoy sending text messages (circle your answer)?

   a lot   a little bit   not bothered   not much   don't enjoy

6. Have you ever used a mobile phone to send a text message?

   Yes ☐ No ☐

7. If you can, list 3 other devices you have used to send a text message?

   ....

   ....

   ....

Figure 8.2: CTEQ version 1

8.6 Children's Technology History Questionnaire (CTHQ)

The purpose of the CTHQ is to provide evidence of the general exposure a child has had to technology. This is not limited to a specific device or piece of technology but instead looks at their broad knowledge of technology as a whole. Due to the constraint to keep each individual questionnaire to one page, this will not go into a vast amount of detail but will allow researchers to get a feel for the amount of technology exposure their sample has had. This questionnaire requires less alteration by researchers adopting it due to not being task or technology specific. Areas that need altering will be identified within this section.

The first thing to establish within this questionnaire is how much technology the children perceive they have access to. We can gain insights into this by asking them about access to technology and also about ownership of technology. As this question is about general exposure to technology it encompasses all devices that run off some kind of power source such as household appliances. Because of this a decision was made not to use the word technology here as children may only relate this to gadgets and computational devices. Two nominal questions are therefore proposed to acquire this data:

Do you have a lot of electrical devices at home?

Do you own a lot of electrical devices?

Two of the most commonly owned technologies by children are the mobile phone and the games console. Both of these devices can offer children a vast amount of technology and task knowledge, often using multiple interaction techniques. Games consoles can also involve interaction with other technologies such as televisions and therefore identifying if a child owns either of these devices can provide evidence of their willingness and desire to interact with technology devices and also indicates a level of technology experience above those children who do not have these devices. Again two nominal questions are proposed to acquire this data:

Do you own a games console?

Do you own a mobile phone?

Knowing about their ownership and access to technology does not gather the children's real opinion about how important technology is to them within their lives. Some children may use technology as often as possible whereas some may only use it when it is absolutely necessary, a point that is missing so far. To address this, the children can be provided with a short series of phrases or scenarios and asked to choose which one most closely resembles how important technology is within their lives. Bell (2007) recommends providing no more than 3 or 4 options in a fixed response question as this can place too great a cognitive load on the child therefore only four options will be provided for this question. The question proposed is:

Tick the statement below that you feel best describes you:

The proposed response options to this question are:

- I use technology as often as I can
- I use technology to make things easier to do
- I use technology when I am bored
- I do not use technology very often

The questions so far have been aimed at gathering children opinions of how much interaction they have had with technologies. Apart from the mobile phone and the games console, no specific knowledge of what technologies they have interacted with has been gathered. The simplest was to do this is by providing the children with a check list of devices and asking them to select which ones they have ever used. The previous question only had four response options due to the fixed response nature of the question. Although this question would be fixed response, the nature of what it is asking makes it more like a large set of nominal questions asked in one go. Because of this, the cognitive load is reduced and therefore no response limit is required.

This question does require the researcher carrying out the questionnaire to populate the check list with a list of technologies they feel are appropriate and potentially some that could have an effect on the results of their study. Due to this, no response options are offered although a set will be present in the complete version of the questionnaire (see figure 8.3). The question proposed is:

Please tick which of the following devices you have ever used:

Finally, the perception of how easy the children find it to learn how to use a new piece of technology is important as it provides yet more evidence of their willingness to try a new technology and experiment with it. A technophobic child will often not find it easy to learn a piece of technology and will have no real desire to do so either. Children have had less exposure to technology and electrical devices than adults and therefore it is expected that they will take this question at face value by thinking about electrical devices in general. Adults may overthink the question by considering the sheer amount, and diversity of electrical devices the question could relate to thus making the question more complicated than it actually is. A VAS thumbs-up scale is proposed here to answer this question:

How easy do you find it to learn how to use an electrical device?

The label proposed for use with the scale from positive to negative is:

- Very easy
- Easy
- Ok
- Hard
- Very hard

8.6.1 CTHQ Version 1

Figure 8.3 shows an example of the first version of the CTHQ where an example of the response options for question 6 is provided. This can also be viewed in more detail in Appendix 3.

The purpose of this questionnaire is to see how much experience you have had with technology and how much you use it. Please answer all the questions and ask the person giving you the questionnaire for help if you are unsure of anything.

1. Do you have a lot of electrical devices at home? Yes ☐ No ☐
2. Do you own a lot of electrical devices? Yes ☐ No ☐
3. Do you own a games console? Yes ☐ No ☐
4. Do you own a mobile phone? Yes ☐ No ☐
5. Tick the statement below that you feel best describes you:

   I use technology as often as I can ☐
   I use technology to make things easier to do ☐
   I use technology when I am bored ☐
   I do not use technology very often ☐

6. Please tick which of the following devices you have ever used

Computer	☐	DVD Player	☐
Television	☐	Washing Machine	☐
Cash Machine	☐	Kettle	☐
Interactive Whiteboard	☐	Toaster	☐
Radio	☐	Mobile Phone	☐
Lift	☐	Games Console	☐

7. How easy do you find it to learn how to use an electrical device (circle your answer)?

Figure 8.3: CTHQ version 1

8.7 Conclusions

Chapter 8 has presented the initial question set for each of the three questionnaires proposed. Thematic analysis of computer experience questions along with extensive experience carrying out research studies with children provided a solid ground for creating questions that both cover the major constructs required whilst also being written in a language that children aged between 7 and 11 should be able to understand.

It is noted at this point that the proposed questionnaire set will not always be able to capture all the relevant task and technology experience and opinions that are specific to a research study and therefore a fourth questionnaire may be required to fill this gap. Research studies may require specific experience of carrying out a task, maybe in a certain way, or perhaps the use of a technology in a specific way that would be irrelevant to other technologies. This would make designing these questions into a generic questionnaire set impossible.

Chapter 10 will present a guide on how researchers should approach the use of the final questionnaire set in conjunction with the guidelines produced in chapter 7. It is here that advice will be given on the creation of research specific questions that could be added to the questionnaire set or to a fourth questionnaire if necessary.

The questionnaires may also require some level of demographic information to be included at the beginning and the information that is recorded will be left to the judgement and requirements of the researcher who is using the tools but again guidance can be sought within the chapter 10 and the guidelines in chapter 7.

The next stage of the process is to test the questionnaire set to improve the reliability and validity before it is ready for use. Chapter 9 therefore presents three pretesting studies, each designed to improve the questions and provide evidence of the validity and reliability of the questionnaires as a whole.

9 CHAPTER NINE: VALIDATING THE QUESTIONNAIRES

9.1 Introduction

Following the creation of the questionnaire set it is important to begin to test out certain aspects that could have an effect on the validity and reliability of responses. As decided in section 8.2, the questionnaires were created using the guidelines from chapter 7, literature (including the thematic analysis of computer experience), and survey experience gathered so far in this thesis giving them a good grounding to begin without the questionnaires ever being used.

The objectives of this chapter are to refine the language in each of the questionnaires through a series of studies involving appropriately aged children and also primary school teachers to ensure that the correct language is used in both the question wording and the terminology being used. A large-scale pilot study will then be deployed to test out the full questionnaire set with children of different ages appropriate to this thesis. Any final changes from the pilot study will then be made and the definitive questionnaire set will be produced.

9.1.1 Contributions

This chapter contributes the final version of the suite of survey instruments that are intended for use by researchers in CCI in order to enable children to reliably self-report their prior technology use (RC1).

9.1.2 Structure

The structure of this chapter is as follows. Section 9.2 presents a pretest of version 1 of the questionnaire set with children designed to identify problems with the language used and also test whether the children understood the construct of each question. A small test-retest study was also performed. Where necessary the questions will be reworded into version 2 of the questionnaire set. Section 9.3 presents a further study to identify problems with the language using version 2 of the questionnaire set. This study asked teachers to assess each question and provide comments on the question wording and structure. When wording issues had been identified in the previous section the teachers were also asked to provide alternatives. Revisions were then made to the questionnaire set and problems needing further study were identified. Section 9.4 presents a pilot test of the questionnaire set (version 3) and includes a fourth questionnaire made up with questions related to issues found in the previous study. The pilot test is analysed for time taken, non-response, and cross question reliability to assess the reliability of the questionnaire set as a whole and provide guidance for researchers using the questionnaire set. The questions in the fourth questionnaire were compared with their corresponding questions in the questionnaire set and where necessary the questions were replaced. Section 9.5 summarises the chapter.

9.2 STUDY 7 - Pretesting the Questions with Children

The literature in this thesis has highlighted the importance of using appropriate language with children to minimise any problems they may have understanding what they have been asked to do in relation to a research study. Within questionnaire design this is paramount in ensuring children fully understand the constructs behind each question as well as any terminology that is used. This can be seen in the guidelines presented in chapter 8 although at this point has not yet been fully addressed within the questionnaire set.

The primary aim of this study is to present the questionnaire set to a group of children to measure how well the children can understand the underlying construct (construct validity) of each question whilst also asking the children to review the wording of the questions and terminology used within them.

9.2.1 Participants

This study consisted of 39 children across three different year groups at a UK primary school. 12 Year 3 (bottom year of KS2) children aged 7 or 8 years, 12 Year 4 (a middle year of KS2) children aged 8 or 9 years, and 15 Year 6 (top year of KS2) children aged 10 or 11 took part. The children who took part in this study have not been involved in any research carried out in this thesis so far.

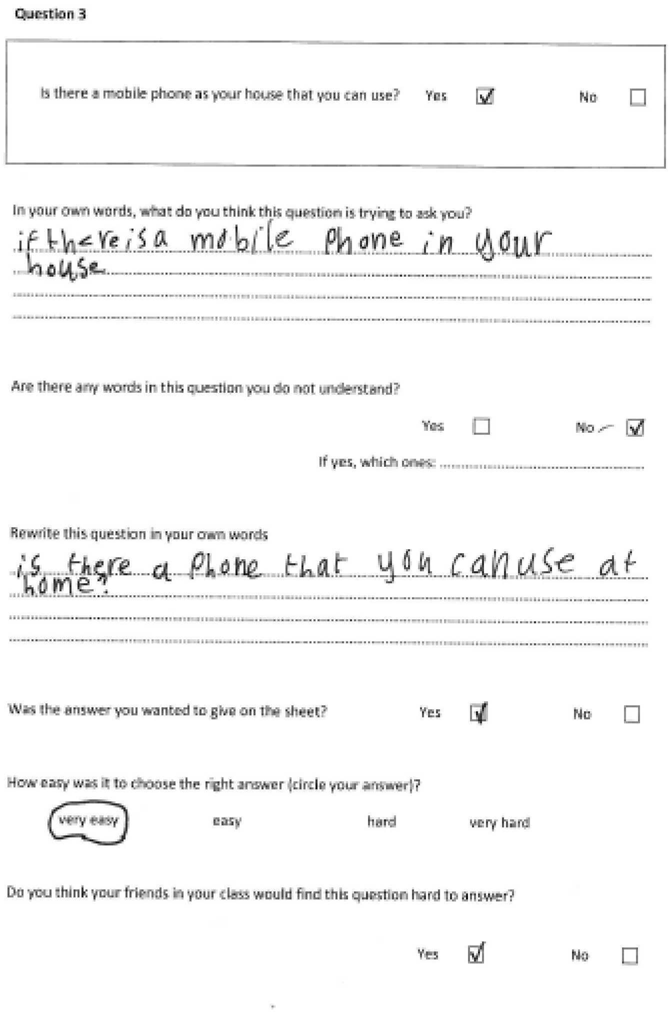
All the children were given the option of participating in the study and were informed they could stop participation at anytime. One child appeared to be uncomfortable with participating and was given the option to withdraw shortly after beginning the study. This child chose to withdraw and therefore her participation is not included within the set of 39 children.

9.2.2 Questionnaire Design & Method

This study was carried out in a communal corridor between two of the classrooms in a local primary school. Three large tables were present within the corridor, which were put together into a large square for the purpose of the study. A chair was placed in the right corner of each side of the table setup to ensure all the children were a large distant apart and had their questionnaires facing in different directions to make it hard for the children to see each other's answers. Between two and three children participated in this study at a time and were given 20 minutes to complete the task.

Each child was presented with a booklet consisting of a copy of the full questionnaire they had been selected to analyse followed by a set of questions relating to each question in the questionnaire, with each set presented on a separate page. The decision for each child to analyse only one questionnaire from the questionnaire set was taken as the full set consisted of 23 questions which was deemed too many to be analysed in one go by the same child. All children in each group of participants were given a different questionnaire to complete so that there was no possibility of collusion.

The initial two questions on the questionnaire asked the child to report their age and sex so that age and gender effects could be discussed if relevant. Each booklet was uniquely coded so that the responses from the same child could be identified without using irrelevant personal data such as the child's name. Each evaluation sheet then consisted of six questions related to a specific question within the questionnaire. The six questions were identical on each sheet meaning the only difference on each page was the specific question presented in a box at the top of the page from the main questionnaire being evaluated (see figure 9.1).



Question 3

Is there a mobile phone as your house that you can use? Yes ☑ No ☐

In your own words, what do you think this question is trying to ask you?

if there is a mobile phone in your house

Are there any words in this question you do not understand?

Yes ☐ No ☑

If yes, which ones:

Rewrite this question in your own words

is there a phone that you canuse at home?

Was the answer you wanted to give on the sheet? Yes ☑ No ☐

How easy was it to choose the right answer (circle your answer)?

very easy easy hard very hard

Do you think your friends in your class would find this question hard to answer?

Yes ☑ No ☐

Figure 9.1: Example page from questionnaire evaluation booklet

The first question on the sheet was an open ended question asking the children to write down what they thought the main question was trying to ask them. The purpose of this is to determine whether each child understood the underlying construct of the question. The second question asked the children if there were any words within the main question that they did not understand. If a child indicated that there was a word they didn't understand they were presented with a space to record the problem word(s) and the word(s) were explained to them so that they then understood (as should be the case in all investigator-administered questionnaires). The third question was open ended where the child was given the opportunity to re-write the main question in their own words. If the child was happy with the wording of the question then they were instructed to say so here also. The next two questions were closed questions related to answers provided for fixed response questions, the first asking the children to state whether the answer they wanted to give was provided as an option, and the second a four point likert scale asking them to state how easy it was to choose the answer they wanted to. The aim of these two questions was to gauge whether the children had any difficulties in selecting the appropriate answer which could lead to the use of satisficing techniques. The final question was a closed question asking the children to choose whether they thought their friends in their class would have problems answering the main question. The purpose behind this was to get the children to look at the difficulty of the question in a non-personal way.

Each questionnaire from the questionnaire set was pretested on 13 children spanning the three year groups.

9.2.3 Results

The results for each of the questionnaires are presented in the next three subsections. The results are summarised into tables, the headings of which are expanded below:

- **Q. No –** question number the row is relating to.
- **Construct** – the percentage of children who understood the question construct.
- **Wording –** the percentage of children who had no problem with any of the words in the question.
- **Rewrite –** the percentage of children that did not feel the question needed to be rewritten.
- **Answer –** the percentage of children who stated the answer they wanted to give was available as a choice.
- **Ease –** a modal score showing the results from a likert scale looking at how easy the children found it to choose one of the answer options presented.
- **Friends –** a percentage score showing how many children felt their friends would be able to answer the question with no problems.

It is worth noting that the younger children (Year 3) were not asked to provide answers to the 'Answer' and 'Ease' questions for nominal yes/no questions but the older children did choose to answer these.

9.2.3.1 Children's Technology Use Questionnaire

Table 9.1 presents the summarised results for the CTUQ.

Table 9.1: The summarised results for the CTUQ

Q. No.	Construct	Wording	Rewrite	Answer	Ease	Friends
1	92%	100%	100%	100%	2	92%
2	69%	100%	100%	89%	1	92%
3	77%	100%	69%	100%	2	54%
4	85%	100%	100%	91%	1,2	69%
5	92%	100%	92%	92%	2	85%
6	92%	100%	92%	89%	2	100%
7	85%	100%	100%	100%	2	100%
8	85%	100%	85%	100%	1	92%
9	85%	100%	100%	100%	1	92%

The results show that question 1 was well understood by all the children and that no issues were found with the question or its wording.

Question 2 *"Do you own a mobile phone?"* received a poor score on understanding the construct. Observations from conducting the questionnaires gave insight into the cause of this being the children's inability to articulate an appropriate response to the question rather than simply not understanding the construct. One child rewrote the question but at the same time changed the construct from ownership of the device to *"Are you old enough to have your own mobile phone?"* which is not an appropriate correction and was therefore dismissed.

Question 3 *"Is there a mobile phone at your house that you can use?"* received an acceptable construct response of 77%. Again their seemed to be an issue with articulation in some children rather than a problem with them understanding the construct itself. Four children rewrote the question, one child changed the word house to home, another replaced mobile phone with telephone, one replaced *'can use'* with *'often use'*, and the final one changed the construct completely.

Interestingly only 54% of the children though their friends would have no problem answering this question.

Questions 4 to 9 received high scores across all the categories and was therefore deemed to be acceptable both for construct and language. Only 69% of the children thought question 4 would cause their friends no problem which is a concern although this was lower than the percentage of children who appeared to have issues with the construct. Two children rewrote question 8 *"Have you ever used your mobile phone to send a text message"* both shortening the term text message (one to *texted* and one to *message*) and one changing mobile phone simply to phone.

9.2.3.2 Children's Task Experience Questionnaire

Table 9.2 presents the summarised results for the CTEQ.

Table 9.2: The summarised results for the CTEQ

Q. No.	Construct	Wording	Rewrite	Answer	Ease	Friends
1	92%	92%	69%	100%	2	69%
2	85%	100%	85%	100%	2	92%
3	100%	100%	77%	92%	1,2	85%
4	100%	100%	62%	100%	2	85%
5	77%	100%	85%	100%	2	85%
6	85%	100%	85%	92%	2	92%
7	77%	85%	77%	89%	2	77%

The results show that question 1 *"Do you know what a text message is?"* received high scores in relation to the children understanding the wording and the construct although four children did rewrite the question. The major outcome from this was potentially shortening the phrase *'text message'* simply to *'text'* and replacing *'know'* with *'understand'*. One child did not know what a text message was and needed this explaining. It is worth noting that this child was from the youngest year group.

Questions 2 to 4 received high scores across all categories supporting their appropriateness of them. However, all three did receive rewrite suggestions from the children. Question 2 *"Have you ever sent a text message?"* rewrites both shortened the length of the question, and as with question 1, one changed the phrase *'text message'* to *'text'*. Question 3 *"How many text messages do you think you send in a* *week (circle your answer)?"* again had the phrase text messages shortened and one child proposed changing it to a nominal question simply asking *"do you send a lot of texts?"*. One child in this question also suggested narrowing the number gaps between the response options. Question 4 *"How good do you think you are at sending text messages (circle your answer)?"* has two children suggesting changing the construct a bit to ask about how fast the children thought they were at writing text messages. Others suggested shorter versions of the question wording that will need to be considered.

Question 5 *"How much do you enjoy sending text messages (circle you answer)?"* received an acceptable score of 77% for understanding the construct and did better in all other categories. The main change appeared to be changing the construct from *enjoy* to the amount of texts a child sends. The rewrite example here was a shortening to *"Do you like sending texts?"*.

Question 6 *"Have you ever used a mobile phone to send a text message?"* received good scores all round with the construct issues appearing to be a struggle to rephrase the construct rather than a problem understanding it. The rewrite here again was a shortening of the words and abbreviation of the task and technology to *"Do you use a phone to text?"*.

Question 7 had the weakest scores overall for this questionnaire although the lowest percentage received was still a relatively high 77%. The younger Year 3 children were the only group who had problems with this question, a potential problem being the word *'device'* that was recommended to be changed to *'things'*. One participant suggested changing the question to the nominal yes/no response question *"Do you send on more than a phone?"*.

9.2.3.3 Children's Technology History Questionnaire

Table 9.3 presents the summarised results for the CTHQ.

