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**KidsQuestions:  
Assisting Children's Digital Information Seeking**

A thesis  
submitted in fulfilment  
of the requirements for the degree  
of  
**Doctor of Philosophy in Computer Science**  
at  
**The University of Waikato**  
by  
**NICHOLAS VANDERSCHANTZ**



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For Dad, who gave so much more than he took.

May this be but one small contribution of my own.

Your support, passion, compassion, and service-before-self teachings live on.



## **Abstract**

The work presented in this thesis aims at supporting children's digital information seeking. Children are known to have difficulties effectively using the information technologies that are available to them. We hypothesize that an interaction model specifically designed to align with the inquiry-based pedagogies common in education today would be beneficial for children's digital information search.

This thesis verifies this hypothesis by considering the example of the New Zealand education system. Within this context, a requirements analysis is undertaken involving children, parents, and teachers. Through a range of user studies, we identify the information seeking practices and the issues school children encounter when using contemporary digital information seeking technology. We found that contemporary internet search engines are used regularly during daily educational pursuits, and identify children's issues constructing and reconstructing search queries, identifying websites that will contain relevant information, and mistaken repeat visiting of websites. Internet search engines do not align with how children are taught to search for information. In particular, inquiry-based learning approaches taught in schools, are not appropriately supported by the available information search systems.

We begin addressing our hypothesis by identifying a target age range of children for which support for information seeking could be improved. We also analyse the interfaces of current commercial internet search engines to highlight the design decisions and to assist with the development of requirements. Activity theory is used as a lens to analyse the results of our studies in order to develop a list of requirements for an interaction model for children's information seeking. These requirements are then used to design our interaction model. To examine this interaction model we developed an interface

prototype, KidsQuestions. A final user study evaluates the effectiveness of our interaction model by exploring school children's use of our KidsQuestions prototype.

Our approach to designing a child-oriented interaction model differs from the common approach of using child-specific design devices such as colour, avatars, or results list simplification. Instead, our interaction model explores the requirements for children's information seeking by aligning with appropriate phases of the inquiry-based learning frameworks children are taught. By addressing the inquiry practices of children through interface elements that support query construction, query reconstruction, along with search planning tools, KidsQuestions can assist children's digital information seeking.

While our interaction model and interface prototype are developed and designed particularly with children in mind, KidsQuestions is not a system that should be considered solely a children's search engine. We believe that its features can be beneficial to children and adults alike, and future work will investigate the use of our prototype with a wider audience.

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# Chapter 1.

## Introduction

This thesis focuses on investigations to support children's digital information seeking.<sup>1</sup> While classrooms and homes are well resourced with a variety of contemporary information communication technology (ICT), children are known to have difficulties effectively using the information technologies that are available to them. This chapter motivates the objectives of this thesis, outlines our research questions and describes the structure of this document.

### 1.1. Motivation

Children are encountering ICT in both formal educational settings and in their daily recreational activities. Cooper (2005) describes this as the *omnipresence of technology*. In earlier work (Timpany & Vanderschantz, 2011), we observed how children in the New Zealand (NZ) classrooms used a broad range of technologies including digital whiteboards, laptop computers, mobile tablets, and personal touch screen interactive devices such as the iPod and iPad. This finding is in line with the wealth of recent research that explores the use of contemporary technology devices in the classroom including tablet and mobile devices such as iPods and iPads (ChanLin, Chou, & Hung, 2015; Falloon, 2015; Falloon & Khoo, 2014), interactive whiteboards (Alvarez, Salavati,

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<sup>1</sup> **Children:** In our published work to date we have interchangeably used the words "children" and "students". It has rightfully been pointed out to us by reviewers that everybody is someone's child, and that perhaps "child" or "children" are colloquial terms in the context of academic writing. While we could use a number of synonyms such: student, youth, young person, participant, or individual; we continue with the terms "child" and "children" in our published work, and in this thesis. We strongly feel this is the best representative noun for the age range of participants that this work specifically focuses on. Additionally we consider that our own work sits alongside the work of (for example) Alison Druin, Andrew Large and Diana Bilal, who all equally use the descriptive noun "child" or "children" in their own work.

Nussbaum, & Milrad, 2013; Hennessy & London, 2013; Mellingsaeter & Bungum, 2015), and voting tools (Moratelli & DeJarnette, 2014; Premuroso, Tong, & Beed, 2011; Scott, 2014).

Timpany & Vanderschantz (2011) reported a broad range of child-targeted software for skill-based learning (e.g. reading and maths). This too is evidenced in the recent literature with focus on reading and searching in digital libraries (Hilary Browne Hutchinson, Rose, Bederson, Weeks, & Druin, 2013; Wu, 2015; Wu & Chen, 2016), and novel teaching of mathematics and programming using tablets, software and haptic devices (Beschoner & Hutchison, 2013; Hegedus, 2013; Pyykkönen, Riekkö, Jurmu, & Sánchez Milara, 2013), and the use of software and devices for the creation of digital media such as video, photography, and digital storytelling (Tsai, Shen, & Lin, 2015).

Given the speed of technology evolution, much of the previous research into children's information seeking appears somewhat dated and only few investigations with children's information seeking appeared in the previous five years. Of the more recent works, we find Jochman-Mannek et al. (2010), who have compared children's search performance on four Dutch search engine interfaces designed for children, with their performance on Google. Foss et al. (2012, 2013) investigated children's use of Google in the home with a small scale interview and observation study series. Gossen and colleagues (Gossen, 2013; Gossen, Low, & Nürnberger, 2011; Gossen, Nitsche, & Nürnberger, 2012a) have studied children's use of a range of search engines including child-specific search engines, and adaptive search user interfaces (2015).

Most of the software used for inquiry-based learning (i.e. for information searching, browsing and use) was found to be generic software designed for adults, e.g., word processor, web browsers, and digitised reference books (Timpany & Vanderschantz, 2011). As we discuss in more depth in Section 3.3, research into children's Internet search showed that children have issues successfully using these technologies. Similar to our own argument, Gossen (2015) identifies a lack of current studies involving children's Internet searching. Gossen observed that due to the mixed ranges of ages studied since the early investigations of children's information seeking behaviour, the existing studies cannot be accurately compared. For these reasons we are unable to accurately extrapolate from these earlier findings to today's situation.

Overall, we found that limited research explores *information search interfaces for, or strategies used in, children's online search for information, either in the classroom or at home.*

## 1.2. Research Hypothesis and Questions

This section presents our research hypothesis and introduces the specific questions that will be addressed in this thesis. This thesis focuses on supporting children's digital information seeking and explores how systems might align with the inquiry-based pedagogies common in education today.

We hypothesise that an interaction design for information seeking that is tailored to children's inquiry-based learning practices can assist with children's information search.

To explore this research hypothesis, we identify the following four research questions, around which this thesis is structured:

**RQ1:** When and how are children conducting digital information seeking?

**RQ2:** What are the issues children encounter when using digital information seeking technology?

**RQ3:** What are the requirements for information seeking interfaces that will assist children's digital information seeking?

**RQ4:** Does the interface prototype introduced in this thesis assist with children's digital information seeking?

We approached the issue of children's information seeking from the perspective of how NZ<sup>2</sup> children are taught to structure their information seeking processes. Here we discuss each research question in more detail. Throughout the thesis, the research questions will be referred to as RQ1 to RQ4.