Table 9.3: The summarised results for the CTHQ

Q. No.	Construct	Wording	Rewrite	Answer	Ease	Friends
1	77%	92%	92%	100%	1	85%
2	100%	100%	100%	100%	2	69%
3	77%	69%	69%	100%	2	60%
4	92%	100%	92%	100%	2	92%
5	85%	92%	92%	91%	1	85%
6	92%	100%	100%	83%	2	100%
7	85%	100%	100%	100%	1	92%

The results show that question 1 *"Do you have a lot of electrical devices at home?"* overall received high scores, as did questions 4 to 7 and therefore do not need attention.

Question 2 *"Do you own a lot of electrical devices?"* received 100% for the important categories. However, even though all the children clearly understood the wording and the question, only 69% thought their friend would have no problems answering it.

Question 3 *"Do you own a games console?"* appeared to be the main question on this questionnaire where the children had issues. All children who had problems understanding the wording struggled with the word console. Rewrites of this question support this with specific consoles being used either to replace the phrase games console or used as an example.

9.2.4 Discussion

Overall the questionnaires received very good scores for the majority of questions showing that in general the children understood the constructs that were being asked and the wording used within the questions. The major issue of children not understanding the construct appeared to be down more to an inability to articulate the construct rather than a problem understanding it which was evident observing the children filling in the evaluation sheets.

There was only one question where the age of the children appeared to be a factor which appears to be due to the task of text messaging perhaps not fitting with the question as well as it could. Text messaging is one task where the mobile phone is the major method for sending them and younger children struggled to think of alternatives. Older children did not appear to have this problem as many were able to answer the question and make links between text messaging and instant messaging. There were no instances across the whole questionnaire set of gender having an effect on a particular question and therefore the questionnaires do not appear to have gender issues associated with them.

The major points to come out with regards to wording are that understanding of the phrase *'games console'* which is interesting as this had not been identified in any previous studies using the phrase, but is not completely unexpected as issues surrounding a generic phrase for these devices did occur several times in chapter 4. The shortening of *text message* to simply *text* occurred frequently although this is more of an issue for practitioners adopting the questionnaire set as this wording is related to the specific task of texting and not the generic parts of the questionnaire wording. This issue will be addressed in relation to rewording the questions and added as an issue to documentation relating to the use of the questionnaire set but does not affect the questionnaire set specifically.

There appeared to be an apparent shortening of questions when the children rewrote questions which will be looked at, together with other specific points, in the rewording of certain questions in the questionnaire. Care needs to be taken not to casualise the wording too much that the meaning of certain constructs gets lost. This is particularly more of an issue for the younger children.

9.2.4.1 Test-Retest

Whilst carrying out this study it became evident that some children were answering the main questionnaire questions whilst completing the evaluation sheets, and also answering the full questionnaire that was presented to them at the beginning of the evaluation. This provided the opportunity to evaluate these for consistency across the responses as they essentially answered each question twice, once in the evaluation, and once answering the questionnaire in full.

It is noted at this point that the time gap between the two sets of answers was short, and the number of children who did this was only 16 (across the 3 questionnaires) therefore the results only provide small insights into test-retest reliability which is why these results are only reported here in brief rather than having a more extensive analysis.

Table 9.4 shows the match between questions across each instance of a questionnaire being filled in twice by the same child. A ‘1’ in the questionnaire column represents a match in responses where as a ‘0’ represents a mismatch in responses. The CTEQ and CTHQ have less questions than the CTUQ and therefore boxes for questions 8 and 9 are left blank for these. The match percentage for each questionnaire is provided together with the average match percentage for the whole group.

Table 9.4: Test-retest results for each questionnaire filled in twice

Questionnaire	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Match
CTUQ	1	1	1	1	1	1	1	1	1	100%
CTUQ	1	1	0	1	1	1	1	1	1	88.9%
CTUQ	1	1	1	1	1	1	1	1	1	100%
CTUQ	1	1	1	1	1	1	1	1	1	100%
CTUQ	1	1	1	1	1	1	1	1	1	100%
CTHQ	1	0	1	1	1	1	1			85.7%
CTHQ	1	1	1	1	1	1	1			100%
CTHQ	1	1	0	1	1	1	1			85.7%
CTHQ	1	0	1	1	1	1	1			85.7%
CTHQ	1	1	1	1	1	1	1			100%
CTHQ	1	1	1	1	1	1	1			100%
CTHQ	1	1	1	1	1	1	1			100%
CTEQ	0	1	1	0	0	1	1			57.1%
CTEQ	1	1	1	1	1	1	1			100%
CTEQ	1	1	1	1	1	1	1			100%
CTEQ	1	1	1	1	1	1	1			100%
								Total Match		**93.9%**

The average test-retest match for all the questionnaires completed was 93.9% showing that in this situation the children were capable of answering the questionnaires extremely accurately. The CTUQ had the best result with an average of 97.8% across 5 participants. The CTHQ came next with an average of 93.9% across 7 participants and the CTEQ came last with an average of 89.3% across 5 children although it is noted that one child had an unusually low match score of 57.1% which potentially gave this questionnaire a lower result that it should.

9.2.5 Conclusions

This study has provided evidence that the questionnaire set has a high level of construct validity with the construct behind the majority of questions being understood extremely well. Amendments will me made where necessary to address some minor issues discovered, as is the case with the language used.

There appears to be little problems for the children understanding the answers presented to them in the fixed-response questions meaning that satisficing should be kept to a minimum.

The results from the test-retest analysis carried out are encouraging although no definitive conclusions can be made. There appears to be a potential issue with question 2 on the CTHQ identified here which will be considered along with the main results in the rewriting of this question.

9.2.6 CTUQ Revisions

Following the results of the CTUQ evaluation, four questions were identified as needing alteration:

- **CTUQ Q2**: Do you own a mobile phone?
- **CTUQ Q3**: Is there a mobile phone at your house that you can use?
- **CTUQ Q4**: How many days a week do you use a mobile phone?
- **CTUQ Q8**: Have you ever used your mobile phone to send a text message?

Question 2 appeared to be causing confusion with the construct and therefore needed rewording. Children often replace the word *own* with *have* when talking about ownership so it was decided to lengthen the question a little whilst incorporating both of these words. The resulting amended question is:

CTUQ Q2 Rewrite: Do you have your own mobile phone?

Whilst question 3 received an acceptable level of construct understanding, it appeared the children were concerned about whether their friends would understand it. To help improve this, the question has been rewritten and shortened to:

CTUQ Q3 Rewrite: Do you use a mobile phone at home?

Question 4 was judged to be fine overall by the children but again they were concerned their friends may struggle to understand the question. This question again was quite long and it was decided that *'at home'* was not required at the end of the question as this was not actually relevant for the question. The responses to this question we left unchanged:

CTUQ Q4 Rewrite: How many days a week do you use a mobile phone?

Question 8 was judged to be too long by the children and the phrase *'text message'* was often shortened. In this case with mobile phone still being in the question it seemed appropriate to shorten this as it would still make sense in the context of mobile phone use. The question has been reworded to make it shorter:

CTUQ Q8 Rewrite: Have you ever sent a text on a mobile phone?

The ownership of the mobile phone was also removed from this question as this question is designed to find out if the child had ever sent a text on a mobile phone and the owner of the phone the text was sent on is irrelevant.

9.2.7 CTEQ Revisions

A common theme from the evaluations in study 7 was the shortening of the phrase *'text message'*. As this was an integral part of this question and not often placed in the context of a mobile phone it was decided to leave this phrase as it was for the most part. Following this after reviewing all the questions on the CTEQ, four questions were identified as needing revision:

- **CTEQ Q3**: How many text messages do you think you send in a week (circle your answer)?
- **CTEQ Q4**: How good do you think you are at sending text messages (circle your answer)?
- **CTEQ Q6**: Have you ever used a mobile phone to send a text message?

- **CTEQ Q7**: If you can, list 3 other devices you have used to send a text message:

Question 3 and question 4 were both considered to be too long. Both questions needlessly have *‘do you think’* incorporated into them and therefore have been reworded to remove this:

> **CTEQ Q3 Rewrite**: How many text messages do you send in a week (circle your answer)?
>
> **CTEQ Q4 Rewrite**: How good are you at sending text messages (circle your answer)?

A decision was also made not to shorten the interval of answers in question 3 as this would increase the number of response options placing extra cognitive load on the children. Question 6 needed to be reworded to be the same as question 8 in CTUQ questionnaire and therefore was reworded to:

> **CTEQ Q6 Rewrite**: Have you ever sent a text on a mobile phone?

Question 7 was potentially the most interesting in this questionnaire as gaining information about other technologies children could use to carry out tasks is important and therefore necessary in the questionnaire but potentially quite difficult to answer with regards to text messaging. It was therefore decided to leave this question in, rewording slightly to remove the beginning making it shorter. The use of the word devices has also not been changed and will be looked at in more detail in study 8. Question 7 was therefore reworded to:

> **CTEQ Q8 Rewrite**: List 3 other devices you have used to send a text message:

9.2.8 CTHQ Revisions

There were two questions identified as needing attention following on from the evaluation of the CTHQ questions, these were:

- **CTHQ Q2**: Do you own a lot of electrical devices?
- **CTHQ Q3**: Do you own a games console?

Question 2 appeared to be the most well understood question across the questionnaire set gaining the highest marks for all evaluation questions except for the fact many children thought their friends would struggle with the questions. This, coupled with the fact this question received the most variation in the test-retest section of the study is a cause for concern. The question itself appears to be simple enough to answer and is not long in length therefore it is more likely to be a problem with the term *'electrical devices'* being used to represent technologies the children own. It is unclear at this point as to a better phrase for this and therefore the question has not been changed and will be a focus of study 8.

The issue with question 3 was in the use of the phrase *'games console'* which was commonly misunderstood by the children. Again an appropriate replacement phrase will be sought in study 8 and therefore the question has not been changed at this time.

Version 2 of the survey taking into account the changes proposed in study 7 can be seen in Appendix 4.

9.3 STUDY 8 - Pretesting the Questions with Teachers

Piloting the language of a questionnaire with children is considered essential to maximise their comprehension of both the questions being asked and the underlying constructs. This is primarily due to the children being able to reword questions in a language that they understand (rather than a language that researchers think that children will understand). Another method of doing this is by testing the language with adults who work/or spend large amounts of time with children of the relevant age groups.

To this end, following on from the revisions to the questionnaire set made in study 7, it was deemed appropriate to evaluate the language of the new questionnaire set (version 2) with a group of primary school teachers in an attempt to identify further enhancements that could be made to the language being used.

9.3.1 Participants

This study consisted of 19 primary school teachers from three UK primary schools, all of which has extensive and recent experience of working with children between the ages of 7 and 11 years.

As with the children who have taken part in the previous studies, the teachers were fully informed of the purpose of the study and given the opportunity to stop participation at any time. Not all the teachers at the primary schools chose to participate in the study.

9.3.2 Questionnaire Design & Method

This study was carried out in the staffroom of two the primary schools, with the head teacher of the third primary school administering the study to staff before an afterschool staff meeting. The teachers who participated in the school staffrooms did so at lunch time during a normal school day and were given no time restriction for completing the task. All teachers completed the task at the same time as their colleagues in their own school but on different days to the staff at the other schools. All teachers we asked not to discuss their answers with their colleagues whilst completing the task.

There was no requirement to ask for any demographic information about the teachers and therefore no personal questions were used within this study. The teachers were presented with a modified version of each of the three questionnaires. The questionnaires were coded so that the results gathered for each questionnaire could be identified as being from the same teacher if required.

For each of the questionnaires, all questions were presented in full to the teachers together with the response options, or space for answering, as they would appear for a child completing the questionnaire. If a question had been changed due to the results of study 7 then the original question was also presented to the teacher so they were able to see what modifications had already been made. Underneath each question, the teachers were presented with a box in which to write any comments they had or suggestions for changes.

From language issues identified in study 7, when evaluating the CTHQ, the teachers were also asked two further questions in an attempt to gather better words/phrases to be using instead of the word ‘device’ and the phrase ‘games console’. A further question was also asked at the end of the CTEQ, again relating to the word ‘device’ in reference to its use in question 7.

9.3.3 Results

The comments received from all the teachers were collated for each question of each questionnaire and analysed separately to identify common themes and important issues that had been identified. Where no comments or suggestions were received for a question, the question was considered to have no issues and therefore not analysed further.

As with study 7, the results section is split into 3 sections, one for each of the questionnaires.

9.3.3.1 Children's Technology Use Questionnaire

Question 3 and question 8 received no comments from any of the 19 teachers who participated and therefore the amended versions of both these questions are considered appropriate to be used in the full pilot of the questionnaire. Question 1 *"Do you know what a mobile phone is?"* received one comment which was to rewrite the question to *"What is a mobile phone?"*. This change would involve changing the question type from nominal closed question to an open-ended question placing a greater burden on the writing skills of the children and ability to articulate accurately a description of the device in question. This would potentially open up the question to the same criticisms that Donaldson (1978) and Wood (1998) pointed to in Piaget's work, the over complication of the task. Because of this, coupled with the results from study 7 this question was not amended further. Question 2 also received just one rewrite and the language used in this rewrite was not considered to be an improvement on the current question, supported by the lack of response from the other teachers, therefore this question was also not amended further.

Question 4 *"How many days a week do you use a mobile phone for (circle your answer)?"* received three comments from teachers, all of which involved changing the response options of the question. The two options provided were to provide a tick list of every day of the week for the children to tick each day, the second was to use less specific answers such as often, sometimes, never, rather than concerning the number of days. 84% of the teachers found no issues with this question and therefore this does not appear to be a major concern. This question will potentially be looked at further in study 9.

Comments for question 5 focussed on the number of options given to the children even though 89% of the teachers had no concerns. The use of 5 point VAS scales with children has been shown to be reliable in literature and therefore the scale will not be changed to reflect these comments.

Questions 6 and 7 only received a small number of comments between them but identified the valid point that question 7 is not relevant if question 7 has been given the answer of ‘no’ as quite rightly if a child has stated they do not have mobile phones in their class at school then they will not be able to use them with their teachers in the class.

Question 9 again only received a small number of comments, one teacher rewrote the question removing the number of answers the children were asked to give which potentially would limit the number of responses received therefore providing a more limited view of what the device is used for. The other comment recommended providing options for the children to select from which would restrict the children to a preset of answers or created the needed for a large number of response options.

9.3.3.2 Children’s Task Experience Questionnaire

Questions 1 and 2 received no comments from any teacher and therefore are considered to be appropriate to be included in the final pilot study as they are. Question 4 received one comment about reducing the options on the VAS and changing it to smiley faces rather than thumbs, the latter of which may be considered further in study 9 although at this point no changes are deemed necessary for this question. Question 6 was deemed to be similar to question 2 which is expected as this question has been specifically included to allow the accuracy of this question between this questionnaire and CTUQ. If question 2 is answered as yes, this question can also be used in this questionnaire to judge accuracy as the answer to question 6 should also be yes.

Question 3 *“How many text messages do you send in a week (circle your answer)?”* received comments from 3 teachers all relating to the ‘send in a week’ section of the question. One teacher thought a week was a too long period for the children to remember where as the other teachers were more concerned with the need for the children to provide an average of their weekly use. One teacher suggested changing the question to ask about text messages sent during the current week. This would not be useful if the questionnaire was conducted on a Monday or Tuesday. A better method would be to ask about how many text messages the child sent last week as this is still a recent period in time and does not require the additional cognitive load of working out averages over an arbitrary number of weeks.

Two teachers recommended changing question 5 to a yes/no nominal question of ‘do you enjoy’ rather than ‘how much do you enjoy’ which changes the amount of enjoyment to a simple yes or no response and therefore will not be implemented.

Question 7 received the most comments on this questionnaire with only 58% of the teachers having no comments on the question as it stands. The major issue appears to be with the word devices, which is supported in the results of study 7. One teacher provided a rewrite of the question *“Have you used anything else to send a text message. Try to write down 3”* which although it lengthens the question, does ask it in a more child friendly manner.

9.3.3.3 Children’s Technology History Questionnaire

The CTHQ received a lot more comments than the other two questionnaires. The main reason for this was the use of the word ‘devices’ in several of the questions in this questionnaire. Without this issue, questions 1, 2 and 6 would not have been identified as being a potential problem. As mentioned in study 7, this issue was already known and predicted and therefore is partially addressed with the extra questions asked at the end of this evaluation. Question 3 also had a similar issue with the phrase games console that is also addressed in the extra questions. Question 4 only received one recommendation which was to change ‘own’ to ‘have’. This issue was addressed in study 7 for the CTUQ and therefore it would be appropriate to do the same alteration to this question also.

The two issues with question 5 that have been highlighted are the use of the word technology, and the use of the word statement. Both of which will need addressing in the next refinement of this questionnaire.

The wording of question 7 was never considered to be satisfactory even though it provided little problems for the children involved in study 7. One teacher suggested rewriting the question to *“Do you find electrical devices easy to use?”* which is a much clearer way of asking the question although it does lend itself more to a yes/no response rather than a VAS response.

9.3.4 Discussion

Overall the wording of the questions in CTUQ appear to be acceptable to teachers as all questions had no comments or suggestions from at least 84% of the teachers, most being higher than this. Of the comments received, only question 4 warranted further consideration. This involved changing the current options to other types of scales, which would in turn require small changes to the question wording. As this was only identified by 16% of the teachers, it will not be changed within the questionnaire itself. Instead a reworded version using a different scale will be used in study 9 with the results of the two questions assessed for non-response and correlation within the answers.

The findings of the CTEQ are similar to the CTUQ with all questions, apart from question 7, again having no comments or suggestions from over 84% of the teachers. The major issue to come out of this question was the use of the word *devices* which was the focus of the extra question added to this evaluation. The two most common alternative presented by the teachers were *'gadgets'* and *'equipment'* so this question will be amended by having the word *devices* changed to *gadgets* (being the most common alternative). A second version of this question will also be included in study 8 using the word technology and the two will be again asses for non-response and correlation between the answers. The re-write suggestion for question 7 will also be taken into account although will need to be amended so as not to ask the children two questions in one.

> **CTEQ Q7 Rewrite:** Try to name 3 other gadgets you have used to send a text message:

Question 3 within the CTEQ will also be rewritten to remove the need for the children to work out the average number of text messages they sent. Focussing the question on the previous week will give the children the chance to use a time period still relatively fresh within their memory reducing the cognitive load the question previously placed on them, which is in line with De Leeuw et al's (2004) view that children are much better at recalling information that is recent:

CTEQ Q3 Rewrite: How many text messages did you send last week (circle your answer)?

All the questions within the CTHQ were identified as requiring changes based on the comments received from the school teachers. This was predominantly again due to the use of the word ‘devices’ in several of the questions although the term *games console* had the same issue. The results of the extra questions added to this questionnaire show that the phrase *‘electrical items’* was preferred as a replacement for *‘electrical devices’* and that *‘games machine’* coupled with providing examples would be an alternative to the phrase *‘games console’*. This led to the following question changes:

CTHQ Q1 Rewrite: Do you have a lot of electrical items at home?

CTHQ Q2 Rewrite: Do you own a lot of electrical items?

CTHQ Q3 Rewrite: Do you own a games machine (examples: Xbox, Playstation, Nintendo DS)?

CTHQ Q6 Rewrite: Please tick which of the following items you have ever used:

Question 4 required changing as similarly worded question (CTUQ question 2) in study 7 was changed to include both the words ‘have’ and ‘own’ therefore to ensure consistency this question was reworded to:

CTHQ Q4 Rewrite: Do you have your own mobile phone?

Several teachers were concerned with the use of the words *‘technology’* and *‘statement’* within question 5 and the response options presented. Using the suggestions received from the teachers this question was rewritten to:

CTHQ Q5 Rewrite: Tick the sentence below that you feel best describes you:

- *I use gadgets as often as I can*
- *I use gadgets to make things easier to do*
- *I use gadgets when I am bored*
- *I do not use gadgets very often*

Question 7 also included the word *'device'* that required altering in addition to one teacher providing a rewrite of the question making the language significantly clearer. To keep the response options the same (not turning the question into a yes/no response) the question was rewritten to:

CTHQ Q7 Rewrite: How easy do you find it to use electrical items?

9.3.5 Conclusions

This study has led to further amendments to several questions across the questionnaire set, particularly within the CTHQ. These amendments will be implemented before the questionnaire set is piloted with a large group of children within study 9 (see appendix 4).

Several questions have been identified as possibly being written, or answered, in different ways and therefore these questions will be written up into a fourth questionnaire and used within study 9 to compare responses across the two versions of the question and also to look for problems such as non-response in order to see if one question would be preferential over the other.

Within this study, some teachers suggested the use of smileys instead of thumbs within the VAS scales and therefore one question will be repeated within the fourth questionnaire with this scale change and the correlation between the two will be tested.

As the questionnaire set is designed to have a fourth part, the use of an extra questionnaire will allow the extra validation of specific questions whilst also providing a more accurate timing of how long it takes children to complete the full questionnaire set.

9.4 STUDY 9 – Piloting the Questionnaire Set

Following on from the language modifications made in studies 7 and 8, the questionnaire set was now ready to receive a pilot test to look at the performance with a set of users.

Pilot testing allows not only a review of the questionnaires and individual questions by its target user group, but also a chance to gather further information for other researchers who use the questionnaire set in their own research.

It is hypothesized at this time that most language issues will have been removed from the questionnaire set although small amendments to the final questionnaire versions are still expected.

9.4.1 Participants

This study consisted of 97 KS2 children (Year 3 – Year 6) from two local UK primary schools who had not been involved in any of the previous work within this thesis and therefore had no prior knowledge of the work, as would be the case if the questionnaire set was used by other researchers in the field. The age spread of the children can be seen in table 9.5.

Table 9.5: The number of children from each age group who participated in study 9

Age	No. of children
7	7
8	22
9	24
10	31
11	13

All the children were given the option of participating in the study and were informed they could stop participation at anytime. One child accidentally missed out a full page of the questionnaire and therefore his results were removed meaning the results of 96 children are reported (with only 12 children aged 11 now participating).

9.4.2 Questionnaire Design and Method

The discussion and conclusions from study 8 identified questions where there was still an uncertainty in the best way to ask them and because of this a fourth questionnaire was added to the questionnaire set containing alternative versions of these questions (see Appendix 5). This led to the addition of five extra questions to the questionnaire set. As the questionnaire set has been designed to include a fourth research specific questionnaire the addition of these questions would provide the children with a more realistic experience of the length of the questionnaire when used in a real world study.

1. How often did you use your mobile phone last week (circle your answer)?

very often often a bit not much never

2. Try to name 3 other pieces of equipment you have used to send a text message:

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

3. How much do you enjoy sending text messages (circle your answer)?

don't enjoy not much not bothered a little bit a lot

4. Do you own a games console? Yes ☐ No ☐

5. Tick the sentence below that you feel best describes you:

I use electrical items as often as I can	☐
I use electrical items to make things easier to do	☐
I use electrical items when I am bored	☐
I do not use electrical items very often	☐

Figure 9.2: The additional questions added to the questionnaire set providing alternative versions of specific questions

Figure 9.2 shows the additional questions that were added to the questionnaire set. This set of five questions is referred to as 'questionnaire 4' or 'Q4' within this study. Question 1 involved a scale change from question 4 in the CTUQ by asking the children how often they used a mobile phone rather than how many days during the week. Question 2 was an alternative version of question 7 on the CTEQ with the word *gadgets* replaced by the phrase *pieces of equipment*. Question 3 is an alternative version of question 5 on the CTEQ where the thumbs-up scale has been replaced by a smiley-o-meter scale to see what effect this has on the answers given.

Question 4 was the original question 3 from CTHQ asking the children whether they own a games console rather than the updated version where *console* was replaced with the word *machine* and examples were also provided. Question 5 was a reworded version of CTHQ question 5 where again the word *gadget* was replaced, this time with the phrase *electrical items*.

The decision was made to administer the full questionnaire set to each child at once to enable an accurate recording of how long the questionnaire set took to complete and identify any issues such as non response in the latter questions due to fatigue. To balance the results received, four different versions of the questionnaire set were produced with the questionnaire presented in a different order in each (see table 9.6).

Table 9.6: The questionnaire order of each version of the questionnaire set administered

Version	Questionnaire order
1	CTEQ, CTUQ, CTHQ, Q4
2	Q4, CTEQ, CTUQ, CTHQ
3	CTHQ, Q4, CTEQ, CTUQ
4	CTUQ, CTHQ, Q4, CTEQ

The questionnaire sets were administered to children in groups of four with each child receiving a different version. The children were given a brief introduction to the purpose of the study and informed they could ask questions to the administrator at anytime if they were unsure of anything and needed clarification or further explanation. There were several occasions where the group size differed due class sizes not being divisible by four. Due to the nature of this study, no time limit was imposed on the children to complete this study. Within one school the study took place in a communal arts area where no classes were taking place. In the other school the study took place at two large tables that were placed in the corridor that linked two of the classrooms.

An administrator sheet was also created to record the time taken by each child and also any interesting observations that could be useful in the discussion section of this study. The final pilot questionnaire set can be seen in Appendix 6.

9.4.3 Results

The average time it took a child to complete the questionnaire set was 7 minutes 23 seconds. Table 9.7 shows the average time taken by children of each age group to complete the questionnaire set. As expected, the older children completed the questionnaire set quicker than the younger children which is likely due to their improved cognitive abilities such as their reading, comprehension, and writing skills.

Table 9.7: The average time taken by children of each age to complete the questionnaire set

Age	Average Time (mins)	Std Dev (mins)
7	13:33	4:51
8	8:33	1:39
9	7:16	2:18
10	6:06	1:38
11	5:15	1:05

On average girls took one minute less (6m 49s) to complete the questionnaire set than boys (7m 49s).

To help assess the validity of the questionnaire, each question was analysed for incorrect answers based on three categories for each child:

- Non response
- Response error due to problems answering the questions
- Response error due to problems understanding the question

Non response received the highest score with each child likely to provide 0.86 answers with no response in the questionnaire meaning that on average each child did not answer one question (although the amount is in fact less than one). The results show no apparent age effects in general non response with the 7 year olds having the highest score of exactly one (one question not answered in the whole questionnaire).

Response errors due to problems answering the question were recorded at an average of 0.26 per child with non response due to problems understanding the question being 0.03 per child, which highlights that the children had no real problems understanding the question or answer format (specific examples will be highlighted later in this section). 50 children (52%) had no errors across all three categories listed above.

Non response was also calculated on a question by question basis, the results of which can be seen in table 9.8.

Table 9.8: The instances of non response for each question

Question	Non Response (*n*)	Non Response (%)
CTEQ 1	0	0%
CTEQ 2	0	0%
CTEQ 3	3	2.9%
CTEQ 4	2	1.9%
CTEQ 5	2	1.9%
CTEQ 6	1	1%
CTEQ 7	31	29.8%
CTHQ 1	0	0%
CTHQ 2	0	0%
CTHQ 3	0	0%
CTHQ 4	0	0%
CTHQ 5	0	0%
CTHQ 6	0	0%
CTHQ 7	1	1%
CTUQ 1	0	0%
CTUQ 2	0	0%
CTUQ 3	0	0%
CTUQ 4	0	0%
CTUQ 5	0	0%
CTUQ 6	0	0%
CTUQ 7	0	0%
CTUQ 8	0	0%
CTUQ 9	10	9.6%
Q4 1	0	0%
Q4 2	26	25%
Q4 3	4	3.8%
Q4 4	2	1.9%
Q4 5	1	1%

The results indicate that only three questions in the entire questionnaire set have issues with non response, those being CTEQ question 7, CTUQ question 9 and Q4 question 2. No other questions warrant further analysis or discussion. These three questions are the only three open ended questions within the pilot questionnaire supporting the position that children are better at answering closed questions where they are able to select the most appropriate response. The results in more detail for these three questions show no significant gender or age effect in the cause of the non response.

There were two sets of (two) questions within the main three questionnaires that were identical. These two questions were analysed for response consistency, the results of which can be seen in table 9.9:

Table 9.9: Response match between identical questions

Question Numbers	Question	Response match
CTEQ 6 & CTUQ 8	Have you ever sent a text on a mobile phone?	83.5%
CTHQ 4 & CTUQ 2	Do you have your own mobile phone?	89.3%

This shows that both questions have a high response match providing support for the accuracy in responses given by the children, thus supporting the reliability of the questionnaire set.

9.4.3.1 Questionnaire 4

Question one in Q4 was created as an alternative to CTUQ question four using a different scale trying to ascertain how often children used a mobile phone for during a week. Both scales contained 5 points and therefore were coded as follows:

Table 9.10: Coding for the different question scales

Q4 1 Scale	CTUQ 4 Scale	Coding Scale
never	0 days	1
not much	1 or 2 days	2
a bit	3 or 4 days	3
often	5 or 6 days	4
very often	7 days	5

Each child was given a score of 1 to 5 for each question and their results were compared to see if the scores matched. The match percentage was only 50.9% showing that only half of the children gave a response that matched. Reasons for the low match can be found in the discussion along with the final question choice.

Question 2 in Q4 was created as an alternative version of CTEQ question 7, the difference being the change of the word *gadget* to the phrase *pieces of equipment* when trying to find out what other devices the children had used to send text messages. With these two questions being open-ended, and highlighted previously as having the highest percentage of non response, it was decided rather than code the answers when the results matched exactly, the questions were coded with a 0 when no response was recorded, and a 1 when a response of any kind was recorded. Using this method there was a 75.8% match in responses. If the occasions where there was no response to both questions were classified as not being a match, this percentage drops to 55.7% showing that just over half the children provided a response to both questions.

Question 3 in Q4 and CTEQ question 5 both ask the children how much they enjoy sending text messages with the thumbs-up scale substituted with a smiley-o-meter both with the same 5 options written underneath. The results of both questions were again compared to see if they matched for each child. There was a 64% match in responses showing that for this question these two scales are not interchangeable.

What is interesting is that the average score received for both questions was identical at 3.43. The score changes from the results in Q4 question 3 were then compared with those of CTEQ question 5 and plotted on the graph shown in figure 9.3 showing no evidence of either scale providing more positive, or more negative, results. As the thumbs-up scale has been validated to work with children in this type of question these result provide no support to change the scale to a smiley-o-meter instead.

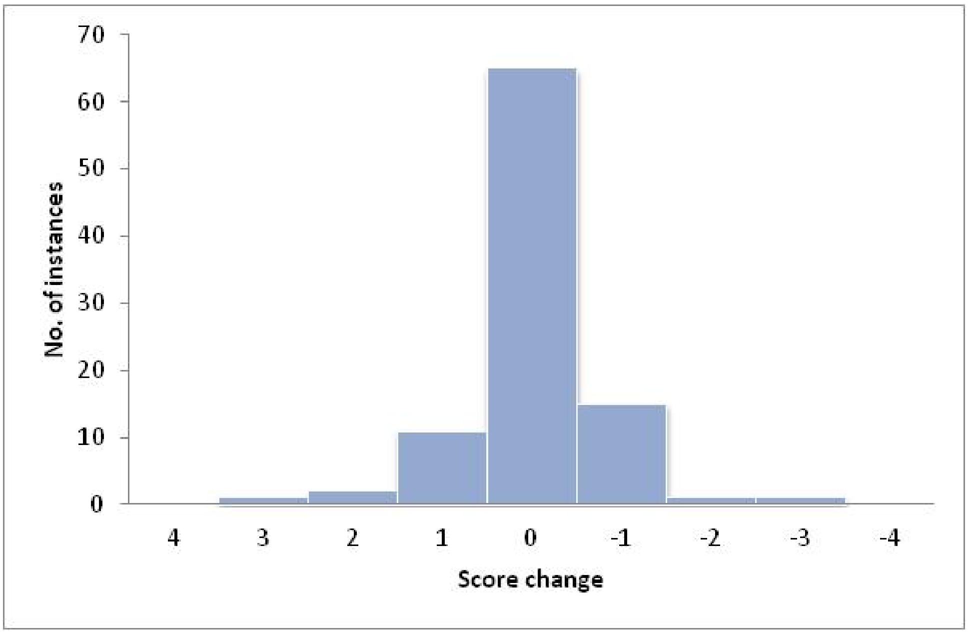


Figure 9.3: Score change between the results of Q4 3 and CTEQ 5

Question 4 on Q4 asks the children the original question of whether a child owns a games console. The results of this were compared with the results of the revised question CTHQ question 3 where *console* is replaced by the word *machine* and examples are also given. The match in responses is 75.8% which would suggest both questions would provide a valid response to this question. Further analysis of the results shows that of the 17 instances where the results did not match, 14 of these occurred due to children stating they owned a games console in CTHQ question 3. This supports the argument that some children don't understand the term games console and when given examples as an assistance, are more likely to fully understand the question. As a result of this, the change to CTHQ question 3 has been supported.

Finally question 5 on Q4 is a rewording of the Likert question 5 in CTHQ asking the children to tick the sentence that best describes them. The difference in the questions is that the word *gadgets* is replaced by the term *electrical items* in Q4. A 65.3% match was recorded suggesting that the change of this word does have an effect on the responses given which will be discussed in the next section. Interestingly there were 13 occasions (13.5%) where at least one of the answers for these two questions was answered incorrectly. Six of these only happened on CTHQ question 5 suggesting this question was the harder to answer of the two.

9.4.4 Discussion

As expected, the average time taken to complete the full questionnaire set reduced with the age of the children. The averages presented in table 9.7 suggest that carrying out the full questionnaire set with children aged 7 (and potentially below) is not advisable and therefore implementing different sections at different points of a study would be worthwhile. The high deviation of time taken amongst this group would also suggest a filler activity may be required for children who complete the questionnaire set quickly so that they are not sat doing nothing whilst waiting for their friends.

Asking the teacher to provide children in similar ability groups and potentially same sex groups may help alleviate this issue as it should provide groups where the time taken by each child is more closely matched. The need to read the questions and answer options to some children aged 7 also suggests that groups of four may be too big in some cases whereas groups could be made larger with the older children. This again is subject to the ability levels, particularly with the younger children.

The non response analysis is encouraging with the children on average not answering 27 or more questions out of the 28 presented. This result would have been even smaller if not for the three occurrences of open-ended questions. The responses shown to these three questions support the argument of not using open-ended questions with children although with a 70% response rate being the worst recorded it is a trade off as to whether the richness of data received in this type of question outweighs the chance of a high level of non-response. The results indicate that closed questions are easy for children to answer and they are unlikely to leave any of these questions unanswered.

One question was added to the questionnaire set twice to provide the researchers with an indication of the response accuracy given by the children. Due to this study revolving around the use of mobile phones, another instance of two identical questions naturally occurred allowing a second check for response accuracy (see table 9.9). The accuracy received for these questions would suggest the results provided in this pilot study are reliable. Several children were recorded by the administrator as noticing the repeat questions and similarity of questions whilst completing the questionnaire set but this was due more to the additional questions presented in Q4. It appeared likely that this had an effect on completion of open-ended questions more than the closed questions and did appear to irritate some. Some children also commented on this question repeat as being a method for the researcher to check they were answering the questions properly. This may contradict the argument of not including at least some repeat questions as they would appear to motivate some children to take more care where completing the questionnaire set.

The different scales used by Q4 question one and CTUQ question four did not provide reliable responses with only a 50.1% match. On further inspection it appears to have occurred due to the scales not being comparable. It was expected that the third responses for each (*a bit* and *3 or 4 days*) would be seen as similar by the children but from observing the children it was evident, for example, that some children chose *a bit* and then *7 days* as they did use their phones everyday but not for a lot of time so for them this response was accurate, it was the scales that were not. The use of the thumbs-up scale in this question on reflection may also not have been ideal as the scale from “very often” to “never” does not relate to thumbs particularly well and therefore this question may have been better without a visual scale. This does not detract from the fact this scale was not asking the same question as the original question in CTUQ.

The purpose of this question was to record how many times a week a device was used and for observing the children it was apparent that the revised scale in Q4 did not do this therefore this change would not be implemented in the final version of the questionnaire.

It was apparent from talking to school teachers in study 8 that in their opinion, the word *gadget* was a better word to use instead of the word technology or the phrase electrical devices. Observing children in this study seemed to contradict this with several children not understanding the word and requiring an explanation of what it meant. The word *gadget* was added into CTEQ question 7 and CTHQ question 5 following on from study 8 and similar questions using the next best suggestions from the teachers were added to Q4 in an attempt to see which version of both were considered best for the final questionnaire set.

On both occasions, it appears that the questions with the word *gadget* in were answered worse than the questions where alternative phrases were used. The open ended question 7 in CTEQ received less responses than question 2 in Q4 and the likert question 5 in CTHQ was answered inaccurately more often than its alternative, question 5 in Q4. Because of this, both questions will be revised to the questions from Q4.

The poor response in the open-ended questions partly appears to be due to the question type. In the case of question 7 in CTEQ (and its alternative question 2 in Q4) it appears the actual question was also to blame. The third open-ended question (CTUQ question 9) was not answered by 9.6% of the children which was significantly less than the other two questions. This question (*Can you write down 3 things that you use you mobile phone for*) should have been easy to answer with the amount of tasks a mobile phone is capable of performing. Even children without a mobile phone will have had experience watching friends and parents using the device and would therefore have some idea of what a phone can be used for, even if they are unable to name three different examples.

The other 2 questions focussed on other devices that can be used to send a text message. It appears a text message is a bad example of the importance of this question as this is one of those tasks predominantly done on a single device, and the use of that device, the mobile phone, was not permitted by the question. A need to establish the main devices used to carry out a task has been identified as being important, and therefore the question will not be removed. However, this example has identified that in certain cases high levels of non response may occur. On top of the difficulties in answering this question, it was evident during the administration of the questionnaire set that having the question appear twice in its similar forms also increased the non response with children not answering the question the second time round within their version of the questionnaire set. It may be a case with this question that if all possible responses are known it can be turned into a closed multiple response question instead.

Also evident from the evaluator sheets completed during the pilot test was that the majority of observations recorded focussed on clarifications to understand the question, make sure the children were answering the questions correctly, and to make sure they were answering the correct parts of the full questionnaire set. This supports the use of an administrator for this questionnaire set as without these clarifications it would have been left to the children's judgement on these issues on how to proceed, which in some cases would lead to less accurate responses. The clarification of how many answers to select in the likert questions (CTHQ question 5 and Q4 question 5) indicates that a simple clarification of this point should be written into the questionnaire. This is supported by the number of times this question was answered incorrectly by children selecting more than one answer option.

9.4.5 Conclusions

The pilot test has provided evidence in the ability of children to answer the questions within it. The response times are useful to other researchers who want to adopt the questionnaire for their own studies to help them make an informed decision on the administration method they use. The use of an administrator has been strongly supported to clarify any remaining issues that children may have.

The very low level of non-response is an indication that the question wording and responses options are appropriate for the age group the questionnaire is designed for, thus supporting the reliability of responses.

Open-ended questions have again come under scrutiny in this study although the inherent problems with one of the questions over inflated the severity of the non-response recorded. It is noted that inevitable this issue could occur again and researchers need to be aware of it. However, the information gathered from such a question is important and should not be lost due to this problem.

Question 2 and question 5 from Q4 have replaced their corresponding questions within the questionnaire set in the final version (see appendix 6) and a small wording adjustment has been made to the likert style question CTHQ question 5 so that the children are informed they should select only one answer from the four options.

9.5 Conclusions

The pre-testing carried out within this chapter has resulted in refinements to the questionnaire set at each stage showing the importance of carrying out these activities when creating a new questionnaire. The number of changes needed did reduce after each study which supported the decision to make the changes that were being made.

The use of 3 different pre-tests has shown that relying on one method would not be advisable, an example being that changes made due to the comments from teachers in study 8 were subsequently changed in study 9 due to the word *gadget* not being appropriate even though a large number of teachers suggested it.