### 1.2.1. Children Conducting Digital Information Seeking (RQ1)

This initial research question aims to help develop the parameters for this research. To begin answering RQ1, examination of research solutions provided by various researchers with similar and related aims is required. This review of the existing approaches will identify opportunities for further contribution as addressed by this thesis. Exploration of this question will also highlight the nature of the modern classroom that is guided by inquiry-based learning frameworks.

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<sup>2</sup> The research discussed in this thesis is performed in New Zealand and some of the discussion herein focuses on facets of the NZ education system that may be unique. However, the research into children's information seeking that is presented is by no means limited to the educational context in which it is explored.

We identify three facets of this question that require exploration: the age at which children use information seeking technologies; where children use information seeking technologies; and what information seeking technologies children use. These questions guide the development of a survey that details the technologies supplied to and used by children so that examination of RQ2, RQ3, and RQ4 is possible.

### **1.2.2. Issues Children Encounter when Using Digital Information Seeking Technology (RQ2)**

Though there are a wide variety of technologies being used in today's classrooms and homes, it is not clear how these technologies are facilitating information seeking for children, nor whether children use these systems effectively. Known issues are reported in the literature, and these will be highlighted through the review of existing approaches outlined in how we will address RQ1. Our studies in this thesis will contribute to confirming if these issues persist in contemporary information technology use and explore the design of solutions for those that do.

We approach this research question through interview and observation studies with children, teachers and parents. The findings of these interviews and observations will be used to develop a list of requirements for a conceptual interaction model for a children's information seeking interface as explored in Research Question 3.

### **1.2.3. Requirements for an Interaction Model for Information Seeking Interfaces that will Assist Children's Digital Information Seeking (RQ3)**

To explore potential solutions for the issues identified by the findings of Research Questions 1 and 2 a requirements analysis for an interaction model for a children's information seeking interface will be undertaken. An Activity Theory approach to developing this list of requirements will be used.

An interaction model for an interface prototype that can assist with children's digital information seeking will be designed and developed to explore these requirements. Our interface prototype will be designed to support children's information seeking in ways that align with the inquiry-based learning we observe in schools and that resolve issues identified by RQ2.

#### 1.2.4. Evaluation of Interface Prototype Introduced in this Thesis for Assisting with Children’s Digital Information Seeking (RQ4)

Any concept for assisting children’s information seeking put forward as a potential exploration of the requirements set out in the previous research question needs to be evaluated to determine whether it meets the objective of assisting children’s digital information seeking. A study will examine the use of our interface prototype for children’s information seeking with school children in Years 5 to 8.

### 1.3. Structure of this Thesis

We outline here the structure of this thesis with particular reference to our research questions and the contributions of exploring our hypothesis.

**Chapter 2:** This chapter provides background for this thesis including an overview of pedagogy and learning theory pertinent to this thesis and the literature pertaining to educational technology. Further, we begin to answer the first research question; when and how are children conducting digital information seeking?

**Chapter 3:** This chapter discusses related work on information technologies and children’s information search behaviour. We identify advantages and issues of the systems discussed. We determine the current opportunities to contribute to the literature and provide evidence of the need for further investigation. This chapter further addresses our first research question.

**Chapter 4:** In this chapter, we identify the current technology access of NZ children in the school and home. A survey of parents and teachers of children throughout the primary school and intermediate school sectors of New Zealand is reported. This chapter further contributes to answering RQ1.

**Chapter 5 and Chapter 6:** These two chapters report the results of semi-structured interviews about children’s information seeking practices. Children and teachers from primary and intermediate schools describe children’s experiences searching for information and the issues they encounter. These two chapters further confirm our findings for RQ1 and provide answers to RQ2.

**Chapter 7:** This chapter analyses Google, Bing, and Yahoo! for the design decisions made by present search engine developers that can influence children’s information seeking.

The findings of this chapter are used to guide the development of further studies in this thesis as well as our interaction model for a children's information seeking interface prototype. In this chapter, we continue to develop answers to the second research question.

**Chapter 8:** This eighth chapter builds on the findings of the work outlined in Chapters 4 through 7 with a user observation study of children in Years 5&6 and 7&8 while these children use Google to find information. This chapter further answers RQ2.

**Chapter 9:** In this chapter, we detail the requirements for our interaction model and outline the design and development of our proof-of-concept interface prototype, KidsQuestions. Our prototype has been developed to answer RQ3 and RQ4 further.

**Chapter 10:** The penultimate chapter describes the user study and the findings of the investigation into the use of our interface prototype by NZ primary and intermediate school children. This chapter further answers Research Questions 3 and 4.

**Chapter 11:** Finally, this chapter summarises and concludes the contributions of this thesis, providing recommendations for information seeking interfaces for children's information seeking as well as providing guidance for future research opportunities.

## **Chapter 2.**

### **Background**

This chapter provides background for this thesis. To address the educational context in which this research is situated, concepts of pedagogy, learning, and developmental theory are discussed. We then highlight the pertinent facets of the New Zealand education system that influence our research. We also provide a review of the current classroom ICT literature.

The chapter is structured as follows: we first discuss pedagogy and learning theory pertinent to our research (Section 2.1), we describe the NZ school system (Section 2.2), and we finally examine the literature on technology use in the classroom (Section 2.3).

This chapter provides background to assist with addressing Research Question 1 (see Section 1.2): *when and how are children conducting digital information seeking?*

#### **2.1. Pedagogy and Learning Theory**

Science, philosophy, and psychology have been responsible for advancing educational practices, theories, and pedagogies. Mono-directional educational techniques are no longer the primary educational methods in schools around the world. Brand-Gruwel et al. (2005, p. 488) observe that students are instead “expected to construct their own knowledge, search and process information and combine it with their prior knowledge in order to tackle authentic tasks and problems.” This observation by Brand-Gruwel et al. gives a concise description of the modern teaching pedagogy, which embraces teaching practices as well as teaching philosophies.

### 2.1.1. Educational Pedagogy in NZ

The pedagogy of the New Zealand primary and secondary school curriculums are widely influenced by the educational theories of Vygotsky, Papert, and Piaget. These theorists describe teaching philosophies that require the student to construct their own problems and explore ways to solve those problems in an active and self-motivated manner (e.g., Shaffer, 2001). Victor Vygotsky is considered the father of *Activity Theory* (a socio-cultural descriptive theory that considers people and their work within their environment and culture). Seymour Papert is known for his work in *Constructionist Theory* (based on constructivist theory, constructionism espouses that students create mental models to understand the world around them, often through tangible real-world objects). Papert's predecessor and mentor Jean Piaget is credited with the theories of *Constructivist Theory* (which posits that learning is an active, constructive process where students create their own learning by linking prior knowledge through construction rather than acquisition).

The constructivist, constructionist and socio-cultural theories of learning and education that we discuss here are not directly referenced within the New Zealand Curriculum document (Ministry of Education, 2007) that we discuss in Section 2.2.3. Pedagogical practices and theories of this nature are encouraged and alluded to within the document itself, but not by name. We find this particularly in the section entitled 'Effective Pedagogy' of the NZ curriculum document (Ministry of Education, 2007, p. 34). However, numerous supporting papers and educationalists have discussed these pedagogies with relation to the New Zealand education system and practices (e.g., Alton-Lee, 2003; Hook & Mills, 2012; Ministry of Education, 2002; Sewell, 2007). Additionally, at this very university seminal papers in a teacher's education at undergraduate and postgraduate levels discuss these theories of learning as central in the education of prospective New Zealand teachers.