The studies have also provided further guidance on how to administer this questionnaire set which will be the focus of the next chapter. The final version of the questionnaire set in their generic form will also be presented in chapter 10. The questionnaire set focuses on Prior Experience of Technology and Tasks (PETT) and therefore the full set will be referred to by this acronym.

10 CHAPTER 10: USING THE PETT QUESTIONNAIRES

10.1 Introduction

The PETT questionnaire set is designed to be used by researchers who are conducting research studies with children where their prior use of technology could have implications on the results of the study. Chapter 9 carried out a thorough pretest of PETT resulting in the final version of each questionnaire that can be found in Appendix 6 – a generic set is presented in Appendix 7.

The final stage in the creation of PETT is to provide guidance on its use for any researcher who adopts the questionnaires for their own studies. Where necessary the guidelines produced in chapter 7 will also be referenced. It should be noted that the guidelines do not specifically have to be used with PETT - the RWC guidelines can be used by any researcher who is conducting a study with children, the SWC guidelines will be useful to researchers who are conducting any survey with children and even more so if they are creating their own, (this may not even be in the field of HCI as the SWC guidelines are not specific to this research area) and the SRT guidelines will be useful to researchers conducting surveys with children where technology is a focal point of the survey or study.

This chapter is primarily designed to provide guidance to researchers who wish to adopt the PETT questionnaire set for use in their own studies. This chapter will therefore be written as if it is instructing a researcher in the use of PETT. From a practical perspective, along with the guidance contained herein, a high resolution version of the thumbs-up scale will be provided, along with an MS Word version of each of the questionnaires so that researchers using the PETT would not have to recreate the questionnaires from scratch.

10.2 Structure

Section 10.4 provides guidance relating to good practice before carrying out the PETT in a real study. Sections 10.5 - 10.7 discuss how to adapt the generic versions of each questionnaire for use in a research study and also highlight the reasoning for each question to be included. Section 10.8 provides guidance on adding additions questions to PETT with section 10.9 providing concluding remarks to the chapter.

10.3 Before the Study

The PETT questionnaire set has been created to provide the research community with a valid and reliable method for collecting prior experience data from children between the ages of 7 and 11. PETT has been tested with children of this age range although this does not mean that it cannot be used with older or younger children. If the intention of the study is to use children outside of this age range then a pilot study will be required to assess how well these children can complete the PETT and also to check if there are any language issues; this will be more relevant to younger children than older children.

Conducting research with children can be considerably different to conducting research with adults and it is recommended that if the research team has little or no experience of working in this area that they initially consult the RWC guideline set as this will provide good practice advice in how to conduct a successful research study. Researchers more experienced in working with children are also advised to read the RWC guidelines as a revision of good practice.

Testing of the PETT has provided information that will be useful to a research team who adopt it for use within a research study. The PETT has been designed to be used either as single questionnaires or as a set. In this discussion, the use of each specific questionnaire in the PETT will be discussed in the section relating to that questionnaire. By splitting PETT up it can also be used at different stages of a research study so that the length of the questionnaire does not have an effect on the children completing it. When conducting PETT as a set of surveys, it would be good practice to vary the order in which each questionnaire is presented - just to be sure of minimising order effects - to the children. However, pretesting did not provide any evidence that varying the order had any effect on the responses received.

Table 10.1 shows the average times taken to complete the whole PETT with children for children of each age between 7 and 11 years old. The standard deviation is also provided to highlight the range of times expected by each age group.

Table 10.1: The average time and standard deviation for the completion of PETT by children of each age group.

Age	Average Time (mins)	Std Dev (mins)
7	13:33	4:51
8	8:33	1:39
9	7:16	2:18
10	6:06	1:38
11	5:15	1:05

Given the lengths of times indicted here, it is recommended that the use of PETT with children of 7 years and below is as separate questionnaires, possibly interspersed throughout a study rather than administered in one single go. For children aged above 7 the questionnaire can be conducted in the way most appropriate for the research study. It is recommended that for children aged 7 or below that the maximum number of children surveyed at once is four so that a researcher can be on hand to assist the children. A smaller number would be preferable in case the need arises to read the questionnaires to children whose reading ability is not good enough to complete the PETT unaided. Four children is an appropriate group size for older children completing PETT although there is no evidence to suggest this could not be increased for older children, particularly aged ten or eleven.

Girls have been shown to complete PETT faster than boys and therefore it is recommended that when conducting the questionnaire set with groups of children that same sex groups are chosen. Experience also shows that where possible the groups should contain children of similar ability ranges as it is more likely that these children will complete the questionnaires in similar times meaning that the quicker children do not have a long time waiting for the rest of their group to finish the questionnaire.

Where the set of questionnaires is administered in a group, the high standard deviation shown with the younger children also suggests the addition of a filler activity for children who may complete the questionnaire as there may be groups within which some children might take considerably more time. This filler activity does not have to be survey related but if possible could be used to provide further data useful to the main research study.

It may be the case that further questions specific to the research study are required to complement the questions provided in PETT. Guidance on the creation of these questions will be provided in section 10.6 following the specific guidance for the three individual questionnaires within PETT. Before conducting a survey with children it is recommended that the research team familiarises themselves with the SWC guidelines for conducting surveys with children. SWC Guidelines 1, 6, 9 and 11 the most important as these are relevant to researchers even if PETT is being used without additional questions being added.

The following sections provide guidance of how to adapt each questionnaire. There may be occasions where each question requires a small amount of editing due to the wording in the technology or task applied to it. The questionnaire set has been designed in English in the UK without the use of regional terms that may be less relevant in other places. If used in other countries it may be necessary to check the language in case any cultural differences exist that require alteration. Translating PETT into other languages needs to be carried out by the research team ensuring the language used is pretested to ensure it is appropriate for the children participating in the study.

10.4 Adapting the CTUQ Questionnaire

The CTUQ questionnaire has been designed to gather children's self report of their prior experience with a specific piece of technology. The questionnaire has been written to enable its use with any piece of technology. If a study involves more than one piece of technology then the CTUQ questionnaire could be adapted and administered for each piece of technology. The CTUQ can be used as a standalone questionnaire to gather knowledge of a specific piece of technology if the use of the other questionnaires within PETT is not deemed necessary. Figure 10.1 shows the full generic question set for the CTUQ questionnaire:

1. Do you know what a *[technology]* is? Yes ☐ No ☐
2. Do you have your own *[technology]*? Yes ☐ No ☐
3. Do you use a *[technology]* at home? Yes ☐ No ☐
4. How many days a week do you use a *[technology]* (circle your answer)?

   0 days 1 or 2 days 3 or 4 days 5 or 6 days 7 days

5. How good do you think you are at using a *[technology]* (circle your answer)?

   very good good okay not very good poor

6. Does your school have *[technology]* you can use in class? Yes ☐ No ☐
7. Do you use it with your teacher in your class? Yes ☐ No ☐
8. Have you ever *[carried out a task]* on a *[technology]*?

   Yes ☐ No ☐

9. Can you write down *[n]* things that you use your *[technology]* for?

   ……………………………………………………………………………………

   ……………………………………………………………………………………

   ……………………………………………………………………………………

Figure 10.1: The generic CTUQ questionnaire

CTUQ Question 1

1. Do you know what a *[technology]* is? Yes ☐ No ☐

Figure 10.2: CTUQ question 1

Question 1 asks the child whether they know what the technology involved in the research study is. If not then this shows the child has no experience of the technology at all.

CTUQ Question 2

2. Do you have your own *[technology]*? Yes ☐ No ☐

Figure 10.3: CTUQ question 2

Question 2 asks the child if they own the technology. If so then this would imply a degree of knowledge of its use over those who do not own it.

CTUQ Question 3

3. Do you use a *[technology]* at home? Yes ☐ No ☐

Figure 10.4: CTUQ question 3

Question 3 asks the child if they use the technology at home. This is different to the previous question as its purpose is to find out if they have access to the technology, and use it, when at home.

CTUQ Question 4

4. How many days a week do you use a *[technology]* (circle your answer)?

0 days   1 or 2 days   3 or 4 days   5 or 6 days   7 days

Figure 10.5: CTUQ question 4

Question 4 asks the child how often during the week they use the piece of technology in order to determine frequency of use. It may occasionally be the case that a week is not an appropriate scale to use in this question in which case the research team would need to alter the scale to reflect this. If the scale is changed it is recommended that the response options are kept to a maximum of 5 and that the question is piloted before use.

CTUQ Question 5

5. How good do you think you are at using a *[technology]* (circle your answer)?

Figure 10.6: CTUQ question 5

Question 5 is designed to gather the child's perception of how good they are at using the technology – this provides a confidence rating of the child in using the specified device.

CTUQ Question 6

6. Does your school have *[technology]* you can use in class? Yes ☐ No ☐

Figure 10.7: CTUQ question 6

Question 6 is designed to measure opportunity of use alongside question 3. Combining the results of both questions highlights how much interaction the child may have with the technology at the two locations in which they spend the majority of their time.

CTUQ Question 7

7. Do you use it with your teacher in your class? Yes ☐ No ☐

Figure 10.8: CTUQ question 7

Question 7 will provide insights into whether the child has had training using the piece of technology at school. If the device is used at school a certain level of training might well have been provided to the child to ensure all children in the class have enough knowledge to interact with it.

CTUQ Question 8

8. Have you ever *[carried out a task]* on a *[technology]*?

Yes ☐ No ☐

Figure 10.9: CTUQ question 8

Question 8 is designed to provide a small amount of knowledge about the main task that the study involves. If the study does not involve a specific task then the task added into this question should be decided upon by the research team. The secondary purpose of this question is for it to be identical to CTEQ question 6 which is the task based questionnaire. This will allow a basic reliability test to be performed to measure whether the responses to these two questions are the same.

CTUQ Question 9

9. Can you write down *[n]* things that you use your *[technology]* for?

……………………………………………………………………………………………

……………………………………………………………………………………………

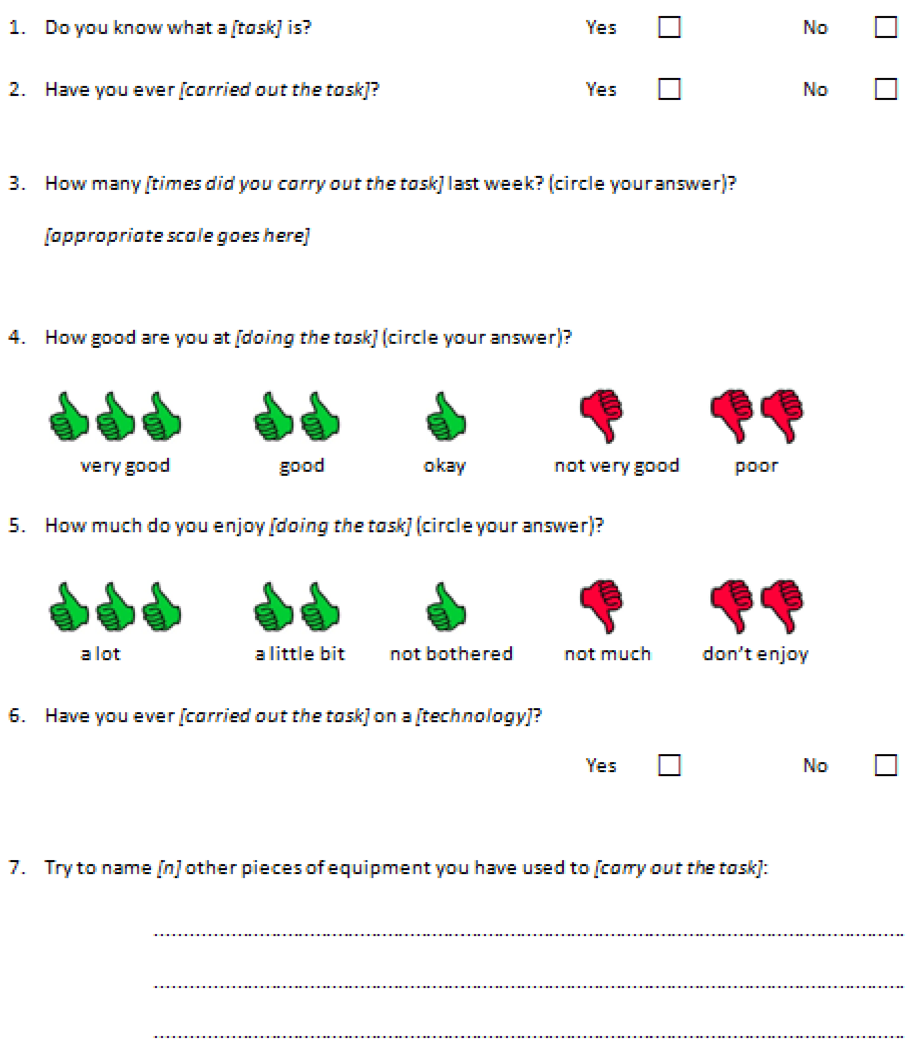
……………………………………………………………………………………………

Figure 10.10: CTUQ question 9

Question 9 provides data on a child's knowledge of the technology and also their diversity of use when using it. It will also allow the research team to gather data on the most salient tasks carried out using the technology by the children in the study. The number of responses required can be determined by the research team with the recommended number of responses being 3 as this number has been shown to be an appropriate number for children in the specified age range.

10.5 Adapting the CTEQ Questionnaire

The CTEQ questionnaire has been designed to gather children's self report of their prior experience in carrying out a specific task unrelated to the technology in which the task was performed. The questionnaire has been written to enable its use with any technology related task. If a study involves more than one task then the CTEQ questionnaire could be adapted and administered for each task. The CTEQ can be used as a standalone questionnaire to gather knowledge of a specific task if technology experience is not required. Figure 10.11 shows the full generic question set for the CTEQ questionnaire:



1. Do you know what a *[task]* is? Yes ☐ No ☐
2. Have you ever *[carried out the task]*? Yes ☐ No ☐
3. How many *[times did you carry out the task]* last week? (circle your answer)?

   [appropriate scale goes here]
4. How good are you at *[doing the task]* (circle your answer)?

   very good | good | okay | not very good | poor
5. How much do you enjoy *[doing the task]* (circle your answer)?

   a lot | a little bit | not bothered | not much | don't enjoy
6. Have you ever *[carried out the task]* on a *[technology]*?

   Yes ☐ No ☐
7. Try to name *[n]* other pieces of equipment you have used to *[carry out the task]*:

   ....

   ....

   ....

Figure 10.11: The generic CTEQ questionnaire

CTEQ Question 1

1. Do you know what a *[task]* is? Yes ☐ No ☐

Figure 10.12: CTEQ question 1

Question 1 asks the child whether they know what the task involved in the research study is. If not then this shows the child has no experience carrying out the task at all.

CTEQ Question 2

2. Have you ever *[carried out the task]*? Yes ☐ No ☐

Figure 10.13: CTEQ question 2

Questions 2 asks the child if they have ever carried out the task, this can show whether they have any experience, as simply knowing about the task does not show they have ever done it.

CTEQ Question 3

3. How many *[times did you carry out the task]* last week? (circle your answer)?

   [appropriate scale goes here]

Figure 10.14: CTEQ question 3

Question 3 is designed to capture the frequency in which the task is performed by the child. This can be used to get a more in depth view of frequency if combined with CTUQ question 4. The creation of an appropriate scale is down to the research team. As in CTUQ, it may also occasionally be the case where the time period of last week is not appropriate for the task in question and therefore this may need to be changed. This question would then require pretesting.

CTEQ Question 4

4. How good are you at *[doing the task]* (circle your answer)?

Figure 10.15: CTEQ question 4

Question 4 is designed to gather the child’s opinion of how good they are at carrying out the task. This data could predict the speed it takes a child to complete the task, their willingness to do the task or their ability to perform the task accurately.

CTEQ Question 5

5. How much do you enjoy *[doing the task]* (circle your answer)?

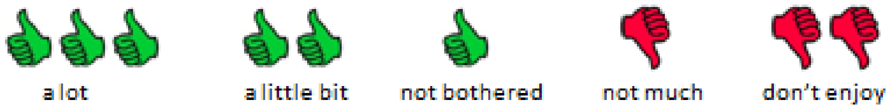


Figure 10.16: CTEQ question 5

Question 5 records how much the child enjoys carrying out the task. Enjoyment, and fun, are common measures used within CCI as they provide insights into areas such as how good a child is at performing a task, their engagement with the task, and how likely they are to explore the task and the device it is being performed on further than just completing the task.

CTEQ Question 6

6. Have you ever *[carried out the task]* on a *[technology]*?

Yes ☐ No ☐

Figure 10.17: CTEQ question 6

Question 6 is designed to be the reliability measure along with CTUQ question 8. The question is also designed to show experience of carrying out the task on a specific piece of technology. If the CTUQ is being used then this technology should be the same as the one chosen for this questionnaire. If not it is recommended that the technology inserted into this question is the one in which the task is most likely to be performed.

CTEQ Question 7

7. Try to name *[n]* other pieces of equipment you have used to *[carry out the task]*:

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

Figure 10.18: CTEQ question 7

This question is designed to capture the most frequently used devices in which the task in question is carried out. On occasions where the task is predominantly carried out on a specific device the level on non-response may be high. In a task based research study this data could be quite valuable and provides the children with the ability to enter their own response providing richer data than fixed responses.

10.6 Adapting the CTHQ Questionnaire

The CTHQ questionnaire has been designed to gather children's self report of their general prior experience of interacting with technology. This questionnaire is not technology or task specific and therefore requires less adaptation than the previous two questionnaires. The CTHQ can be used as a standalone questionnaire when a basic level of technology exposure is required without the need for more detailed data of a specific technology or device. Figure 10.19 shows the full generic question set for the CTHQ questionnaire:

1. Do you have a lot of electrical items at home? Yes ☐ No ☐
2. Do you own a lot of electrical items? Yes ☐ No ☐
3. Do you own a games machine (examples: X-Box, PlayStation, Nintendo DS)? Yes ☐ No ☐
4. Do you have your own mobile phone? Yes ☐ No ☐
5. Tick the sentence below that you feel best describes you (only choose one):

   I use electrical items as often as I can ☐
   I use electrical items to make things easier to do ☐
   I use electrical items when I am bored ☐
   I do not use electrical items very often ☐

6. Please tick which of the following items you have ever used:

[item]	☐	*[item]*	☐
[item]	☐	*[item]*	☐
[item]	☐	*[item]*	☐
[item]	☐	*[item]*	☐

7. How easy do you find it to use electrical items (circle your answer)?

Figure 10.19: The generic CTHQ questionnaire

CTHQ Question 1

1. Do you have a lot of electrical items at home? Yes ☐ No ☐

Figure 10.20: CTHQ question 1

Question 1 asks the child to provide their opinion on the amount of electrical items they have at home. This question is not about ownership it is designed to gather data on how much the child perceives technology to be a part of their home life.

CTHQ Question 2

2. Do you own a lot of electrical items? Yes ☐ No ☐

Figure 10.21: CTHQ question 2

Question 2 again relates to access and opportunity of use but this time asks the child to self-report how much technology they personally own. As well as providing further information about access to technology it also provides insights into the child’s everyday use of technology.

CTHQ Question 3

3. Do you own a games machine (examples: X-Box, PlayStation, Nintendo DS)? Yes ☐ No ☐

Figure 10.22: CTHQ question 3

Question 3 is designed to provide insights into the amount of technology exposure the child has had. The games console is one of the most owned technologies by children and is often used for lengthy amounts of time. Games consoles are known to provide multiple interaction techniques and are often used in conjunction with other technologies so a child owning their own games console is likely to have had more experience interacting with technologies than a child who has not. The specific games consoles provided as an example in this question should be checked and if necessary updated before use to ensure the examples offered are up-to-date.

CTHQ Question 4

4. Do you have your own mobile phone? Yes ☐ No ☐

Figure 10.23: CTHQ question 4

Question 4 has a similar purpose to question 3 in that it is designed to provide insights into general expose to technology. The mobile phone is the most popular mobile device used by children and is used to carry out many everyday tasks. Again mobile phones can require different interaction techniques and are often used frequently for both short and extended periods of time. In the future it may be a case that another technology such as tablet computers becomes the most popular mobile devices at which time this question would need to be altered to reflect this.