These educational and learning theories are relevant to our research because the subjects of our investigations, NZ schools, are implementing teaching and learning strategies based in these pedagogies. These strategies result in children who are expected to engage in learning situations that require sound information problem-solving skills. Further, as we show in Section 2.3 the implementation of ICT in NZ classrooms means that pedagogies influence the inclusion of information technologies will form a significant part of the everyday task completion of children in NZ classrooms. Therefore, both

digital and analogue documents are likely to be assessed on a daily basis, and thus, supporting the need for our on-going investigations.

#### 2.1.1.1. Inquiry-based learning

Inquiry-based learning is a common term which describes a teaching strategy used in NZ schools that implement constructivist and socio-cultural theories discussed in Section 2.1. Inquiry-based learning has been a central tenet of education for a number of years with a focus being present in the revised NZ curriculum, which was published in 2007. Hook and Mills describe inquiry-based learning as “a process of exploration, questioning, making discoveries, and testing the reliability and validity of these discoveries to create new understanding” (Hook & Mills, 2012, para. 1). They continue suggesting that many New Zealand schools have adopted inquiry-based learning approaches and methods using traditional as well as ICT resources. Hook and Mills also discuss how inquiry-based learning practices have been a part of many school workshops and a common theme of the Learning@School conferences which are a New Zealand Ministry of Education professional development initiative.

While inquiry-based learning is not stipulated or directly referred to in the curriculum document, it can be tied to the Values and Key Competencies sections of the NZ Curriculum. The Values section of the NZ Curriculum describes values, which are to be “encouraged, modelled and explored” (Ministry of Education, 2007, p. 10). Here we find listed seven values that students are expected to develop. One of these values is that of “innovation, inquiry, and curiosity, by thinking critically, creatively, and reflectively” (Ministry of Education, 2007, p. 10). Inquiry-based learning methods are inherent in this value and are clearly emphasized by this as a central value of the curriculum. The Key Competencies section of New Zealand Curriculum describes “capabilities for living and lifelong learning” (Ministry of Education, 2007, p. 12). The ‘Thinking’ competency requires students to use creative and critical thinking processes to become problem solvers who “actively seek, use and create knowledge” with “intellectual curiosity” being described as central to this competency (Ministry of Education, 2007, p. 12). As part of this competency the act of asking questions and challenging the basis of assumptions, perceptions and theories are encouraged. Further, the ‘Using language, symbols, text’ competency details the use of language, symbols, and texts in a range of contexts while understanding that meaning, language and symbol can affect understanding. This competency describes students who “confidently use ICT to access and provide information and to communicate with others” (Ministry of Education, 2007, p. 12). We

can see that in both the 'Thinking' and 'Using language, symbols, text' competencies inquiry-based learning is likely to be an appropriate model of teaching and learning.

There are many inquiry frameworks that teachers implement in classrooms. These frameworks may be models that have been developed by the school itself or may be models based on published inquiry models. Some of the models that teachers were familiar with when interviewed by Jan-Marie Kellow (2006) were Action Learning (Gawith, 1988), Big 6 (Eisenberg & Berkowitz, 1990), Research Cycle (McKenzie, 2000), and SAUCE (Bond, 2002). Kellow notes that a number of these inquiry-based learning models are in fact based on information literacy models, which she states "fit well with inquiry-based learning" (Kellow, 2016, para. 5).

Inquiry-based learning is often described as a "study into a worthy question, issue, problem or idea" (Friesen, 2014, para. 2). Inquiry-based learning should encompass investigation by the students and the creation and testing of new knowledge. Engagement, collaboration, communication and questioning by the students is actively encouraged in all inquiry frameworks that we encountered in our search of the literature.

Many of the inquiry frameworks describe a cyclic process with a number of phases. The number of phases and the level of detail of the activities and processes involved in these phases is the subject of numerous well-considered investigations over some years (e.g., Eisenberg & Berkowitz, 1990; Gawith, 1988; Kuhlthau, 2004; McKenzie, 2000). We would propose that if viewed from a very high level, the myriad of inquiry frameworks encompass three very broad phases that we describe loosely here. The initial phase encourages exploration of the problem space to develop the question of the investigation by the student. The second phase involves investigation of the problem and the solution by the student through collaborative multi-medium investigation and information seeking strategies. Lastly, the final phase requires delivery of the tested solution(s) to the teacher and to the students' peers.

Kellow states that "the heart of inquiry-based learning is the problem, task or question under investigation" (2006, p. 7) and it is this part of the inquiry process that is most relevant to this thesis. There are many processes to be undertaken by students and teachers during a full inquiry-based learning project. In this thesis, we do not attempt to satisfice all processes but to address issues that arise in the problem identification phase and the investigation phase, where digital documents are being assessed.

While not central to the investigations that we were undertaking, both teachers and students in our studies have alluded to facets of inquiry-based learning. It is noted by the researcher that participants in interview studies, as well as observation studies reported in later chapters, have alluded to specific inquiry models or parts of inquiry models such as inquiry cycles, questioning, and “big problems.”

### 2.1.2. Developmental Stages

A child’s problem-solving skills and intellectual development are known to develop throughout a child’s life. As with many forms of psychology research descriptions of the developmental or cognitive functions present in a given situation can be difficult to deduce or describe. Case (1985, p. 5) states “the central problem in the study of intellectual development is to explain the transformation that takes place, as time passes and these limitations [of an infants developing mind] slowly disappear.” Numerous theorists and researchers including Jean Piaget, Robbie Case, Andreas Demetriou to name but a few have asserted that this is an active process that develops in a series of stages. It is commonly agreed that intellectual development, like physical and motor development progresses from birth, throughout adolescence into early adulthood. Theorists including Piaget, Case (1985), Vygotsky (1978) and Demetriou (2011) have all offered views on these stages or phases that intellectual development progresses through. We provide here very brief discussion of a portion of this literature as a means to discuss the focus of our age-range targeting for this thesis and as such only the features of the developmental stages appropriate to our research are detailed.

Piaget’s two developmental stages of most relevance to our work are the *concrete-operational stage* (ages 7 to 11 or 12), and the *formal-operational stage* (ages 11 or 12 and beyond). Tuckett & Stoffle state that at the formal-operational stage children “have the ability to formulate, test, and discard the whole range of possible solutions to a problem until an appropriate solution is found” (1984, p. 62) and that this is essential to effective problem-solving. While Piaget’s specific stages with their hard boundaries are hotly debated in the literature, Siegler (2005) notes that Piaget’s “descriptions feel right” (p.27) and although his stages have shortcomings they give “us a good feeling for how children think” (p. 62).

While his evidence and stage names differ, Case (1985) builds on Piaget’s theories. Case argues that every child progresses through the same sequences of sub-stages and do so at the same rates during the same age ranges. Case’s stages and sub-stages fall into similar

age ranges to Piaget's own. Of note is Case's (1985) discussion that children begin to develop the ability to reason abstractly at approximately the age 11 or 12 years old which is the top of his *dimensional stage* and the bottom of his *vectorial stage*.

Demetriou et al. (2011) describe milestones rather than stages, where these milestones have similar age correlations to Piaget's stages. Demetriou's *logical necessity* milestone begins around the ages of 7 to 8 years and encompasses understanding "the multiplicity of knowledge and that the nature and 'quality' of knowledge depend upon the methods or processes generating it" (2011, p. 633). The subsequent milestone *suppositional thought* begins at approximately the ages of 13 or 14 years and encompasses grasping "the complementarity of methods and processes in knowledge production and revision" (2011, p. 633).

Taken together, these theories suggest that children at 12 or 13 years old and older can be or can become effective problem solvers, and thus, we argue that younger children will require further assistance with problem-solving. Should we consider information seeking and information problem-solving to be at the centre of the work for this thesis, we, therefore, hypothesize that there is a need for information seeking solutions to assist these younger information users. For this reason, studies discussed in Chapter 5 and beyond have specifically targeted children who were in year levels Year 5 through Year 8 with ages ranging from 9 to 13 years old.

## **2.2. The New Zealand School System**

We briefly describe here the structure of the NZ school system to assist with the reading of this thesis.

### **2.2.1. NZ School Years**

New Zealand government-funded schools at pre-high school level (i.e. Years 1 through 8) are typically separated into *primary schools* (catering to new entrant Year 1 through Year 6) and *intermediate schools* (catering to Year 7 and 8). In New Zealand Year 1 students typically begin school on the day of their fifth birthday. Children must be enrolled in primary education by the time of their sixth birthday. A child who enters school before the first of June in a given year will be considered a Year 1 in the year that they begin school. However, a child who enters school after the 1<sup>st</sup> of June will complete the remainder of that year and the year following as a Year 1 student; these students are sometimes described as a New Entrant, or Year 0.

Primary schools in New Zealand typically stream into individual year levels with a teacher facilitating a single year level in a classroom for the early years of primary schools. The middle and senior years of primary schools in NZ (Years 3, 4, 5 and 6) may be taught as streamed or composite classrooms. A composite classroom is found when a teacher facilitates two-year levels together (i.e. Year 5&6 students) in a single classroom. Composite classrooms are also typical in the intermediate schools (middle schools) in New Zealand with a teacher facilitating Year 7 and Year 8 students in a single classroom.

We focus only on Year 1 to Year 8 students in this thesis; New Zealand *high schools* continue offering education through until Year 13, with mandatory education until 16 years of age unless specific Ministry of Education permission is given to an individual.

#### 2.2.1.1. NZ School Dates and Terms

The New Zealand school year is broken into four relatively even school *terms* of approximately 10 weeks each. Each term is separated by roughly two weeks of school holidays, with a longer period of summer vacation in December and January. The school year typically begins in the final week of January or the first week of February and ends one to two weeks before Christmas. Where relevant, throughout this thesis, we will discuss the time of year that a study is performed concerning the school dates and terms.

### 2.2.2. New Zealand School Regions

The research conducted for this thesis is undertaken in the Waikato School Region of New Zealand. At the time of this research, the Waikato School Region had 252 schools at primary or intermediate school level (Education Counts, 2013).

#### 2.2.2.1. Rural and Suburban Schools

Throughout this thesis, we will refer to both suburban and rural schools. Differing from the Suburban Schools, Rural Schools in New Zealand typically have a much smaller enrolment and are far more geographically isolated than suburban schools. Due to the smaller school roll of a rural school, it is typical for a single teacher to conduct a composite of year levels spanning more than the usual two-year levels seen in suburban schools. It is also not unusual for the teaching to be performed by a single teacher with all year levels (for example at a rural primary school, Years 1 through 6) in a single classroom.

We used the *Directory of Schools* (Education Counts, 2013) to estimate that approximately 7% (176 of 2503 schools) of the total number of New Zealand schools listed are Rural Full Primary, Contributing, Composite, or Intermediate schools with rolls less than 30 students. We also estimate that at the time of writing approximately 9% (23 of 252 schools) are Rural Primary, Full Primary, Contributing, Composite, or Intermediate schools with rolls less than 30 students in the Waikato region of New Zealand.

Rural schools are not unique to NZ, and an agreed definition of rural schools and rural education has long been lamented as discussed by Rios (1988). For a succinct description of rural schools and rural education in New Zealand, Nancy Swarbrick (2015) describes country schooling in NZ in *Te Ara – The NZ Encyclopedia*.

#### 2.2.2.2. Decile

The Decile Rating System (Ministry of Education, n.d.) in NZ is the measure used to describe the socio-economic status of the homes within a school's catchment zone. Each publicly funded school in NZ is given a decile rating with a range from 1 to 10. The decile ratings are calculated based on the five-yearly censuses conducted in NZ. A Decile 1 rating indicates a high proportion of students will come from low socio-economic communities while a rating of 10 indicates a low proportion of students from low socio-economic communities. When inviting participant schools to contribute to studies during this thesis, the Decile Rating System has been taken into consideration in an attempt to fairly include a cross section of NZ schools in our research.

#### 2.2.3. The New Zealand Curriculum

The *New Zealand Curriculum* is a government mandated education framework and is the official and foundational policy that governs teaching, learning, and assessment for all New Zealand children. This policy document is called The New Zealand Curriculum (Ministry of Education, 2007) and is produced by the NZ Ministry of Education. The current curriculum document that we refer to within this thesis was published in 2007 and is the current curriculum document for the NZ education system. Curriculum statements and levels of achievement have been developed by the Ministry of Education to guide teachers in developing specific learning objectives for their own teaching practices and classrooms (Education Review Office, 2006).

The New Zealand Curriculum has eight essential learning areas that describe the material that NZ schools are expected to cover during a child's education. Eight levels of

achievement cover five-year-olds at level 1 through to 17 and 18 year-olds at levels 7 or 8. The eight essential learning areas of the New Zealand Curriculum are English, the arts, health and physical education, languages, mathematics and statistics, science, social sciences, and technology.

In line with pedagogical practices (described in Section 2.1), inquiry-based learning practices (discussed in detail in Section 2.1.1.1) are encouraged throughout the curriculum and across the full range of levels of achievement. Digital and information literacy is, therefore, a key portion of children's required learning during their education in New Zealand. While this requirement for digital literacy and information literacy is a given, specific discussion of these facets of technology and English education are missing from the Curriculum.

The *Literacy Learning Progressions* (Ministry of Education, 2010) is a set of resources to support the NZ Curriculum. These resources outline key literacy competencies and levels of proficiency of children at various stages of their progression through the NZ school system. According to the NZ Curriculum under the *Listening, Reading, and Viewing* section of the *English* curriculum, students at Level 2 (ages 7 to 10 years), are expected to "show some understanding of ideas within, across, and beyond texts" (Ministry of Education, 2014, para. 4). This ability to use texts, both printed and digital comes with a requirement to also be able to find texts. Finding texts today requires a broad range of information discovery tools, both conceptual and physical and will likely require the user, in this case, a child, to be able to search, locate, triage, and assimilate detail from within. In the fields of computer science, this is described in the broadest sense as information behaviour and will be discussed in Chapter 3.

The New Zealand Curriculum (Ministry of Education, 2007) does not refer directly to information behaviour, information literacy, or use of technology to solve information problems. Further, there is no mention throughout the curriculum of digital documents or the use of ICT for the search or use of information. Within the *Technology* curriculum, there is no mention of information seeking, information use, or information strategy. In contrast, the United Kingdom's February 2013 Draft Computing Programme of Study (Department of Education, 2013) specifically references analysis and evaluation of data and information for Key Stage 2 (ages 7 to 11 years) requiring the inclusion of educational training for information literacy in its ICT curriculum.

The lack of discussion of information use with digital documents nor information seeking or searching in the NZ Curriculum is indicative of the lack of NZ focussed related work in the area of this thesis.