CTHQ Question 5

5. Tick the sentence below that you feel best describes you (only choose one):

I use electrical items as often as I can	☐
I use electrical items to make things easier to do	☐
I use electrical items when I am bored	☐
I do not use electrical items very often	☐

Figure 10.24: CTHQ question 5

Question 5 is designed to gather the child's opinion as to how important technology is to them in their lives. The answer to this question may have an effect on areas such as how quickly they learn to carry out a carry out a task, their focus on carrying out the task and their enjoying in doing it.

CTHQ Question 6

6. Please tick which of the following items you have ever used:

[item]	☐	*[item]*	☐
[item]	☐	*[item]*	☐
[item]	☐	*[item]*	☐
[item]	☐	*[item]*	☐

Figure 10.25: CTHQ question 6

Question 6 is designed to measure the diversity of experience the child has in interacting with different technologies within their lives. The items within this question should be populated by the research team ensuring then any items that could have an effect on the study results are included. The number of items that can be presented in this question is not limited although care should be taken not to be excessive.

CTHQ Question 7

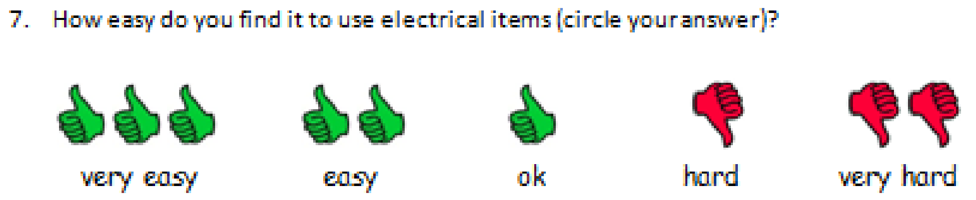


Figure 10.26: CTHQ Question 7

Question 7 asks the child for their opinion on how easy they find it to use electrical items. This question allows the child to show their confidence in using technology which could have an effect on their ability to perform a task, or learn how to perform it. It may also affect factors such as their willingness to participate, their concentration levels, and the level of enjoyment they report when participating in the study.

10.7 Adding More Questions to PETT

At the beginning of this guide on using the PETT the need for further questions was introduced in case questions specific to the study are not currently covered. This section discusses this in more detail and provides guidance on how this should be done.

It is recommended at this point that the research team should read the entire SWC and SRT guidelines on carrying out surveys with children and creating surveys to elicit self report of technology use.

The wording of the additional questions should be similar to that used within PETT to ensure consistency across the full questionnaire. The language used should be pretested with a group of children of the relevant age to ensure they understand the wording and the constructs being asked. Teachers are also a good resource for checking the language of questions and could be used instead of, or as well as, children

Open-ended questions have been shown to increase the level of non-response recorded in questions compared to the use of closed questions therefore it is recommended that the use of open-ended questions should be kept to as minimum. If all response options are known for a particular question than using a fixed response format would be preferential. Scales should be presented using a maximum of 5 points with the VAS thumbs-up scale being validated as appropriate visual scale.

It is not recommended that too many reliability questions are added to a questionnaire to be completed by children as repeated questions have been shown to annoy children, this is the place where the addition of such question could be done. The use of negative questions covering the same constructs are also not advised but the inclusion of a single one should not cause to much anxiety to the participants.

Finally it is recommended to provide no more than 6 to 8 additional questions in order to keep the questionnaire size a small as possible so as not to overburden the participants.

10.8 Conclusion

Chapter 10 has presented an overview of how the PETT should be carried out with a group of children. Guidance has been provided to inform researchers how to adapt each question for use in their own studies with a brief description of what the results from each may be used for.

It is not expected that every question presented in PETT will be relevant to a research study and the data for some may be omitted when it is deemed unnecessary.

Guidance has also been provided on how to create further research specific questions to add to PETT ensuring that the questions are in keeping with the rest of the questionnaire and are tested for both their language and understanding of the construct with children.

11 CHAPTER ELEVEN: CONCLUSIONS

This chapter summarises the thesis contributions and situates their relevance in the light of the current state of CCI. Future research is outlined and the chapter closes with a personal reflection on the journey undertaken.

11.1 Summary of the Research

The thesis set out to design a tool that researchers could use in order to better gather children's reports of their technology use. In this quest, it also aimed to highlight and pinpoint best practice and to provide guidelines for researchers working in this field. The research developed a set of questionairres (CTEQ, CTUQ and CTHQ), a set of guidelines (RWC, SWC and SRT) and contributed knowledge in regard to children's technology use, most notably, in the area of multifunctional devices.

The research employed a grounded, user-centred approach and took advantage of the extensive experience of the author in carrying out research studies with children. Pilot studies and literature searches informed the early designs of the products and the initial set of questionnaires was iteratively validated using expert review by teachers and user studies which employed children.

Early parts of the research have been published in peer reviewed venues and the main contributions from the work are currently under review.

11.2 Answers to the Research Questions

The first research question (RQ1) was 'to what extent can a usable survey tool be designed for children that can be a) generic and b) user friendly?' Evidenced by the PETT tool, such a survey can be developed. The generic version (seen in Appendix 7) and the version specific to mobile phones and texting (seen in Appendix 6) demonstrate that this survey can exist in these two forms and the guidelines for users found in chapter 10, demonstrate how the PETT survey can be specifically used. The PETT products have been shown, with extensive testing with appropriately aged children, in the studies in chapter 9, to be user friendly, reliable and valid.

The second research question (RQ2) asked 'what knowledge would be required to administer and adapt such a survey?' Based on a survey of the literature on working with children and on the design of questions (Chapters 2, 3 and 8) the guidelines in chapter 7 (RWC, SWC, and SRT)), and the user guide in chapter 10, this knowledge has been demonstrated. Whilst not tested with use cases, the research is built on a firm theoretical and experiential grounding.

Determining 'best practice in surveying children for self-report' (RQ3), was evidenced in chapter 7 with the guidelines (SWC, RWC and SRT) and was based on literature and the studies in chapters 5 and 6.

11.3 Contributions of the Research

There are two main contributions, and one secondary contribution, from this thesis. The two main contributions are the survey instrument and the guidelines. These contributions are considered unique in CCI research to the extent that such a survey tool has not existed in this form prior to this thesis and that the set of guidelines, whilst being generated in part from previously published work, extends what is currently known in this area especially in the specific context of gathering self-report data from children in terms of prior technology use. These two contributions are summarised here:

- RC1: The PETT (Prior Experience of Technology and Task use) survey tool, designed from an extensive study of the literature and from finding from a set of pilot studies and validated with user testing and expert testing over three iterations – this is a generic survey tool consisting of three specialised tools (CTEQ, CTUQ and CTHQ) together with instruction for manipulating and populating the questionnaires for specific use cases as well as guidance for the creation of additional questions specific to the research context within which it is being used.

- RC2: Three sets of theoretically grounded, experientially validated guidelines (RWC, SWC and SRT) that can be used by researchers in HCI and CCI to better carry out research with children (RWC), surveys with children (SWC) and surveys for the self-report of technology (SRT).

A secondary contribution, and one which was not initially anticipated relates to the use of technology by children. Whilst a significant amount of data has been gathered from children during this research, in the main this has not been analysed as the intention has always been to devise tools. However, in the earlier pilot studies and specifically the multiuse study (chapter 6), data was collected that sheds light on current trends. This contribution is described below:

- RC3: Research data that demonstrates a clearer understanding of technology use by children – this data illustrates the timely shift toward multifunctional devices to carry out tasks that were original considered mono device and data from the pilot studies that show the current use of technology, and the terms used, by children.

There are several small contributions also within this thesis including the literature review, the method of pretesting the PETT products with children and teachers, and the research findings in the pilot studies that were not followed up in this thesis (for example the impact of drawings in surveys) that could be of use to researchers in CCI.

11.4 Limitations

As would be expected in a study of this nature boundaries had to be set in regards to the age group of children being designed for, the location for user studies, and the definitions and scope of technology at the point of the research.

In terms of age, the most studied age group in CCI is primary age children (roughly 6 – 11 years) which suggested that designing for this group would bring most benefit to the CCI community. Research also indicated that this group would be both able to respond to questions but could also, and perhaps most importantly for this current study, be able to reflect on and discuss their answers (see chapter 9).

Situated in UK, it was an obvious choice to work with UK children who would be expected to have at least working, and probably primary, knowledge of the English language. Given that the survey have only a limited vocabulary and given that they were designed to not include regional variations of language, the decision to constrain the studies to children being schooled in state education in Lancashire was considered to have little effect. As no selection was made of participants there were children included from multiple ethnic groups.

Early studies of self report of technology use were solely concerned with computers. This work has extended in this thesis to consider devices such as mobile phones and games consoles. The expectation is that the surveys will be used to ask children about programmable/interactive devices with which they are at least vaguely familiar. Whilst not shown in this thesis it could well be that the surveys would work with non interactive products e.g. a paper notebook, with heavily disguised technologies e.g. such as in-trainer GPS pods. The surveys are intended for current (2013) technologies – future technologies may require alterations to the questions.

11.5 Future Directions

Subsequent work will include investigations of the PETT tools in use in many different contexts. This will be facilitated by making the tools and products available to the CCI community in electronic form. Research questions that remain to be answered include the extent to which younger and older children can use and are satisfied by the survey tools and the portability of the questionnaires into different languages.

The guideline sets will also be studied in use and further refinements would be expected as the CCI community critiques and reflects on them. It is expected that case studies and ethnographic studies will inform this.

The initial set of questionnaires was specifically designed to cover one page for each version, this was in line with research literature that was published in a paper based era. As children, schools, families move towards interactive tablet computers and dependency on paper reduces it will be interesting to investigate the impact and possibilities for survey designs for the future.

11.6 Closing Remarks

My contributions in this research will, I hope, help the CCI community to better ground their evaluation and research studies, to conduct research with children in a more effective and more child friendly way and will hopefully provide a rich corpus of data about technology use that can direct the community in the future.

As previously acknowledged this work would not have been possible without the enthusiastic cooperation and contribution of the children and teachers of the participating schools. In all my research it has been my aim to work ethically and provide a great experience for the children – who are the motivation and drivers behind all of my research in CCI.

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13 Appendices

Appendix 1: Published Work from the Thesis

Interactive Whiteboards in the Living Room? - Asking Children about their Technologies

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ABSTRACT
In this poster we report the findings from a study of technologies in the home and school and use these results to discuss the validity and variability of children's reports of technologies.

The results indicate that children may not understand well the types of interactive technologies that were discussed and that there may be some confusion about the names of technologies. In addition, the study indicated some confusion about where a technology resides.

Categories and Subject Descriptors
H.1.2 [**Models and Principles**]: User/Machine Systems - human factors;

General Terms
Measurement, Design, Human Factors.

Keywords
Children, Surveys. Technology

1. INTRODUCTION
Asking children about technology is a technique used by both designers and evaluators of many different kinds of products. It is mainly used by designers to see what level of exposure children of different ages have had to technologies (either general or specific) which can be useful is determining the level of sophistication in a product. Evaluators use experience surveys slightly differently to find out children's prior use of technology is. This prior use could have a significant impact on how the child uses or interacts with a product during an evaluation session. For research studies, knowledge of prior experience is often essential to ensure a balanced design.

This paper looks at one popular method of eliciting this information from children and discusses some of the validity issues of the data that is collected using this method.

2. TRADITIONAL METHODS
There are many different methods used in eliciting information from children, the most common of which include questionnaires, interviews, brainstorming and think-aloud.

Questionnaires are primarily used as they can be completed by a large amount of people simultaneously without the need for the creator / owner to be present. Whilst they do allow for large amounts of data to be gathered, the quality of this data is questionable due to the owner not knowing exactly why an answer has been chosen.

With children, there is a particular risk of satisficing (choosing a good enough answer [1] and so to overcome this, special methods, like the Fun Toolkit [3], are sometimes applied.

Interviews are one of the best methods of gathering information as they allow the administrator to deviate from the questions they have to ask in order to get exactly the information they require. They do however bring in the possibility of administrator bias as it is easier to lead a person, especially a child, to answer a certain way. In addition, interviewing children can be very stressful as children do not well understand the question- answer process. [2]

Brainstorming and think-aloud are similar methods, both designed to gather large amounts of information from groups of people. These methods have been found to be less stressful or 'scary' for children as they are more comfortable working in groups with their peers. It does however lead to the quieter children being left out if the administrator is not able to engage them.

When eliciting information from users it is always best to use more than one method for example brainstorming may come up with ideas that due to the design of a questionnaire or interview would never appear.

3. THE STUDY
This research was carried out in a local primary school using two classes from different Key Stage (KS) levels of the National Curriculum. 23 children aged 6 and 7 from a year 2 (KS1) class and 20 children aged 9 and 10 from a year 5 (KS2) class.

All children within the class were given the option to take part in the study and the children were told they could stop participating in the research at any time.

The children were given a written questionnaire made up of two questions. The first asked the children to indicate which of a list of technologies the had at home, the second asked the same question but this related to school. The choices of technologies were presented to them in a two columned list and the children were asked to tick the boxes against the items they had.

To reduce 'copying' the two questions were presented on different sides of the questionnaire.

Published by the British Computer Society

4. RESULTS

The results from the questionnaires were entered into a spreadsheet to be analyzed by the researchers. Table 1 shows a condensed version of the results with the number being the number of children who said that a specific technology was present either in their home or at their school. Group 1 is the year 2 (KS1) children and group 2 in the year 5 (KS2) children.

Table 1. Questionnaire Results

	Group 1		**Group 2**	
	Home	**School**	**Home**	**School**
Mobile Phone	20	20	18	1
Laptop	16	22	9	19
Games Console	11	7	19	16
Photocopier	11	17	4	18
Video Camera	15	14	12	15
Video Recorder	13	1	12	8
DVD Player	22	5	18	14
Printer/Copier/Scanner	3	2	7	6
Home Telephone	16	19	17	19
Computer (PC)	14	12	12	19
Handheld Console	11	0	17	4
Printer	13	18	9	17
Interactive Whiteboard	6	20	2	19
Television	21	17	18	18
Digital Camera	14	10	16	18

5. DISCUSSION

Here we discuss some of the interesting results that can be seen from the table above. Whilst both questions provided us with interesting data, the technology in the school question does allow us to do a comparison between the two groups as all the children attended the same school.

5.1 Technologies in the home

Without talking to parents or visiting each child's house we cannot say whether the data gathered is totally accurate, however, from the results we can make a few assumptions that lead us to the conclusion that this information is not 100% accurate.

Certain items within the technology list were added as they can be found in the majority of primary schools in the UK. These items are less likely to be found in the home (although we acknowledge that it is possible). 8 of the children reported to having interactive whiteboards within their homes and 15 of the children reported having photocopiers – notably, most of these reports came from the younger children..

There are three possibilities that could explain these reports; the first is that the child misunderstood the question – maybe couldn't read the words, the second is that the child 'thinks' that he or she has this item in the home but really hasn't got it, the third is that the item does indeed exist in the home. To discover which of these explanations fit, we will need to further question the children to ascertain exactly what prompted this answer. We might need to ask what they consider to be these devices and what they understand by the terms such as 'interactive whiteboard' as they may, for example, have a whiteboard notice board at home that looks similar to the whiteboard they have at school but has no interactivity at all.

Further to this 2 of the children reported to having every piece of technology at home (they ticked every box) which could be due to this being true, but could also be put down to them 'wanting to look good' or possibly not taking the questionnaire seriously. It was noted that these children did not tick every box for the question their school.

5.2 Technologies at school

The comparison between the two groups has provided some interesting results to question the validity of this style of questionnaire.

If the questionnaire had just been completed by group 1 then we would assume that the children have access to mobile phones at school as 87% of the children said they have these at school. However only 5% of the children in group 2 answered the same way. Therefore if this questionnaire had only been done with 1 group we would have had completely differing results for this question.

A lot of questions did however receive similar results across the two groups leading us to believe that these results are accurate; it is only a few technologies where results differ significantly.

Listening to the children talk whilst completing the questionnaires brought up an interesting question. What exactly does 'at school' mean. Children said that teachers have their mobile phones at work. Whilst these are not for school use, they are in school and have clearly been seen by the children. Also the after school club at the school has a games console but after speaking to the teachers the school does not. Whilst the after school club takes place on the school property it is run by a different organization and uses it's own equipment.

6. FURTHER WORK

The data gathered for this poster is part of a larger piece of research looking into different methods of administering questionnaires to children. The data from this questionnaire will be compared with the data from a pictorial version of the same questionnaire that was carried out with the same children several weeks prior to this written questionnaire.

7. ACKNOWLEDGMENTS

Our thanks to the children and teachers of English Martyrs Primary School for their participation in this research.

8. REFERENCES.

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Making Your Mind Up? The Reliability of Children's Survey Responses

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Survey tools are widely used within Child Computer Interaction however the validity and reliability of children's responses are often brought into question. This paper reports on a study on the effects of asking the same questions to the same children over a period of a week to ascertain the validity of children's responses when completing a single questionnaire. The results showed that over 50% of the children, for each question, had less than half the items they stated as having at home in their results for both questionnaires questioning the validity of either questionnaire alone. Further research will look at the differences in time gaps and use of identical questionnaire styles.

Child Computer Interaction. Survey Methods. Technology.

1. INTRODUCTION

Survey tools are widely used within the child computer interaction domain to elicit information from children as part of the design or evaluation process (Horton & Read, 2008). There are many methods which are reliant on an appropriately designed and valid survey tool such as the Fun Toolkit (Read et al, 2002), This or That (Zaman, 2009). In using surveys concerns arise over the validity of the data due to satisficing, the use of appropriate language (Borgers & Hox, 2001) and evaluator bias (Borgers et al, 2004). Studies that have been conducted with children have validated the tools for internal consistency based on a number of constructs but there is limited research into the reliability of the tools over time. This paper aims to investigate whether there is consistency in response to survey instruments within the context of children's understanding of technology within their home. This work will enable researchers to understand the limitations of children's responses and help improve the validity and reliability of existing methods.

2. METHOD

This research was carried out in a local primary school using 19 children aged 6 and 7 from a year 3 (KS2) class. All children within the class were given the option to take part in the study and the children were told they could stop participating in the research at any time.

The children were given a pictoral questionnaire and asked to stick pictures of the technologies they had at home on the picture of the house. A week later the children were given a written version of the same questionnaire, using the same questions and same technologies and asked to tick the technologies that they had in their homes.

3. RESULTS

The results from each question have then been split showing technologies that were chosen only in the pictoral questionnaire, technologies that were chosen in both questionnaires and then technologies that were only chosen in the written questionnaires. The final column shows the percentage of technologies that were chosen by each child that appeared in the results from both questionnaires.

Table 1: *Children's results from the two questionnaires*

Child	Only Pictoral	Pictoral & Written	Only Written	% on both
1	*4*	*0*	*4*	*0%*
2	*2*	*1*	*5*	*13%*
3	*3*	*1*	*6*	*10%*
4	*2*	*3*	*8*	*23%*
5	*0*	*2*	*6*	*25%*
6	*2*	*8*	*0*	*80%*
7	*2*	*7*	*2*	*64%*
8	*2*	*3*	*3*	*38%*
9	*2*	*4*	*5*	*37%*

10	*8*	*0*	*2*	*0%*
11	*2*	*7*	*2*	*64%*
12	*1*	*9*	*1*	*82%*
13	*1*	*7*	*4*	*58%*
14	*3*	*8*	*3*	*57%*
15	*2*	*1*	*6*	*11%*
16	*4*	*7*	*1*	*58%*
17	*4*	*1*	*4*	*11%*
18	*2*	*10*	*2*	*71%*
19	*6*	*7*	*0*	*54%*
			mean	***40%***

The results show that 53% of the children had less than half the technologies they stated to have on both questionnaires. The majority of children with less than half the technologies had significantly lower results than this. None of the children produced the same results for a question across the two questionnaires.