## **2.3. Technology in the Classroom**

Education practitioners, as well as the education literature, refer to the subject of information technology as ICT (*information communication technology*). The terms *information resources*, *technology resources*, and *information assets* or *ICT assets* are often used interchangeably.

### **2.3.1. ICT Debate and Controversy**

The study of ICT is closely related to pedagogy and has long formed debate within the education literature. In the 1960s, Papert and others suggested using the computer as a tool to enhance learning (Leaning, 2010). Initially, ICT was viewed as a means for teaching science and other technology-based subjects. However, it became apparent through Papert's work that the computer could be a tool for creative learning in a range of academic disciplines for children.

During the 1980's, the Piagetian theory of real world experiences and the constructivist views of learning were used to argue against computers in the educational environment. Computers and computer software were considered contrary to the real world and "too abstract" (Yelland, 1999, p. 5). It is now largely agreed that ICT alone cannot replace good educational practice as Piaget argued. However, it is argued that ICT should be part of a "blended" solution, in which technology is "integrated into a coherent educational program" (Leaning, 2010, pp. 240–241) alongside appropriate teaching interventions. Shaffer reports that the results of "literally hundreds of studies reveal that classroom use of computers produces many, many benefits" (2001, p. 582). In citing early studies by (Clements & Nastasi, 1992; Collis, Knezek, Lai, Miyashita, & Pelgrum, 1996; Lepper & Gurtner, 1989), Shaffer further claims that students learn more and report increased enjoyment in school when they receive "computer assisted instruction" (2001, p. 582).

The research for this thesis focuses on the use of educational ICT as a tool for information seeking and use in the form of search, retrieval, and consumption of information. Differing from our own work, the literature often examines the use of high-level or globalised concepts and resources such as a computer, an Interactive White Board (IWB),

an iPod Touch or other such hardware in the classroom. These are primarily examined as methods for distributing or delivering content or educational outcomes. In contrast, our research will seek to understand information behaviour processes and develop software tools for children's information search. These tools will not be designed for content creation or information dissemination, but to provide solutions for children's successful information search and information problem-solving.

Sims states, "there remains much to learn about the impact of interactivity on learning within the context of computer-based applications" (1998, p. 630). Twelve years on, Tamim et al. (2011) argue that the debate about technology's role in education has still not been fully resolved, even after numerous studies at all levels of the education system globally that date as far back as the 1960's. It seems fair from these two researchers alone to argue that there is more to be done in the realm of educational technology use and that our own research purposeful.

### **2.3.2. ICT in Education**

Ham et al. (2010) argue that the 1998 NZ Ministry of Education publication *Interactive Education* (ICT Strategy Reference Group & New Zealand, 1998) was the beginning of the NZ government's initiative to advance teachers' and principals' professional development around ICTs. They also see this as the point at which the government began to assist schools in building technical infrastructures. Today children are encountering information seeking opportunities both in formal educational settings and in their daily recreational activities. The breadth of information search tools and ICTs available in the classroom includes a variety of digital books on CD-ROMs, eBooks, and Internet resources, OPAC systems, along with specific educational software on a range of desktop and mobile computing devices. We previously observed that children in New Zealand classrooms use this full range of technologies during their daily education (Timpany & Vanderschantz, 2011; Vanderschantz, Hinze, & Cunningham, 2014a).

An increase in ICT research investigations in NZ schools appears to have been occurring over the previous 15 to 20 years (e.g., Probert, 2009; Wright, 2010). Pelgrum (2001) identifies the rise of the Internet and the world wide web throughout the 1990's as a key factor that spurred many governments and policy makers to invest in ICT in schools as well as research to support this initiative.

In earlier work (Timpany & Vanderschantz, 2011), we observed how children in the New Zealand (NZ) classrooms used a broad range of technologies including digital whiteboards, laptop computers, mobile tablets, and personal touch screen interactive devices such as the iPod and iPad. This finding is in line with the wealth of recent research that explores the use of contemporary technology devices in the classroom including tablet and mobile devices such as iPods and iPads (ChanLin, Chou, & Hung, 2015; Falloon, 2015; Falloon & Khoo, 2014), interactive whiteboards (Alvarez, Salavati, Nussbaum, & Milrad, 2013; Hennessy & London, 2013; Mellingsaeter & Bungum, 2015), and voting tools (Moratelli & DeJarnette, 2014; Premuroso, Tong, & Beed, 2011; Scott, 2014).

Timpany & Vanderschantz (2011) reported a broad range of child-targeted software for skill-based learning (e.g. reading and maths). This too is evidenced in the recent literature with focus on reading and searching in digital libraries (Hilary Browne Hutchinson, Rose, Bederson, Weeks, & Druin, 2013; Wu, 2015; Wu & Chen, 2016), and novel teaching of mathematics and programming using tablets, software and haptic devices (Beschorner & Hutchison, 2013; Hegedus, 2013; Pyykkönen, Riekkilä, Jurmu, & Sánchez Milara, 2013), and the use of software and devices for the creation of digital media such as video, photography, and digital storytelling (Tsai, Shen, & Lin, 2015).

Much of the research pertaining to ICT in schools is predominantly influenced by investigation of high-level concepts and hardware or software resources such as a computer, mobile device or another ICT learning tool. Studies conducted in NZ examine concepts common to the international perspective. These studies primarily examine methods for distributing or delivering content or educational outcomes rather than during information seeking opportunities and often focus on teachers use of ICT (e.g., Jones, Harlow, & Cowie, 2004; Jones & Moreland, 2004) or ICT in preschools (Terreni, 2010) and high schools (e.g., Lai & Pratt, 2004; Probert, 2009).

Our research focuses on children's use of ICT for information seeking and use. Successful use of information and technology for information search is integral to current educational practices at primary and secondary schools. We argue that information search is also a fundamental part of adult society as a whole. Further investigations into the specific issues children have with information technology for information search, and use is required and forms a central tenet of this thesis. The literature does not report the contemporary availability of ICT tools in homes and classrooms across the relevant target

age ranges for our studies. Nor does the literature discuss the tools that are required, nor the issues met by children during information seeking and information use in the classroom and home. Related work in this area from the perspective of the information sciences is further addressed in Section 3.1 of this thesis.

## 2.4. Chapter Summary

This chapter explored the context of our research in the New Zealand educational environment through discussion of the pedagogical and educational theories related to this research. We then offered background discussion of the NZ education system and curriculum. Finally, we identified gaps in the research that investigated ICT in schools.

The NZ education system encourages inquiry-based learning strategies by children across the schooling years. This requires active use of information seeking practices and technologies. It is not revealed in the literature to what extent and how information seeking takes place in today's classroom or home. This strengthens our argument for a need for exploration of an interaction model for children's information seeking that aligns with children's information seeking practices.

The section on ICT in education is indicative of the types of technologies being used within education today. This literature review has not revealed a complete picture of what is currently being used for information search in the classroom or home by children. The common focus in the field of education has been the use of ICT tools for content creation as opposed to information-search, information-use or information-problem-solving. This content creation focus indicates further opportunities for research investigating what is currently being used in the classroom and home by children for information search and information use as well as investigations exploring how to design these information seeking technologies.

This chapter has begun to address RQ1 (see Section 1.2), exploring when and how children are interacting with information technology and resources.

**RQ1** seeks to discover the ages at which children are using information technologies. Age range targeting of the studies pertaining to this thesis and future investigations is a relevant concern because reading, comprehension, and literacy skills vary drastically across the schooling years. Therefore, a suitable year level or year level range to target is needed for this and future studies by ourselves and other researchers. These year level

ranges should be based on an understanding of appropriate educational outcomes and access to technology for the age of the students targeted.

While we observed here that the literature on ICT use in schools is sparse, we identified developmental theory that suggests that targeting children who are not currently in the concrete operational stages of development (i.e. children who are not expert problem solvers) is likely appropriate for future studies.

RQ1 also seeks to uncover what information seeking technologies children are using. We found that information seeking technology requires further empirical investigation to reveal clearly what technology is currently used within the classroom and home.

## Chapter 3.

### Related Work

This chapter discusses related work of investigations into systems and software to support children's information seeking needs. This encompasses information behaviour, information seeking and problem-solving, and children's information search interfaces. Despite the broad literature on children's information search and retrieval, it is still unclear how children conduct a search using contemporary information search interfaces in educational settings and what is required in a system to support children.

The goal of this chapter is to outline the literature relevant to our work and to show the relevance of our work within the field of Information Science.

The chapter is structured as follows: we first describe information behaviour (Section 3.1), we next discuss children's information seeking studies (Section 3.2), and we finally examine interfaces for children's information seeking (Section 3.3).

This chapter further addresses the related work pertinent to RQ1 (see Section 1.2): *when and how are children conducting digital information seeking?*

### 3.1. Information Behaviour

A child's success with digital information and information technology use can be considered to be the child's ability to browse, search and find information. As discussed in Section 2.1.1.1, successful information and technology use for information seeking is integral to current educational practices.

*Information behaviour* is the term used to describe the high-level processes involved with seeking and searching for information, while *information literacy* and *information problem-solving* is often used to describe the steps to complete information seeking tasks.

### **3.1.1. Information Behaviour Models**

Wilson (1999, p. 249) describes information behaviour as “those activities a person may engage in when identifying his or her own needs for information, searching for such information in any way, and using or transferring that information” (p. 249). Therefore, information behaviour is the broad description for the wide variety of activities and circumstances in which people are engaging with information.

Our research focuses on information seeking behaviour and specifically children’s information search behaviour. In his extensive survey of the information seeking behaviour literature, Wilson (1999) acknowledges that many models of information search behaviour exist. He discusses his own three models of information behaviour (1981), Dervin’s sense making theory (1983), Ellis’s behavioural framework (1989), Kuhlthau’s ISP model of information seeking (2004), Saracervic’s model of the IR process (1996), and Spink’s model of the IR interaction process (1997).

We will briefly outline Ellis and Kuhlthau’s models as these most elaborately describe the processes involved in seeking and searching for information. Ellis (1989) model describes seven features or stages of information seeking. These features as he calls them are *starting*, *chaining*, *browsing*, *differentiating*, *monitoring*, and *extracting*. In 1993 Ellis, Cox and Hall extended Ellis’s 1999 work to include *verifying* and *ending* along with the original six features of information seeking behaviour (David Ellis, Cox, & Hall, 1993).

Kuhlthau’s *Information Search Process* (ISP) model (2004) comprises six stages: initiation (the presence of an information need), selection (choosing a topic of investigation and a process for investigation), exploration (early search for information, typically progressing from general to specific), formulation (development of a focus that provides direction to the information collection and relevance decisions), collection (selecting information pertinent to a task and taking detailed notes) and presentation (organising information for giving to others).

We will use Kuhlthau’s (2004) ISP model as a model to compare the findings of this thesis again in Chapter 5. Kuhlthau’s model is appropriate because of its simplicity and its focus on information activities and information needs. The three phases of the ISP model most

pertinent to this thesis are those of exploration, formulations and collection. The phases before and after this have not directly been investigated during our studies.

### 3.1.2. Information Literacy Frameworks

For children to develop successful information behaviour strategies, they must learn suitable information literacy skills (Bawden, 2001; Leaning, 2010). Moore (1995) and Brand-Gruwel et al. (2005) discuss the need for people to be able to identify their information needs and to locate, identify, collate, and organise appropriate sources. They must be able to extract and combine information from these sources into sound solutions to their identified needs. Brand-Gruwel et al. (2005) describe this as the definition of *information literacy* or *information problem-solving*. Further, Marchionini describes information seeking as a “special case” of problem-solving, which “includes recognizing and interpreting the information problem, establishing a plan of search, conducting the search, evaluating the results, and if necessary, iterating through the process again” (Marchionini, 1989, p. 54).

The areas of information literacy and digital information literacy are well established: Enochsson (2005) notes a number of studies (Bilal, 2002c; Bilal & Kirby, 2002; AB Enochsson, 2001, 2003; Hultgren & Limberg, 2003; J. Schacter, Chung, & Dorr, 1998; Slone, 2004; Watson, 1999) that show that children lack information seeking experience and, therefore, require training and teaching to assist with development of their information literacy. Enochsson (2005, para. 3) states “Eisenberg and Berkowitz call information literacy an essential life skill.”

Our research focuses on information seeking which is influenced by information literacy. Information literacy frameworks often consider the functional procedures required when searching and seeking and offer steps an information user may follow during a search. Information literacy frameworks have been developed to aid teachers and educators in assisting children to develop information problem-solving skills.

Enochsson (2005) discusses the work of Rask, who in 1999 introduced *the 4th basic skill* into the Swedish curricula. Rask's 4<sup>th</sup> basic skill is otherwise known as Information Literacy. In Sweden information literacy now stands alongside the 3 traditional *basic skills* - common around the world - reading, writing and arithmetic. Enochsson also discusses the work of Eisenberg & Berkowitz (1990) who developed the *Big6* approach to teaching information and technology skills. The six steps in this Big6 approach are listed as task

definition, information seeking strategies, location and access, use of information, synthesis, and evaluation.

Such frameworks for analysis of an information need are a requirement for successful completion of an information search task. Tuckett & Stoffle discuss the eight phase *Question Analysis* framework, along with the three-stage *learning cycle* framework and *guided design* when a student is given a problem and works through a series of tasks with an instructor to solve this problem (Tuckett & Stoffle, 1984, p. 61). One can clearly see the connection of information literacy to inquiry-based learning models discussed in Section 2.1.1.1 where it is noted that Kellow (2006) links inquiry-based learning to information literacy.

The pedagogical approaches to training or teaching of information literacy skills are outside the scope of this thesis. However, we propose that alongside the development of tools to support children's information seeking, classroom education of strategies for using these tools will be required to enhance children's digital information literacy.

### **3.2. Children's Information Seeking Studies**

Studies that explore children's information seeking behaviour began to appear in the 1980's alongside the work that investigated adult's information seeking behaviour that had existed for some time previously. Colleen Cool claims that the "decade of 1980-1990 witnessed an explosion of computer-based information systems" (Cool, 2004, p. 1). She continues to state that it is "not an exaggeration to say that electronic information systems of all varieties have changed the way we live and think" (Cool, 2004, p. 1). Andrew Large describes the emergence of digital information resources appropriate for inclusion in educational environments as happening in the mid-1980's and considers this to be the reason for the advent of information seeking studies with children from this time onward (Large, 2004). Early children's information seeking behaviour studies explored use of electronic databases (e.g., Marchionini & Teague, 1987; Spavold, 1990), OPACs (Online Public Access Catalogues) (e.g., Dinet, Favart, & Passerault, 2004; Solomon, 1993), digital libraries (e.g., Druin et al., 2001, 2003), and CD-ROMs (e.g., Large, Beheshti, & Breuleux, 1998; Shenton & Dixon, 2003). For a detailed review of the theories, models and issues related to children's information seeking the thorough work encapsulating work spanning the two decades from 1980 to 2004 presented in *Youth Information-Seeking Behaviour* (Chelton & Cool, 2004) is highly recommended.