4. DISCUSSION

This study has provided some interesting findings that do bring into question the validity of children's responses. If over 50% of the children have less than a half of the same answers on two questionnaires asking the same questions then either of these questionnaires would have produced results that look perfectly valid but are completely different and all this just one week apart. An example of this could be that one week the majority of the children could report as having computers at home where as the next week the same children state they do not. Using these findings to evidence children's computer usage could have a profound effect on an entire research study.

One area that does require further study is that of picture matching. This occurs, for example, when a child is given a pictoral questionnaire and asked if they have a computer at home. The child may have a computer but it is not the one that is pictured so because of this it is not chosen.

Not a single child on either of the questions had exactly the same result on both questionnaires. Looking at this as a comparison of the same question asked twice to the same person, none of the 19 questions resulted in exactly the same answer. If this is the case then once again how can the results from either questionnaire be valid.

Further work needs to be carried out to see if the length of time between the two questionnaires contributes to the varying results.

It is unlikely, but not impossible, that within the week between the questionnaires the households acquired all the technologies only chosen in the second questionnaire and removed the technologies only present on the second questionnaire.

5. CONCLUSION

This study has highlighted some serious issues with the validity of questionnaire answers given by children from the varying results that have been highlighted. Further investigation needs to be carried out to see if any methods can be found to help reduce this problem.

It is noted that this study was carried out using two different questionnaire techniques and that it is it possible this may have had an impact on the results therefore a similar study is planned following the same method but using exactly the same questionnaire each time.

6. ACKNOWLEDGMENTS

Our thanks to the children and teachers of English Martyrs Primary School for their participation in this research.

7. REFERENCES

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Parents and Children Having and Using Technology – What should we ask?

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ABSTRACT

In this paper, we report the findings from a study investigating children's responses to technologies they have within their home by comparing them with the responses given by their parents.

The results indicate that children can report this information accurately as there was an 84% match between the responses of a parent and their child. Furthermore it appears that children do not associate items they have within the house with items their parents report they have access to as the match in responses fell to 74% in this case.

The discussion focuses on the understanding of technology with the multi use nature of some technologies being a fascinating issue that must be taken into consideration.

Categories and Subject Descriptors

H.1.2 [**Models and Principles**]: User/Machine Systems – human factors.

General Terms

Reliability, Experimentation, Human Factors.

Keywords

Children, Survey Methods, Reliability.

1. INTRODUCTION

Research with children has been carried out in disciplines such as sociology and psychology for decades [9], [4], [8]. It is only since the emergence of the Child Computer Interaction (CCI) and Interaction Design and Children (IDC) communities in the late 1990's that this unique research area has began to establish itself within HCI.

Traditionally children have been the focus of research rather than participants in the research itself [1]. The assumptions and requirements of the adult researchers have taken precedence over the views and opinions of children themselves [10] with adult researchers being content in the knowledge that they were once children and therefore know how children think, know their likes and dislikes, and have a shared view of the world around them. It is through the introduction and adoption of user-centred and participatory research methods that this stance has been challenged, highlighting the importance of children's own ideas and opinions.

When working with children, researchers must address considerations and challenges that may not exist with other user groups. Survey methods are widely used within the CCI domain as an effective way to elicit information from children to help inform researchers during the design or evaluation process [5]. Survey methods range from traditional methods used without modification for use with children, traditional methods that have been modified for use with children and survey tools that have been created specifically for use with children such as the Fun Toolkit [7] and This or That method [11]. In each instance, the reliability of children's responses has been brought into question with issues such as satisficing, the use of appropriate language [2] and evaluator bias [3] being just some of the factors that can have a profound effect on the answers given by children.

Previous work by the authors has begun to examine the reliability of children's responses by further investigating where the answers given are questionable [5] and looking at the reliability of answers over a short period of time [6] both of which bring further into question whether the responses of children are accurate enough to inform research and design.

The aim of this research is to investigate the accuracy of children's responses in terms of what technologies they have in their homes by comparing the answers given by the children to those given by their parents.

2. METHOD

A questionnaire was created to gather information from parents about what technologies they had in their houses. A technology list had been created and used in previous related studies and it was decided that the same technologies should be used in this study. The parents would be asked to tick which of the technologies they had in the home, who was the owner of the technology (or whether it was shared), and also to tick whether the child was allowed to use it.

The idea behind asking the parents whether the child was allowed to use the technologies was to test whether this had an effect on the child's responses. By asking who owned each technology we could further analyse this if required.

This questionnaire was sent out to 90 parents at a local primary school with children across the age range of 6 to 10 years old. Along with the questionnaires the parents were given information about the purpose of the experiment and a prepaid envelope to return the completed questionnaire to the research team.

IDC 2012, June 12–15, 2012, Bremen, Germany.

The children of the parents who completed and returned the questionnaire were then given a similar questionnaire, in school time, but were, in their version, only asked which technologies they had in the home.

As part of the ongoing larger study by the authors, the parents were also asked if they thought any of the technologies should be removed from the technology set and if there were any they thought should be added to help evidence the changing nature of technologies within the home. Some of this information is discussed further in section 4.

3. RESULTS

Out of the 90 questionnaires sent out only 13 were returned, one of which had to be disregarded due to insufficient information about the participant (discussed in section 4). Therefore the return rate for the completed questionnaire was a disappointing 13% meaning that only 12 families participated in the study.

The results in table 1 show that when comparing the children's responses on what technologies they have in their home with the responses of their parents (CP) there is an 84% match with the majority of the children having a match over 80%. When comparing the children's responses against the responses given by the parents stating which of the technologies the children have access to (CA) we can see that the match is reduced to an average of 74% which suggests that children are capable of accurately identifying technologies they have in their homes and also have the ability to identify items they do not use or have access to. It is worth noting that on 2 of the occasions where the results of CP and CA have the same percentage the answers between the two questions were different (eg: in the CP answer it was the response to the printer that was different whereas in the CA answer it was the games console). This difference although worth mentioning was not analysed further.

Table 1: The accuracy between the Child/Parent (CP) and Child/Access (CA) responses.

Child	CP (%)	CA (%)
1	86.67	86.67
2	66.67	66.67
3	100	100
4	93.33	53.33
5	80	80
6	86.67	80
7	80	66.67
8	80	60
9	60	46.67
10	86.67	73.33
11	93.33	80
12	93.33	93.33
	83.89%	**73.89%**

Table 2 shows a comparison of the results that would have been gathered by asking the parents and the children as two separate groups which technologies they have within their homes. Over half of the technologies produced identical results between the two samples with 87% of the technologies having a difference of two or less. The two items that showed a larger difference in responses were the video recorder and printer.

Table 2: The responses differences between the child and parents as separate groups to the question of which items they have within their homes.

Item	Children	Parents
Mobile Phone	12	11
Laptop	12	12
Games Console	12	12
Photocopier	7	5
Video Camera	9	10
Video Recorder	10	6
DVD Player	12	12
Printer/Copier/Scanner	10	10
Home Telephone	12	12
Computer (PC)	9	9
Handheld Console	11	9
Printer	11	7
Interactive Whiteboard	0	0
Television	12	12
Digital Camera	10	11

4. DISCUSSION

The results shown in table 1 and table 2 provide evidence that children are capable of reporting the technologies they have in their homes accurately. The more interesting findings come from the qualitative analysis of the both the parent and child versions of the questionnaire.

From the results of table 2 we can start to identify items that are becoming the norm in most households that contain children. We can see the children and adults reported all the households as having laptops, games consoles, DVD players, home telephones and TVs. Almost all houses also contain mobile phones, some kind of printing device and a digital camera. This sort of data is useful as it allows us to identify common technologies that the majority of children will be introduced to and have knowledge of. Care must be taken by researchers not to mix this knowledge of technology with the experience a child has had using the technology as having a laptop in the house does in no way imply that a child has ever used it. A validity of a whole study could be brought into question by a researcher misinterpreting the difference between having access to a technology and the experience of using it. There is also a risk with this sort of demographic information that it does not fit an entire population. The demographics may only be true of children in a single town in a single country; they could however be true for a whole city, state, country or several different countries. What a child has access to in a US or UK house will be different to that of a child living in poverty in a third world country.

The video recorder and the printer were the two devices where the results had a greater difference (seen in table 2) and further investigation has come up with some interesting possibilities for why.

The video recorder (VCR) is a device for playing and recording video tapes. Whilst this technology is still widely used it has been overtaken by technologies such as DVD, Blu-ray and digital recorders and players. The decline of the VCR coincided with invention of the DVD in the late 1990's and its wide uptake in the early 2000's. Current pre high school children (aged 12 and below) will not have been born until after the year 2000 which could be a reason why there appears to be confusion as to what this device actually is. One child in the study stated he had a video recorder on his IPod (this was written on the questionnaire where the tick should have been placed in the box). We as researchers know that it is impossible to put a video cassette into an IPod and play it however the IPod is capable of recording and playing digital content so as far as a child is concerned this device could quite conceivably be classed as a video recorder.

The printer was the other device with differing results. It is worth noting at this point that the multifunctional printer/copier/scanner and also a photocopier were present on the questionnaire as separate items to the common printer. There were instances in the results, both with the children and parents, where all three of these items had been selected. This is more evident with the children's results but does highlight a possible problem with technologies that have multiple functions. It is quire plausible that some of the families have all three devices but it is more likely that in most cases a family will have a multifunction device that is capable of printing, scanning and photocopying. This presents a child with a dilemma when completing a questionnaire as to whether they should state they have all these devices as technically they do or whether they should just select the multifunctional device from the list and ignore the other two if they do not have a device that specifically carries out the one task.

Another observation from this current study is that it appears that in the time between the first study [5] in 2008 and now this study there has been a shift in the understanding of different technologies within the home. Children in the 2008 study appeared to struggle to understand what an interactive whiteboard was with several stating they had them in the home. This current group appeared to understand these devices completely. This is probably due to the UK government policy requiring all school classrooms to contain interactive whiteboards in them. The reverse of this is the decline in the understanding of what a video recorder is over the same period.

The range of technologies that children have within their homes is changing all the time. What is interesting and potentially important for a researcher is the point at which a certain technology is no longer considered to be important. There is strong evidence to suggest mobile devices such as Android Tablets and IPods should be included in a list of technologies that children could have at home and this view was supported by comments made by the parents in the study who were asked about the technology list and what should and should not be included. The responses to these questions also brought up the question of should the video recorder be removed? Is there any advantage in knowing whether a child knows how to use the out of date functionally of this device? Maybe… Maybe not?

More and more devices, particularly mobile devices such as mobile phones and tablet/touch devices (including Android Tablets, IPods and IPads) are being created with more and more functionality. It is not implausible for a mobile device to be a phone, digital camera, video camera, video player, music player, sound recorder, games console, television or even classed as a mini PC with functionality such as basic word processing, spreadsheets and photo editing all available on these devices through programs and apps. This poses a dilemma for those seeking to discover the extent of, and the expertise in, technology use in the home. Should a child be stating they have say a mobile phone or should they be able to tick they have several technologies even if they are built in to just one device.

An interesting side note to this study was that there appeared to be at least 5 instances across the 12 responses from the parents where the parent had failed to complete the questionnaire. This ranged from one parent who filled in the whole questionnaire but neglected to fill in their name or the name of their child so the child questionnaire could not be carried out and the results were therefore not used to two separate parents stating they did not have certain technologies in the house but then stating that the children had access to these technologies in the house and also stating which members of the household owned the devices in question. One parent commented that IPod and IPads should be removed from the technology list (these items are not actually in the list that was used) when asked the question of what should be removed. The same family also said that IPod and IPads should be added to the questionnaire in the next question. Whilst this does not directly affect the children in this study it does highlight how easy it can be for adults to make simple mistakes when completing questionnaires meaning researchers must be even more careful and vigilant when designing surveys for children and analyzing their results.

5. CONCLUSIONS

This small study has highlighted the accuracy in children's responses to technologies they have within their households and their ability to recognize technologies that are in these spaces that they may not actually use or even have access to.

The more interesting findings come from the discussion where the constant changing and enhancements to technology is affecting children's knowledge, understanding and perceptions of certain devices. Multifunctional devices and the addition of more and more features to devices that originally had only one function appears to cause confusion for children (and adults) and further studies are required to investigate how much of an impact this has on their answers.

Surveys in the future for children may need to concentrate on the functionalities of products rather than on the products themselves; thus, a future survey may need to look more like this:

- Do you have a mobile phone ?
    - Do you take photos with this device?
    - Do you make phone calls with this device?
    - Do you make videos with this device?
    - Do you watch videos with this device?
    - Do you play music on this device?

- Do you play games on this device?

- Do you have a laptop ?
    - Do you take photos with this device?
    - Do you make phone calls with this device?
    - Do you make videos with this device?
    - Do you watch videos on this device?
    - Do you play music on this device?
    - Do you play games on this device?

You could end up asking the same questions for devices that were originally created for completely different purposes but now offer similar functionality. In reality a laptop is likely to be used for more traditional computer related activities such as word processing on top of this as this becomes increasing more difficult on devices with smaller screens and therefore less likely, although not impossible.

It appears that in the quest for more reliable responses we need to ask more questions however with additional questions being put in front of children and parents there will then be more risk of improper completion, more guesswork, and less reliability. This will then lead to questions being asked about the extent to which the use of the device is important and questions about the experience of the function perhaps being more important than the experience of the device. This is without taking into account the time each device or function is used and also the frequency. The true issue may be finding the point where the amount of questions starts to have a negative effect of the survey process.

The community is beginning to understand the importance of survey design with children to ensure the validity of their research but only time will tell whether the constantly changing technological world in which children are being brought up in impairs our ability to do this.

6. FURTHER WORK

The sample size of this study is low due to a 13% response from parents in participating in this study. It is the intention of the research team to reproduce this study with a larger sample size taking into account some of the insights found in this study.

The work is being carried out as part of a larger study to identify guidelines for creating surveys and using survey methods with children. Further work in understanding children's responses and issues completing surveys is being undertaken with the aim of fully understanding this complicated domain. The debate about function versus device and the best way to determine the experience of children with technology will be a central feature of future work in this area.

It is hoped that a research tool to assist the community in the creation of questionnaire based surveys will be created.

7. ACKNOWLEDGMENTS

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Appendix 3: PETT Version 1

CTUQ Version 1

How old are you? ....

Please tick whether you are a boy or a girl:

Boy ☐ Girl ☐

The purpose of this questionnaire is to see how much experience you have had using a mobile phone. Please answer all the questions and ask the person giving you the questionnaire for help if you are unsure of anything.

1. Do you know what a mobile phone is? Yes ☐ No ☐

2. Do you own a mobile phone? Yes ☐ No ☐

3. Is there a mobile phone at your house that you can use? Yes ☐ No ☐

4. How many days a week do you use a mobile phone at home (circle your answer)?

   0 days 1 or 2 days 3 or 4 days 5 or 6 days 7 days

5. How good do you think you are at using a mobile phone (circle your answer)?

   very good good okay not very good poor

6. Does your school have mobile phones you can use in class? Yes ☐ No ☐

7. Do you use it with your teacher in your class? Yes ☐ No ☐

8. Have you ever used your mobile phone to send a text message?

   Yes ☐ No ☐

9. Can you write down 3 things that you use your mobile phone for?

   ....

   ....

   ....

CTEQ Version 1

How old are you? ....

Please tick whether you are a boy or a girl:

Boy ☐ Girl ☐

The purpose of this questionnaire is to see how much experience you have had sending a text message. Please answer all the questions and ask the person giving you the questionnaire for help if you are unsure of anything.

1. Do you know what a text message is? Yes ☐ No ☐

2. Have you ever sent a text message? Yes ☐ No ☐

3. How many text messages do you think you send in a week (circle your answer)?

   0 – 10 10 – 20 20 – 30 30 – 40 40 – 50 Over 50

4. How good do you think you are at sending text messages (circle your answer)?

very good good okay not very good poor

5. How much do you enjoy sending text messages (circle your answer)?

a lot a little bit not bothered not much don’t enjoy

6. Have you ever used a mobile phone to send a text message?

   Yes ☐ No ☐

7. If you can, list 3 other devices you have used to send a text message?

   ....

   ....

   ....

CTHQ Version 1

How old are you? ....

Please tick whether you are a boy or a girl:

Boy ☐ Girl ☐

The purpose of this questionnaire is to see how much experience you have had with technology and how much you use it. Please answer all the questions and ask the person giving you the questionnaire for help if you are unsure of anything.

1. Do you have a lot of electrical devices at home? Yes ☐ No ☐
2. Do you own a lot of electrical devices? Yes ☐ No ☐
3. Do you own a games console? Yes ☐ No ☐
4. Do you own a mobile phone? Yes ☐ No ☐
5. Tick the statement below that you feel best describes you:

   I use technology as often as I can ☐
   I use technology to make things easier to do ☐
   I use technology when I am bored ☐
   I do not use technology very often ☐

6. Please tick which of the following devices you have ever used

Computer	☐	DVD Player	☐
Television	☐	Washing Machine	☐
Cash Machine	☐	Kettle	☐
Interactive Whiteboard	☐	Toaster	☐
Radio	☐	Mobile Phone	☐
Lift	☐	Games Console	☐

7. How easy do you find it to learn how to use an electrical device (circle your answer)?

very easy   easy   ok   hard   very hard

Appendix 4: PETT Version 2

CTUQ Version 2

How old are you? ....

Please tick whether you are a boy or a girl:

Boy ☐ Girl ☐

The purpose of this questionnaire is to see how much experience you have had using a mobile phone. Please answer all the questions and ask the person giving you the questionnaire for help if you are unsure of anything.

1. Do you know what a mobile phone is? Yes ☐ No ☐

2. Do you have your own mobile phone? Yes ☐ No ☐

3. Do you use a mobile phone at home? Yes ☐ No ☐

4. How many days a week do you use a mobile phone (circle your answer)?

   0 days 1 or 2 days 3 or 4 days 5 or 6 days 7 days

5. How good do you think you are at using a mobile phone (circle your answer)?

   very good good okay not very good poor

6. Does your school have mobile phones you can use in class? Yes ☐ No ☐

7. Do you use it with your teacher in your class? Yes ☐ No ☐

8. Have you ever sent a text on a mobile phone?

   Yes ☐ No ☐

9. Can you write down 3 things that you use your mobile phone for?

   ....

   ....

   ....

CTEQ Version 2

How old are you? ....

Please tick whether you are a boy or a girl:

Boy ☐ Girl ☐

The purpose of this questionnaire is to see how much experience you have had sending a text message. Please answer all the questions and ask the person giving you the questionnaire for help if you are unsure of anything.

1. Do you know what a text message is? Yes ☐ No ☐

2. Have you ever sent a text message? Yes ☐ No ☐

3. How many text messages do you send in a week (circle your answer)?

   0 – 10 10 – 20 20 – 30 30 – 40 40 – 50 Over 50

4. How good are you at sending text messages (circle your answer)?

very good good okay not very good poor

5. How much do you enjoy sending text messages (circle your answer)?

a lot a little bit not bothered not much don't enjoy

6. Have you ever sent a text on a mobile phone?

   Yes ☐ No ☐

7. List 3 other devices you have used to send a text message?

   ....

   ....

   ....

How old are you? ....

Please tick whether you are a boy or a girl:

Boy ☐ Girl ☐

The purpose of this questionnaire is to see how much experience you have had with technology and how much you use it. Please answer all the questions and ask the person giving you the questionnaire for help if you are unsure of anything.