Knight & Littleton (2015) amongst others (e.g., Bartlett & Miller, 2011; Livingstone, Bober, & Helsper, 2005) point to a number of studies that report that children across a wide range of ages experience difficulties with many facets of digital information seeking. Findings of these numerous studies show that technological capability, searching, selecting, and triaging all play a part in the issues experienced by children.

### **3.2.1. Methods**

Many quantitative and qualitative methods have been used when exploring children's information seeking in both analogue and digital environments. From the related work we can see that questionnaire (Bilal, 2000, 2001), and individual and focus group interview (Bilal & Kirby, 2002; Branch, 2000; Hirsh, 1999; Madden, Ford, Miller, & Levy, 2006) instruments have been described; observations of individuals and groups of users (Bilal, 2000; Gross, Dresang, & Holt, 2004; Jochmann-Mannak et al., 2010) using analogue and digital resources have been identified; and finally lab environments and naturalistic environments have all been investigated. Many of the empirical studies described in this chapter can be seen to comprise multiple measurement techniques in drawing their conclusions.

Early studies of children's digital information seeking described by Cool (2004) in her review of the literature are outlined as investigations of the effectiveness of the technologies. Cool suggests that the research that she synthesizes was framed in the standpoint that the electronic information retrieval systems would have positive effects on the children's ability to search for and find information. Goals of these early studies were to investigate children's ability to use the tools.

Cool further describes the division of these early studies into "system-oriented" studies and "user-oriented" studies (Cool, 2004, p. 9). System-oriented studies she describes as those, which evaluated the ability of young users to retrieve information effectively from electronic information systems with a focus on the effects of the system on the user. User-oriented studies are described as studies that investigate the information searching behaviours of the children and impact that electronic systems have on these. Thus, system-oriented research is interested in the ability to use the system while user-oriented research is concerned with the cognitive and problem-solving processes that take place during the utilization of the system. Often system-oriented research intends to improve the system or make recommendations for future systems while user-oriented research

may both recommend improvements to the systems but also the empowerment of users with information seeking abilities.

Interview studies both with children and with parents or teachers are reported in the literature.

Studies have measured query<sup>3</sup> constructions, including use and number of keyword searches, natural language searches, miss-spellings, repetition and text entry (Bilal, 2000, 2001, 2002b; Large, Beheshti, & Moukdad, 1999; Large, Beheshti, & Rahman, 2002b; J. Schacter et al., 1998). Researchers have counted the number of pages visited and revisited as well as the looping of search paths by children (Bilal, 2000, 2001, 2002b; Large et al., 1999, 2002b; J. Schacter et al., 1998). Research has also considered the time to complete a search task and the time spent within individual pages (Borgman, Hirsh, Walter, & Gallagher, 1995; Zhang, 2003). Interaction and use of the search engine and the resulting pages have also been reviewed (McCrorry Wallace, Kupperman, Krajcik, & Soloway, 2000; J. Schacter et al., 1998).

Very few studies of children's information seeking behaviour have investigated measures of *success* or assessed the *quality* or *relevance* of the results returned by the participants when considering the meaning of the results. Bilal's (2000) *Web Traversal Measure* formula is one method which was developed to quantify effectiveness, efficiency and quality of children's web moves. Alternatively, Schacter et al. (1998) developed a measure of the relevance of the documents bookmarked by students and experts. It must be noted that both of these studies required an expert evaluation of the resulting websites to determine accuracy and effectiveness of the results of the information seeking by the study participants. These few studies that have measured relevance have tended to be studies of information behaviour compared to studies of issues encountered during information seeking and therefore differ compared to the types of studies undertaken for this thesis.

It is typical for study methods in this area to be approaches that provide only a snapshot of the situation. Longitudinal studies are unique in this area and limited. Future work,

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<sup>3</sup> We use the words Search Query and Search Term interchangeably throughout this thesis. Both terms are used to describe the string entered into a search box by a user. Search Term was found to be a well understood, and often used noun by participants in our interviews in Chapter 5 and Chapter 6 of this thesis while the word search query is often used in the literature.

our own future work included, will need to explore the longitudinal and generalizable nature of the findings of these studies.

### **3.2.2. Size and scope of research studies with children**

It is typical for studies involving children to involve relatively small numbers. This is often due to the many ethical considerations and constraints involved in developing a study involving minors, schools and educators. Bilal (2004) notes the many challenges involved with federal regulations, institutional review boards, ethical consent and approval as well as pre-study paperwork loads which all contribute to producing barriers to researchers involving young people in their studies. Gossen (2013) also discusses the difficulties involved with including children in studies that investigate children's digital information seeking interfaces. Gossen (2013), like ourselves, notes the need for collaboration with the principals, and teachers of primary schools as well as the explicit permission of students and caregivers of the primary level children. She notes how this is different for naturalistic studies compared to lab-based user studies, which likely require less overhead of the researcher in developing and conducting user studies. Gossen reports that studies with 10 to 30 participants are common within this field of children's human-computer interaction research (p. 13).

Gossen & Nurnberger (2013) argue that studies have not suitably segmented the range of ages investigated stating that "researchers view children as a consistent user group" (p. 756). Bilal states that "children are not 'small adults' but an entirely different user population with their own culture, norms, complexities, curiosities, interest, abilities and information needs" (Bilal, 2004, p. 285). Additionally, Gossen (2012b) describes primary school children as being a target market with many challenges worth pursuing. Gossen & Nurnberger (2013) argue for narrow targeting of age groups in user interface studies and in the development of interface designs for children. Their work investigates adaptive search user interfaces for solving issues related to children's digital information seeking (Gossen, Nitsche, Vos, & Nürnbergger, 2013).

### **3.2.3. Information Seeking and Schools**

Most of what is known is dated and focuses on children searching for printed artefacts, (e.g., Moore, 1995), or using web search engines that utilise less robust search algorithms, (e.g., Bilal, 2000), than available today. More recent investigations have included larger samples of anonymous log data from naturalistic inquiries of information search logs,

(e.g., Duarte Torres, Hiemstra, & Serdyukov, 2010a), from which information needs and purposes are difficult to ascertain. Similarly, recent studies that include qualitative as well as quantitative analysis have predominantly investigated search in the home, for example (Druin, Foss, Hutchinson, Golub, & Hatley, 2010) rather than in an educational setting.

It is often argued in the literature that there is a need for teaching and training for information literacy since children often lack experience or practice in information seeking (e.g., Bilal, 2002b; Bilal & Kirby, 2002). De Vries et al. (2008) argue that web searching must be embedded in a learning task so that learners will develop personally relevant questions, so they might learn to search the web reflectively. Moore's (1995) work indicates that project exercises used in early school years, which are intended to develop students understanding of the use of information, may not currently meet children's needs. Moore suggests that students at this young age often require suitable intervention by an adult or expert-information-user. Druin et al. (2009) state that even though children in their study may have been exposed to computers for most of their lives, difficulties with spelling, typing, search query formulation, and analysis of search results, may still prevent children from finding or using information.