1. Do you have a lot of electrical devices at home?	Yes ☐	No ☐
2. Do you own a lot of electrical devices?	Yes ☐	No ☐
3. Do you own a games console?	Yes ☐	No ☐
4. Do you own a mobile phone?	Yes ☐	No ☐

5. Tick the statement below that you feel best describes you:

   I use technology as often as I can ☐
   I use technology to make things easier to do ☐
   I use technology when I am bored ☐
   I do not use technology very often ☐

6. Please tick which of the following devices you have ever used

Computer	☐	DVD Player	☐
Television	☐	Washing Machine	☐
Cash Machine	☐	Kettle	☐
Interactive Whiteboard	☐	Toaster	☐
Radio	☐	Mobile Phone	☐
Lift	☐	Games Console	☐

7. How easy do you find it to learn how to use an electrical device (circle your answer)?

very easy easy ok hard very hard

Appendix 5: PETT Version 3 (including Q4)

CTUQ Version 3

How old are you? ....

Please tick whether you are a boy or a girl:

Boy ☐ Girl ☐

The purpose of this questionnaire is to see how much experience you have had using a mobile phone. Please answer all the questions and ask the person giving you the questionnaire for help if you are unsure of anything.

1. Do you know what a mobile phone is? Yes ☐ No ☐

2. Do you have your own mobile phone? Yes ☐ No ☐

3. Do you use a mobile phone at home? Yes ☐ No ☐

4. How many days a week do you use a mobile phone (circle your answer)?

   0 days 1 or 2 days 3 or 4 days 5 or 6 days 7 days

5. How good do you think you are at using a mobile phone (circle your answer)?

   very good good okay not very good poor

6. Does your school have mobile phones you can use in class? Yes ☐ No ☐

7. Do you use it with your teacher in your class? Yes ☐ No ☐

8. Have you ever sent a text on a mobile phone?

   Yes ☐ No ☐

9. Can you write down 3 things that you use your mobile phone for?

   ....

   ....

   ....

CTEQ Version 3

How old are you? ....

Please tick whether you are a boy or a girl:

Boy ☐ Girl ☐

The purpose of this questionnaire is to see how much experience you have had sending a text message. Please answer all the questions and ask the person giving you the questionnaire for help if you are unsure of anything.

1. Do you know what a text message is? Yes ☐ No ☐

2. Have you ever sent a text message? Yes ☐ No ☐

3. How many text messages did you send last week? (circle your answer)?

   0 – 10 10 – 20 20 – 30 30 – 40 40 – 50 Over 50

4. How good are you at sending text messages (circle your answer)?

very good good okay not very good poor

5. How much do you enjoy sending text messages (circle your answer)?

a lot a little bit not bothered not much don't enjoy

6. Have you ever sent a text on a mobile phone?

   Yes ☐ No ☐

7. Try to name 3 other gadgets you have used to send a text message:

   ....

   ....

   ....

CTHQ Version 3

How old are you? ....

Please tick whether you are a boy or a girl:

Boy ☐ Girl ☐

The purpose of this questionnaire is to see how much experience you have had with technology and how much you use it. Please answer all the questions and ask the person giving you the questionnaire for help if you are unsure of anything.

1. Do you have a lot of electrical items at home? Yes ☐ No ☐

2. Do you own a lot of electrical items? Yes ☐ No ☐

3. Do you own a games machine (examples: X-Box, PlayStation, Nintendo DS)? Yes ☐ No ☐

4. Do you have you own mobile phone? Yes ☐ No ☐

5. Tick the sentence below that you feel best describes you:

   I use gadgets as often as I can ☐
   I use gadgets to make things easier to do ☐
   I use gadgets when I am bored ☐
   I do not use gadgets very often ☐

6. Please tick which of the following items you have ever used:

Computer	☐	DVD Player	☐
Television	☐	Washing Machine	☐
Cash Machine	☐	Kettle	☐
Interactive Whiteboard	☐	Toaster	☐
Radio	☐	Mobile Phone	☐
Lift	☐	Games Console	☐

7. How easy do you find it to use electrical items (circle your answer)?

very easy easy ok hard very hard

Questionnaire 4

1. How often did you use your mobile phone last week (circle your answer)?

very often　　often　　a bit　　not much　　never

2. Try to name 3 other pieces of equipment you have used to send a text message:

....

....

....

3. How much do you enjoy sending text messages (circle your answer)?

don’t enjoy　　not much　　not bothered　　a little bit　　a lot

4. Do you own a games console?　　Yes ☐　　No ☐

5. Tick the sentence below that you feel best describes you:

I use electrical items as often as I can	☐
I use electrical items to make things easier to do	☐
I use electrical items when I am bored	☐
I do not use electrical items very often	☐

Appendix 6: PETT Version 4

CTUQ Version 4

How old are you? ....

Please tick whether you are a boy or a girl:

Boy ☐ Girl ☐

The purpose of this questionnaire is to see how much experience you have had using a mobile phone. Please answer all the questions and ask the person giving you the questionnaire for help if you are unsure of anything.

1. Do you know what a mobile phone is? Yes ☐ No ☐
2. Do you have your own mobile phone? Yes ☐ No ☐
3. Do you use a mobile phone at home? Yes ☐ No ☐
4. How many days a week do you use a mobile phone (circle your answer)?

   0 days 1 or 2 days 3 or 4 days 5 or 6 days 7 days

5. How good do you think you are at using a mobile phone (circle your answer)?

   very good good okay not very good poor

6. Does your school have mobile phones you can use in class? Yes ☐ No ☐
7. Do you use it with your teacher in your class? Yes ☐ No ☐
8. Have you ever sent a text on a mobile phone?

   Yes ☐ No ☐

9. Can you write down 3 things that you use your mobile phone for?

   ....

   ....

   ....

CTEQ Version 4

How old are you? ....

Please tick whether you are a boy or a girl:

Boy ☐ Girl ☐

The purpose of this questionnaire is to see how much experience you have had sending a text message. Please answer all the questions and ask the person giving you the questionnaire for help if you are unsure of anything.

1. Do you know what a text message is? Yes ☐ No ☐

2. Have you ever sent a text message? Yes ☐ No ☐

3. How many text messages did you send last week? (circle your answer)?

   0 – 10   10 – 20   20 – 30   30 – 40   40 – 50   Over 50

4. How good are you at sending text messages (circle your answer)?

very good   good   okay   not very good   poor

5. How much do you enjoy sending text messages (circle your answer)?

a lot   a little bit   not bothered   not much   don’t enjoy

6. Have you ever sent a text on a mobile phone?

   Yes ☐ No ☐

7. Try to name 3 other pieces of equipment you have used to send a text message:

   ....

   ....

   ....

CTHQ Version 4

How old are you? ....

Please tick whether you are a boy or a girl:

Boy ☐ Girl ☐

The purpose of this questionnaire is to see how much experience you have had with technology and how much you use it. Please answer all the questions and ask the person giving you the questionnaire for help if you are unsure of anything.

1. Do you have a lot of electrical items at home? Yes ☐ No ☐

2. Do you own a lot of electrical items? Yes ☐ No ☐

3. Do you own a games machine (examples: X-Box, PlayStation, Nintendo DS)? Yes ☐ No ☐

4. Do you have your own mobile phone? Yes ☐ No ☐

5. Tick the sentence below that you feel best describes you (only choose one):

   I use electrical items as often as I can ☐
   I use electrical items to make things easier to do ☐
   I use electrical items when I am bored ☐
   I do not use electrical items very often ☐

6. Please tick which of the following items you have ever used:

Computer	☐	DVD Player	☐
Television	☐	Washing Machine	☐
Cash Machine	☐	Kettle	☐
Interactive Whiteboard	☐	Toaster	☐
Radio	☐	Mobile Phone	☐
Lift	☐	Games Console	☐

7. How easy do you find it to use electrical items (circle your answer)?

very easy easy ok hard very hard

Questionnaire 4

1. How often did you use your mobile phone last week (circle your answer)?

very often　　often　　a bit　　not much　　never

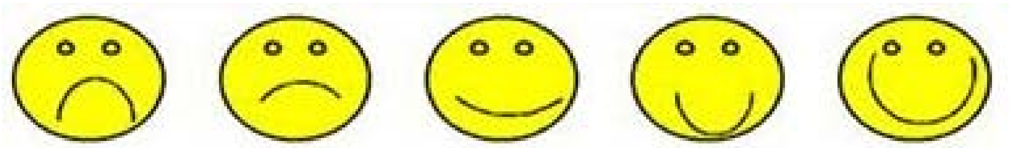
2. Try to name 3 other pieces of equipment you have used to send a text message:

....

....

....

3. How much do you enjoy sending text messages (circle your answer)?



don't enjoy　　not much　　not bothered　　a little bit　　a lot

4. Do you own a games console?　　Yes ☐　　No ☐

5. Tick the sentence below that you feel best describes you:

I use electrical items as often as I can ☐
I use electrical items to make things easier to do ☐
I use electrical items when I am bored ☐
I do not use electrical items very often ☐

Appendix 7: Final Generic PETT Questionnaires

How old are you? ....

Please tick whether you are a boy or a girl:

Boy ☐ Girl ☐

The purpose of this questionnaire is to see how much experience you have had using a mobile phone. Please answer all the questions and ask the person giving you the questionnaire for help if you are unsure of anything.

1. Do you know what a *[technology]* is? Yes ☐ No ☐
2. Do you have your own *[technology]*? Yes ☐ No ☐
3. Do you use a *[technology]* at home? Yes ☐ No ☐
4. How many days a week do you use a *[technology]* (circle your answer)?

   0 days   1 or 2 days   3 or 4 days   5 or 6 days   7 days

5. How good do you think you are at using a *[technology]* (circle your answer)?

   very good   good   okay   not very good   poor

6. Does your school have *[technology]* you can use in class? Yes ☐ No ☐
7. Do you use it with your teacher in your class? Yes ☐ No ☐
8. Have you ever *[carried out a task]* on a *[technology]*?

   Yes ☐ No ☐

9. Can you write down *[n]* things that you use your *[technology]* for?

   ....

   ....

   ....

CTEQ – Final Generic

How old are you? ....

Please tick whether you are a boy or a girl:

Boy ☐ Girl ☐

The purpose of this questionnaire is to see how much experience you have had sending a text message. Please answer all the questions and ask the person giving you the questionnaire for help if you are unsure of anything.

1. Do you know what a *[task]* is? Yes ☐ No ☐

2. Have you ever *[carried out the task]*? Yes ☐ No ☐

3. How many *[times did you carry out the task]* last week? (circle your answer)?

   [appropriate scale goes here]

4. How good are you at *[doing the task]* (circle your answer)?

very good | good | okay | not very good | poor

5. How much do you enjoy *[doing the task]* (circle your answer)?

a lot | a little bit | not bothered | not much | don’t enjoy

6. Have you ever *[carried out the task]* on a *[technology]*?

   Yes ☐ No ☐

7. Try to name *[n]* other pieces of equipment you have used to *[carry out the task]*:

   ....

   ....

   ....

How old are you? ....

Please tick whether you are a boy or a girl:

Boy ☐ Girl ☐

The purpose of this questionnaire is to see how much experience you have had with technology and how much you use it. Please answer all the questions and ask the person giving you the questionnaire for help if you are unsure of anything.

1. Do you have a lot of electrical items at home? Yes ☐ No ☐

2. Do you own a lot of electrical items? Yes ☐ No ☐

3. Do you own a games machine (examples: X-Box, PlayStation, Nintendo DS)? Yes ☐ No ☐

4. Do you have your own mobile phone? Yes ☐ No ☐

5. Tick the sentence below that you feel best describes you (only choose one):

   I use electrical items as often as I can ☐
   I use electrical items to make things easier to do ☐
   I use electrical items when I am bored ☐
   I do not use electrical items very often ☐

6. Please tick which of the following items you have ever used:

[item]	☐	*[item]*	☐
[item]	☐	*[item]*	☐
[item]	☐	*[item]*	☐
[item]	☐	*[item]*	☐

7. How easy do you find it to use electrical items (circle your answer)?

very easy easy ok hard very hard

Appendix 8: Literature Review on Survey Methodology

1.1 Introduction to Survey Methods

Fink (Fink, 2003) defines a survey as *"a system for collecting information from or about people to describe, compare, or explain their knowledge, attitudes, and behavior"*. In short, it is a data collection technique that is used to gather information from, and about, individuals.

The earliest type of survey known to have been conducted is the census, the first of which can be traced back as far as the Babylonian civilisation as early as 3800BC (Missiakoulis, 2010). More recently surveys have been carried out to help understand specific social problems, an early example being the Charles Booth's survey into life and labour in London in the late 19th century (Groves et al., 2009). This was followed by a growing need to gather people's opinions; spurred on by journalists and market researchers who were interested in the views of the typical 'man on the street'. Today, survey methodology and the use of surveys has become multidisciplinary within the scientific field with examples predominantly being found in areas such as psychology (Sudman, Bradburn, & Schwarz, 1996; Gullone & King, 1992), health (Ware, Kosinski, & Keller, 1996; Chan, Orlando, Ghosh-Dastidar, Duan, & Sherbourne, 2004), sociology (Finch, 1987; Maynard & Schaeffer, 2000) and mathematics (Bethlehem & Keller, 1987; Konovsky, Jaster, & McDonald, 1989). Survey methodology does not solely belong to the scientific community however; vast amounts of work in this area is carried out by governments who produce survey reports into the popularity of policies, opinions of potential voters and needs of certain communities for example. There are also professional organisations that carry out independent market research for companies, and opinion polls that are used by the media.

Creating and administering a survey may seem simple in theory, ask some questions, then analyse the answers received and use the results. In practice however, the creation of a successful survey takes a lot of time and careful planning. Mitchell & Jolley (2010) identify three objectives that must be met in order to conduct a successful survey:

- Know your research hypothesis before you create the survey in order to know exactly what you want to measure.
- Ensure your survey is able to accurately measure the feelings, opinions, or behaviours that you wish to measure.
- The results produced must be generalizable to a certain population.

This section of the thesis uses literature to understand and explore the important concepts of survey methods that will be used later in the thesis to aide in the creation of child friendly surveys to elicit the self-report of technology use and the prior experience of children.

1.2 Survey Instruments

There are several different methods of conducting survey research with these methods falling into one of the two categories of survey instrument; the written survey (questionnaires) where responses are written down by the participant, and interviews, where the questions are verbally given to the participants who then provide their responses orally (Markopoulos, Read, MacFarlane, & Hoysniemi, 2008; Mitchell & Jolley, 2010).

1.2.1 Self-Administered Questionnaires

The most frequent method of carrying out a questionnaire is by self-administration. A self-administered questionnaire is read and completed by its participants without the involvement of an administrator. Traditionally, research of this type has tended to focus on the use of postal questionnaires (Adamson, Ben-Shlomo, Chaturvedi, & Donovan, 2003; Mallen, Peat, Thomas, & Croft, 2005; Blais, 2009) where the cost of administering the questionnaire to a large number of participants is very low when compared with methods where an administrator is involved. With postal questionnaires, there is an abundance of literature on improving response rates (Edwards, 2002; Puffer, Porthouse, Birks, Morton, & Torgerson, 2004; Nakash, Hutton, Jørstad-Stein, Gates, & Lamb, 2006) and investigations into non-response bias (Bowling, 2005) highlighting possible error and reliability trade-offs with using this method.

The advent of email, coupled with the rapid expansion and surge in use of internet technologies has led to newer methods of self-administered questionnaires where the cost is reduced further as the postage costs are all but removed. The email questionnaire was perhaps the direct successor of the postal questionnaire (although not complete replacement) expanding the potential target sample or population into the millions of participants with relative ease despite the huge geographical distances that may be involved (Wright, 2006). Response rates using email questionnaires have often proved to be equal, if not better than that of postal questionnaires (Stanton, 1998) however this is not always the case (Sheehan, 2006) with the sample group often having an effect on this. The time cost of sending a questionnaire by email, receiving the digital response, and reduction in work needed to transcribe the already digital responses further makes them a compelling alternative to the postal questionnaire. There are disadvantages to using email as the administration method such as the need of an email address, access to an internet enabled device, and the demands of using the technologies that could have an effect of questionnaire response. As with other self-administration techniques, email questionnaires still suffer from the sampling and non-response biases related to the self-selection of the participants who take part (Sheehan, 2006).

Online surveys have provided the biggest change to occur in the area of self-administered questionnaires. These questionnaires can combine the question styles of a traditional written questionnaire with the media affordances of a website (Lumsden, 2007) such as images, videos and audio. As well as sharing the cost advantages associated with email questionnaires, there is the added benefit of analytical and statistical backend systems that are capable of automatically producing statistical analysis or providing the data in a format that can be easily imported into a statistical package such as SPSS (Wright, 2006). Hundreds of free and commercial online survey packages are available to aide researchers in the design and administration of their surveys making this survey medium highly popular. Again, this method shares similar disadvantages with email questionnaires only issues such as the learning demands of the survey tool will be greater than simply replying to an email, thus increasing these effects on responses.

Self-administered questionnaires are invaluable when a large number of participants are required and where control over the sample of a population is not deemed to be too important. One of the major drawbacks to this technique is the lack of an administrator to aide in the completion of the questionnaire. Respondents are being asked to answer questions that have a certain meaning and purpose to the researcher and research study which may differ to the perceptions of the respondent in what the question is asking (Jenkins & Dillman, 1997). Without an administrator being there to interact with the respondent this type of problem is hard to identify and impossible to correct meaning the answers given by some respondents could actually be to a different question than what the question was meant to ask (Mitchell & Jolley, 2010).

1.2.2 Investigator-Administered Questionnaires

Investigator-administered questionnaires are completed by respondents under the supervision of an administrator, or investigator, who may, or may not, be the individual who designed the questionnaire. These types of questionnaires share many of the advantages associated with self-administered questionnaires such as the ability to survey many participants at the same time (although perhaps to a lesser extent). The major advantage of this method is the presence of an administrator who is available to clarify any points in which a respondent may be confused or unsure. The presence of an administrator can also act as an encouragement to make respondents complete the questionnaires and therefore has been found to increase response rate (Mitchell & Jolley, 2010).

A negative aspect to this type of questionnaire is the potential effect the presence of the administrator could have on the responses of respondents. The administrator could inadvertently cause the respondent to feel less anonymous and therefore provide less honest responses, or the administrator could possibly give unintentional facial expressions that sway a participant to answer in a certain way.

1.2.3 Psychological Tests

A psychological test in many ways is similar to an investigator-administered questionnaire with the difference being that it attempts to measure some underlying psychological construct in a reliable and valid way, whereas a questionnaire is simply a method of data collection that does not necessarily measure any underlying psychological construct.

The British Psychological Society (British Psychological Society, 2012) state there are two types of psychological test:

- Measuring aptitude, ability or attainment.
- Assessing personal qualities such as personality, beliefs and values.

Psychological tests are often developed over much longer timescales than questionnaires, sometimes even years, to ensure they are correctly measuring the constructs and maximise their reliability and validity (Mitchell & Jolley, 2010).

1.2.4 Interviews

Interviews in some instances are similar to questionnaires in that both methods are interested in participant’s responses to questions, the main difference being that interviews allow direct discussion to take place between an interviewer and participant (interviewee). Perhaps the biggest advantage to this technique over questionnaire surveys is that participants are able to provide detailed and rich responses that would often be lost, or incredibly stifled in a questionnaire (Lazar, Feng, & Hochheiser, 2010). How rich and deep these responses can actually be often depends on how structured the interview is. These types are distinguished in three ways:

- Unstructured
- Semi-structured
- Structured

Unstructured interviews are flexible in that the interviewer does not have a specific interview schedule to follow. They are often carried out as exploratory studies where the researchers know little about the topic being studied (Langridge & Hagger-Johnson, 2009). By not having a specific set of questions the interviewer is able to probe answers in more depth and can lead the interview in whatever direction they feel necessary depending on the responses of the interviewee. This does however mean the data collected can be difficult to analyse as the interview direction may differ significantly between participants, ultimately leading to reliability issues.

Semi-structured interviews offer a certain amount of flexibility in that the interviewer will have a set of questions they wish to ask although will still have the flexibility to explore responses and ask further questions if required. As long as the main questions get answered they have the freedom to lead the interview in different directions when required. This method has the advantage that key questions are answered and responses to these can be compare more easily although the loss in flexibility will lead to a reduction in the amount of rich data that can be gathered (Langridge & Hagger-Johnson, 2009).

Structured interviews are closest to questionnaires in that the interviewer will have a set of questions that they will ask and stick to this rigorously. The answers provided may still be richer than those received in a questionnaire, but nothing like that collected in less structured techniques. This in turn makes the data much easier to analyse, easier to administer and easier to replicate.

Perhaps the biggest disadvantage of using interviews is the time it takes to administer an interview (Lazar et al., 2010). Interviews only allow one participant to be interviewed at time and the process of turning interviewers notes and recordings into responses to specific questions can take many hours for each hour of interview (Robson, 2002). The personal nature in carrying out interviews can also lead to interviewer bias where by the interviewer influences the response given (Mitchell & Jolley, 2010), whether intentionally or not. This can be further exacerbated by participants wanting to impress, or nor upset, the interviewer leading then to giving answers they think the interviewer wants to hear rather than telling the truth (De Leeuw, 1992).

1.2.5 Telephone Interviews

One method of reducing problems such as interviewer bias is the use of telephone interviews. Using this method, means that the participant cannot see the interviewer directly and therefore cannot see any involuntary visual cues that could bias a response (Mitchell & Jolley, 2010). It also allows participants to feel more anonymous which has been shown to provide more accurate and truthful answers (Lazar et al., 2010).

The downsides to telephone interviews are similar to that of postal questionnaires in that non-response becomes a problem due to people not answering their phones, and sampling biases due to only including people with a telephone. You cannot tell if the participant is actually the person who is supposed to be doing the interview, and also whether that person is distracted by other factors such as the television, or children.

1.3 Populations and Samples

In survey research, a population is the entire group of people that one would aim to survey. Whether this be every person in the UK, or simply every child in a class, the population includes every single person belonging to the group that the survey is looking at. It is however, extremely difficult, and often impossible to survey an entire population (de Vaus, 1994; Langridge & Hagger-Johnson, 2009) due to sheer size or difficulty in accessing the whole group.

A sample can be thought of as a group of people chosen to represent the population that it is aimed to survey. The purpose of surveying a sample of the population is that this smaller group will provide an accurate representation of the entire group. A representative sample should contain people with the same characteristics as the population to be studied as a whole. These characteristics could be in the form of demographic information, habits, computer experience to name but a few. Oppenheim (Oppenheim, 2005) highlights the issue that often in survey research, the size and demographic information of a population may be unknown as, for example, we may want to interview all people who own a computer at home in the UK. We have no way of knowing how many people own one, the demographic makeup of these people is also unknown, and the location of owners is not known – so choosing a sample that is representative can be problematic. In this case, strict probabilistic sampling cannot be carried out.

Within HCI, Lazar (Lazar et al., 2010) notes that there is a long history of using surveys without probability samples and this is considered to be just as valid due to the lack of data-sets of populations. HCI researchers often have to find users, collect the data, and analyse it themselves which is often not the case in other disciplines.

1.3.1 Random Sampling

Random sampling is the random selection of participants to take part in a survey where every person in the population has an equal chance of being chosen. Each member of the population is assigned a number and then the sample is selected using random number tables or numbers randomly generated by a computer (Oppenheim, 2005). Random sampling is sometimes carried out using a simpler method of participant selection known as systematic sampling. This is where the fractional value of the population to be sampled is used to select the participants, for example, if a sample of 1/5 of the population was required, then one in every 5 people would be chosen. The starting point for this sample would have to be within the first 5 people in the population list and then every 5^{th} person after that would be selected (de Vaus, 1994).

1.3.2 Stratified Random Sampling

Stratified random sampling involves dividing a population up into a number of group depending on specific characteristics they have in common. These groups, known as strata, then have a random sample of people selected from them depending on the percentage of the population that strata makes up (Langridge & Hagger-Johnson, 2009). An example of this might be a survey of high school children where the children can be split up into year groups. The number of children in each year group to be sampled would be based on what percentage that year group made up of the entire school population. So if the school contained 1000 children and 250 were in Year 7, a quarter of the sample of children would be selected from the Year 7 strata.

This method is useful to ensure a representative sample across the stratifying variable which can make the sample a better fit (de Vaus, 1994). In the previous example if we had used random sampling, it is possible that every child selected to take part in the study was from the same year group which would be a random sample but would not be a representative group of the school population as a whole.

1.3.3 Snowball Sampling

Snowball sampling is a useful technique when it is difficult to identify members of a population. In this situation a few people who fit the population are identified to complete the survey and are then asked to identify more people who fit the same population and recruit them to complete the survey also. Hopefully this new group with identity more people and the number of participants would ‘snowball’ as more and more participants identify more and more potential participants. Using this type of sample does make it difficult to make generalisations about a population as there is no way of knowing how representative the sample is (Oppenheim, 2005).

1.3.4 Convenience Sampling

Convenience sampling is one of the commonest methods of sampling and is often considered as one of the worst methods as it does not produce a representative sample (Langridge & Hagger-Johnson, 2009). The basis of this technique is to choose the most convenient people to act as the participants. This technique is often used with HCI with many studies using university students as subjects in studies where the researcher involved works at the same institution. This is ok if the study is about 18 year old Computer Science students for example, but this group is not a representative sample of 18 year olds, university students, or computer users.

1.3.5 Non-probability Sampling

Non-probability sampling is used when the use of probability sampling techniques are not possible or are unnecessary (de Vaus, 1994). As previously highlighted, this is often the case in HCI research and it is viewed within this field as being no less valid (Lazar et al., 2010). In the preliminary stages of research it is often acceptable to use non-random samples for example when designing and pre-testing questionnaires. Other areas where probability sampling is deemed unnecessary include:

- Scale development.
- Obtaining ideas about the range of responses given.
- Exploratory research looking at patterns in responses.

- Hypothesis generating surveys.

(de Vaus, 1994)

1.3.6 Sampling Bias & Sampling Error

Sampling bias is an important issue if it is important to be able to make generalisations about a population from the sample data. In this case it is important to make sure the sample is representative of the whole population. Methods such as convenience sampling and snowball sampling are known not to provide representative samples and therefore surveys using these methods, and non-probability methods, will contain high levels of sampling bias. Of the methods highlighted above, stratified sampling is perhaps the best way of reducing sampling bias but it is not always possible or practical to do this.

Sampling error refers to accuracy of results reported in a survey based of the size of a study related to the size of the population as a whole. In relations to the size of the population, the smaller the sample size, the greater the sampling error will be. Sampling errors can be calculated using statistical error tables which can then be applied to results. An example is that if a survey had a sampling error rate of 2%, then an answer where 30% of the participants said yes to a question, the true value would lie somewhere between 28% and 32% (Oppenheim, 2005).

1.4 Variables

In its simplest form, a variable is simply something that varies. Within survey research this variable is something that we wish to measure or has an effect on what we wish to measure. One of the key starting points in creating a survey, and considered to be one of the most important factors in creating a successfully survey is knowing exactly what we want to measure, exactly what variable we wish to measure, and what variable might affect it.

There a three kinds of variables (Langridge & Hagger-Johnson, 2009) that need to be considered:

- Independent variables.
- Dependent variables.
- Confounding variables.

Independent variables are variables that can be manipulated in order to measure the effect on something. Another way to look at this is in relation to cause and effect. The cause of something would be classed as the independent variable. By altering the cause we can see what the effect is. An example of this might measuring the effect education level has on income level. The independent variable would be the education level. The income level, the variable in which we will measure the effect is the known as the *dependent variable* (de Vaus, 1994).

Confounding variables are variables that may have an effect on the responses to a survey that are not dependent or independent variables. If a survey was looking at children's concentration within different lessons at school then the time of day might be a confound variable as the results may show that children are more attentive in Geography than Maths, but if Geography is the first lesson in the morning, and Maths is last lesson of the day then the result may be because the children are more tired at the end of the day, rather than because they find Geography more appealing. A key issue in survey design is minimising, and if possible, eliminating confound variables by a process of exclusion, keeping them constant, or randomisation (Oppenheim, 2005).

The reports of technology use and prior experience, as is the focus of this thesis, may often be used as an independent variable itself which is why it is so important to make sure this is done as accurately as possible to enable inferences and assumptions to be made to support a hypothesis or confirm a result.

1.5 Question Types

There are many different ways to ask questions within surveys however they all fall into one of two categories:

- Open-ended questions
- Closed questions

An open-ended question allows a participant to answer a question in their own words without the constraints of a fixed list of options they can choose from. Closed questions are the opposite in that the participant is only provided with a fixed set of answers and must choose the one they deem to be most appropriate.

1.5.1 Open-ended Questions

As previously stated, open-ended questions allow a participant to answer a question in their own words using as much or as little information as they see fit. Researchers who advocate the use of this type of question highlight the spontaneity from this type of question giving clues as to the most salient information that is in a respondents mind at the time (Foddy, 2001; Oppenheim, 2005). They allow for unexpected answers that are not possible within closed questions and can be a measure of the knowledge of a respondent, together with their feelings on a particular topic (Fowler Jr, 1995; Foddy, 2001). Sometimes participants may have different reasons for giving the same answer to a question which again will be lost in a closed question (Mitchell & Jolley, 2010).

Open-ended questions also have their downsides however. Participants can often find them hard to answer and therefore are more likely to skip these types of questions (Mitchell & Jolley, 2010; Oppenheim, 2005). Many people have difficulties in putting their thoughts and ideas down on paper which advocates the use of this type of question more in interviews than questionnaires (de Vaus, 1994). Within interviews however, these questions can cause problems with interviewer bias as respondents are more likely to satisfice when probed for more information and explanations into their answers. Probing also opens up the potential to turn open questions into closed questions if done poorly (Foddy, 2001). Perhaps the most important issue with open-ended questions to researchers are the issues with coding the data. Due to the sheer volume and variety of answers that can be recorded, the time and complexity of coding these questions is well documented (Groves et al., 2009; Lazar et al., 2010; Oppenheim, 2005; Foddy, 2001; Fowler Jr, 1995) and therefore the data gathered from these questions as often seen as less reliable.

1.5.2 Closed Questions

Closed questions can only be used in surveys where all possible answers are known in advance and therefore can be presented as the responses choices (Rogers, Sharp, & Preece, 2011). The main advantages to using this type of question is that for the researcher they are much easier to code than open questions and for the participant they are much easier to answer (de Vaus, 1994; Oppenheim, 2005) as in questionnaires they require no writing, often only the ticking of a box or circling of a word, and answers in interviews are limited to the options given. This simplicity allows for more questions to be asked within a time period which is advantageous as it can reduce the cost of a survey or make it appear to offer more value for money. Drawbacks to closed questions often stem from the need to limit users to a small number of predefined choices (Lazar et al., 2010). Not all closed questions have this problem however, questions asking for information such as the sex of the participant or yes/no questions only need to provide a few set responses. If the option set is not complete the options given may guide the participant to give a certain answer introducing bias into a survey. The answer that is selected may be different to that given by the respondent if the question was asked in an open format, potentially forcing them to choose a response they did not want to give (Oppenheim, 2005). A way to partially combat this is by introducing an opt out option such as *'other'* or *'don't know'* that allows the participant to choose this response when the options presented to them are not acceptable (de Vaus, 1994; Rogers et al., 2011).

To better understand the different types of closed questions, it is important to understand the four types of data these questions can contain, these are:

- Nominal
- Ordinal
- Interval
- Ratio

Nominal data, sometimes referred to as categorical data, is a type of discrete data meaning that the data gathered fits into one of a set of categories and can only fit within one category. The types of questions are often dichotomous (providing only two options) such as yes/no questions and questions such as sex (male or female) and marital status (married or unmarried). In this type of data there is no ranking of answers and no answer is weighted more than another. Non-dichotomous examples could include questions about a participant's country of birth, religion, or hair colour. All participants can only fall into one category. Nominal data is often represented in the form of multiple choice questions, or a checklist where each response is treated as a single yes/no variable.

Ordinal data is a type of scale data where each item in the scale has a different value, going from largest to smallest, or vice versa, but the difference between each value is unknown. To that point, ordinal data can be counted or ranked, but it cannot be measured. An example of ordinal data could be the positioning of people in a test. The data will show who came first and second for instance, but does not show the difference in scores between the people in each place (Langridge & Hagger-Johnson, 2009). The most common form of ordinal scale is the Likert scale often used to see how much a participant agrees or disagrees with a particular question or statement. Likert scales can be carried out on a scaled of any number of points which odd numbers such as 5 or 7 used often that allow for a neutral value in the middle. Other types include paired comparison questions where the participant is forced to choose one of two options based on certain criteria such as which is their favourite, and rank order scales where participants are made to rank a given list of items.

Interval data is scale data that can be measured as each interval has the same difference in value. An example of an interval scale can be measuring temperature in Celsius. The difference between 10 and 20 degrees Celsius is the same as the difference between 40 and 50 degrees; a 10 degree increase in value. Interval data has an arbitrary start point (zero degrees Celsius is not the lowest temperature) and because of that this data cannot be multiplied or divided as the ratios between the values on the scale are not meaningful. We cannot say that 40 degrees is twice as hot as 20 degrees without having a true start point of zero degrees.

Ratio data scales are similar to interval scales in that the intervals used for the data are of equal amounts. The difference being that the data on a ratio scale has a true zero point which allows the data to make sense in terms of proportions or ratios. In the previous paragraph Celsius was used as an example of interval data as it does not have a true zero point whereas the temperature in Kelvin is ratio data as it does have a true zero point (absolute zero). With this scale we can say that 40 degrees Kelvin is twice as hot as 20 degrees Kelvin which was not the case in Celsius.

1.6 Pretesting

Pretesting, or piloting as it is alternately known, is the only way to evaluate surveys in advance to identify problems with the survey or with the questions being asked (Presser et al., 2004). It is not simply a case of pretesting each question, the questionnaire as a whole must also be evaluated (de Vaus, 1994). There are different opinions in the amount of respondents required to carry out a successful pretest with Fowler advocating between 15 and 35 (Fowler Jr, 1995) and Sudman advocating between 20 and 50 (Sudman, 1976) however Presser highlights the fact there is no scientific evidence to support these numbers (Presser et al., 2004). Where pretesting with actual respondents it not possible, Rogers et al (Rogers et al.,

2011) recommend getting colleagues and peers to complete and analyse the survey as they may find at least some of the problems that could be encountered.

Although respondents are used in pretesting it is often the evaluations done by the interviewers or administrators that provide the most information including practical problems in administering the survey and the length of time it takes participants to complete it. (Fowler Jr, 1995) Foddy (Foddy, 2001) highlights the questions that should be answered by all administrators/interviewers when carrying out pretest surveys taken from Converse and Prosser's (Converse & Presser, 1986) seminal work in this area:

- Did any of the questions seem to make the respondents uncomfortable?
- Did you have to repeat any questions?
- Did the respondents misinterpret any questions?
- Which questions were the most difficult or awkward or you to read? Have you come to dislike any specific questions? Why?
- Did any sections seem to drag?
- Were there any sections in which you felt that the respondents would have liked the opportunity to say more?

What a researcher expects to happen in a survey, or how a respondent might interpret a question is likely to differ from what happens in reality (Lazar et al., 2010) and therefore even in questionnaire pretesting it is recommended that an administrator sits with the participant while they repeat the survey (Langridge & Hagger-Johnson, 2009). Foddy (Foddy, 2001) warns of the problems with administrator overload in this situation however and recommends pretesting is carried out by pairs of administrators, one to conduct the survey and one to simply observe the whole process.

De Vaus (de Vaus, 1994) identifies three stages in the pretesting process:

- Question development.
- Survey development.
- Polishing the pilot test.

Question development involves issues such as establishing how to correctly phrase each question, ensuring that respondents accurately interpret the questions, and that, in closed questions, the range of responses is sufficient. *Survey development* involves analysing the responses received together with comments from the administrator to make improvements. *Polishing the pilot test* involves the final revision of all the questions, the reordering of the questions if required and, with respect to questionnaires, the final layout of the survey.

1.7 Validity

With a scientific study, validity is when a study accurately measures what it has set out to measure. Within survey research, it is the extent to which a measure relates to the underlying construct is trying to measure (Groves et al., 2009). Validity is often looked at in two ways, external and internal. External validity is the extent that the results of a study are generalisable to a group or groups other than the sample that participated in the study. Internal validity refers to the rigor in which the study has been developed and conducted. De Vaus states that there "*is no ideal way of determining the validity of a measure*" (de Vaus, 1994) however acknowledges and discusses the three main methods in which to accomplish it:

- Criterion validity
- Content validity
- Construct validity

Reliability, which will be discussed in more detail later in this section, is also a necessity to insure validity, however is well documented as not being sufficient in itself (Langridge & Hagger-Johnson, 2009; Oppenheim, 2005).

1.7.1 Content Validity

In its simplest terms, content validity is the verification that a measure actually measures what it is intended to do so. If a test was designed to measure science but all the questions were related to biology then the test would not have content validity as it neglected both chemistry and physics.

To measure content validity it is necessary to have the questions of a survey judged by experts in the field to ensure that it covers all aspects of the construct that is being measured and does not contain questions that are repeated or unnecessary. By using experts content validity is quite subjective in that is relies on their opinions however it is deemed necessary as it ensures important questions have not been missed (Langridge & Hagger-Johnson, 2009).

1.7.2 Criterion Validity

Criterion validity is measured by comparing how well a test correlates with another test, measuring the same construct, which has already been proven to be valid. This is useful if another measure does in fact exist however if it does, asks the question of why the new measure is being created. Often a test is created as no test exists to measure the construct in which case criterion validity cannot be used. If an existing method does exist it is important to ensure that it is itself valid as a test could be rejected or altered unnecessarily due to the method it has been measure against being invalid and therefore the result produced are different (de Vaus, 1994).

1.7.3 Construct Validity

Construct validity, in its essence, is the measure of observable or physical traits that supposedly reflect the underlying, theoretical, construct. It is the extent to which what is to be measured is actually measured. A crude example of this could be if we are measuring a person weight we would use scales and not something else such as a tape measure as it is accepted that scales are an accurate way of measuring weight whereas a tape measure is not. By knowing a person's height we cannot say how much they weigh.

To ensure that a piece of research has construct validity Carmines and Zeller (Carmines & Zeller, 1979) identify three stages:

- The theoretical construct must be defined.
- The empirical relationship between the construct and the measure must be examined.
- The result must then be analysed to show how it clarifies the validity of the construct being tested.

1.8 Reliability

One of the underlying themes within the literature so far in this thesis has been to improve reliability. Whether this be in understanding the problems in doing research with children, or in understanding the nuances of survey methodology, the end goal is to do things correctly whilst trying to minimise any problems that could be caused by the survey, the participants, or the administrator. All of the advantages and disadvantages of using specific techniques, reports of problems encountered (and their solutions), and literature on how we can reduce errors and biases help provide a route to a more reliable survey.

It is interesting how the stability of responses is regarded as a good measure of reliability (Groves et al., 2009), by looking at the consistency of responses between two questions asking basically the same question and yet redundancy in a questionnaire is seen as negative (de Vaus, 1994) being something that can frustrate participants and provide little benefit in the analysis of results. One of the easiest and most effective ways of gathering reliable responses is to use questions that have been proven reliable in other tests. If the participants or context of these questions are different to those of the survey being developed, they may be less reliable and need adapting in some way but they are a least a good starting point.

1.8.1 Test-retest Method

Perhaps the easiest measure of reliability is the test-retest method where that same questions are asked to the same participants over a period of time and the results are compared to see if they are consistent (Langridge & Hagger-Johnson, 2009; de Vaus, 1994). It is expected that a participant should answer the same questions the same way. Of course, this may not always be the case. The answer to some questions may change over time, particularly when related to prior experience or the use of technology as people are constantly interacting with technology in their daily lives and therefore even in a short space of time something may have occurred leading to a participant giving a different answer. This may lead a question to fail a test-retest test when in fact the question is reliable and it is the test that is incorrect.

Pilot testing is perhaps the best way of improving the reliability of a survey (as discussed previously) however where scientific tests can be performed to help confirm it then that can only be a good thing.