Should children not learn sound information literacy skills, there may be a negative flow-on effect to later education and employment. Moore points to a number of investigations (e.g., Rudduck & Hopkins, 1984; Tuckett & Stoffle, 1984) which show that school leavers often have limited abilities to find or use information successfully.

Penny Moore states that "detailed descriptions of the cognitive demands of information problem-solving as experienced by children are scarce, most being written from the adult viewpoint" (Moore, 1995, p. 2). Moore's work with children indicates that project exercises used in early school years which are intended to develop students understanding of the use of information may not currently meet children's needs. Moore suggests that students at this young age often require suitable intervention by an adult or expert-information-user. One such intervention may be *guided design* such as described by Tuckett & Stoffle (1984). Bilal & Kirby's work with children and adults searching the Internet (2002) is some of the earliest to show that children do indeed have different cognitive abilities, information seeking needs as well as information searching and problem-solving strategies.

Moore (1995, p. 17) suspected that children in her study (6<sup>th</sup> Grade, NZ intermediate school) were expecting to find the exact information they sought in the exact format they needed it. Students seemed to expect the title of the book to tell them what was in the book. For example, one subject was looking to understand what birds ate. In searching the titles of books could not identify a book that was entitled with the word “eat” and took this to indicate that books of this nature or with this information do not exist (Moore, 1995, p. 15). In his 2004 work, Large also observes that children expect sources to produce results with content and vocabulary that matches what they require for their school project and in the way that they have searched for it. Large reports that children “express frustration if they cannot find the precise information they are seeking” (2004, p. 303).

Moore (1995) concludes that students in her study appeared to have a sole method of searching for information for their project task; “identify its keywords, look up the subject index for a Dewey number, go to the shelves and find the answer in the exact form it is wanted. If any part of that sequence failed they often seemed surprised and confused” (1995, p. 28). For digital information seeking this breakdown when a strategy fails is also present. Researchers (Bilal & Kirby, 2002; De Vries et al., 2008) note that children are rarely able to develop synonyms or alternate words when their initial attempt fails. It is often discussed that adult intervention from a teacher, librarian or domain expert is sought by children should their own strategies fail (Gross, 2004).

Moore proposes a pedagogical approach to this issue being that educating students of the problem-solving nature of their project and encouraging the understanding that there are many ways of reaching a solution and finding information. Moore suggests that students must learn to make mistakes, take time and construct answers to problems from multiple sources and through multiple strategies.

#### **3.2.4. Issues when Conducting Digital Information Searches**

As discussed previously in this chapter, children’s information seeking behaviour provides many unknowns. Studies have investigated the issues children experience when creating query constructions. These studies have included investigations of the types of queries, miss-spellings, repetition and text entry (Bilal, 2000, 2001, 2002b; Large et al., 1999, 2002b; J. Schacter et al., 1998). Researchers have counted the number of pages visited and revisited as well as the looping of search paths (Bilal, 2000, 2001, 2002b; Large et al., 1999, 2002b; J. Schacter et al., 1998) to understand what features of

information display effect information search and information use. Children interacting with search engines and the resulting web pages has also been reviewed (McCrary Wallace et al., 2000; J. Schacter et al., 1998).

Our research focuses primarily on the information seeking interfaces that assist with search and seeking for information rather than use, evaluation or interpretation of information sources. For an introduction to research that has explored primary school children's information evaluation and interpretation see for example Kafai & Bates (1997), Schacter, Chung, & Door (1998), Hirsh (1999), McCrary Wallace, Kuperman, Krajcik, & Soloway (2000) and Large (2004). These various studies discuss children's inaccuracies in accessing the validity, authoritativeness or correctness of information. Additionally, these studies showed that children spent significant time searching for information and scarce time assessing the information once a source or website was resolved upon. Kafai & Bates (1997) who worked with children across the elementary school age range report that children were quick to assume everything they found was accurate and only after some time did children begin to differentiate marketing material from informative sources. Kafai & Bates (1997) specifically noted difficulties for the younger children at Years 1 to 4 which is below the age range we focus on in our studies. Further, information use (Marshall & Bly, 2005; Stelmaszewska & Blandford, 2004) by children may form interesting research within this context and is an area yet untapped. Information and document triage is described as the investigation of multiple documents to analyse the appropriateness of each for the information needs of the user. We classify this work as relevant to the development of children's information literacy skills and a current gap in this literature space yet outside the primary focus of this thesis.

#### **3.2.4.1. Search Query Construction**

Large (2004) noted that for children to effectively use text based web search engines, the child was most often required to use keywords (Large, 2004). He pointed out that children needed to be able to identify one or more effective keyword search queries that fully encapsulated their information need and that matched the words used in web pages relating to their information problem. Large further reported that in 2004 few search engines accepted natural language question or sentence queries. Generating an appropriate set of keywords is often difficult for children; they tend to use keywords that were used in the initial discussion of a project or that a teacher gave to them at the beginning of a project.

As web search engines have developed, natural language queries have become suitable for some search instances, however, in 2010, Van der Sluis & Van Dijk (2010) noted children's difficulty in identifying when a Boolean Logic search would be more appropriate than the use of a Natural Language Query Construction. These more recent results are in line with difficulties experienced by children using web portals and digital information resources in the early information seeking literature (Bilal, 2000, 2001; Kafai & Bates, 1997; Marchionini, 1989; J. Schacter et al., 1998; Spavold, 1990).

#### 3.2.4.2. Search Query Reformulation

A further confounding issue with text-based search interfaces is that children are rarely able to develop synonyms or alternate words when their initial attempt fails (Bilal & Kirby, 2002; De Vries et al., 2008). A lack of vocabulary or domain knowledge is known to hinder query formulation (Druin et al., 2010). The vocabulary problem is a widely accepted information retrieval (IR) problem for both children and adults. Bilal (2000) observed that keyword searches by children were either too narrow or too broad for their information need. Spelling difficulties further contribute to the query construction issues for children. Many studies have proposed browsing interfaces for children's information seeking (Bilal, 2002b; Bilal & Kirby, 2002; Large, 2005) to solve the issue associated with query construction by children.

Query reformulation is the term given to the necessity to recreate a query when the first query has not produced the results the user requires. It is an area that has received noteworthy discussion in the literature with many issues remaining unresolved. Related work observed that adults do not conduct significant numbers of query reformulations or subsequent searches (Spink & Jansen, 2004), while children older than those in our own study are reported to reformulate search queries a number of times when using dated internet search engines (Bilal, 1998; Bilal & Kirby, 2002).

#### 3.2.4.3. Perceptions of Internet Search

When perceptions are probed children, tend to show confidence with using digital sources including the Internet. Children often describe self-confidence in finding information on the Internet and portray a sense of belief that the information on the Internet is authoritative and current (Watson, 1998). Children report ease with finding information (Bilal, 2000), and note the speed and efficiency of searching for information on the Internet compared to in print (Large & Beheshti, 2000). Equally, children describe

frustration with load times, inability to find relevant information and anxiety when they encounter information overload (Large & Beheshti, 2000).

Bilal (2004) argues that little is known about gender differences when searching for information on the Internet. Bilal details the findings of a few investigations that have reported gender differences (Large, Beheshti, & Rahman, 2002a; J. Schacter et al., 1998), and she notes that these studies were conducted in group search settings and not individual search settings. The findings of these studies have detailed search behaviour differences between boys and girls rather than specific features of interfaces or difficulties experienced by each gender that may be targetable by an interface development. More research is required to investigate the gender differences present for children's individual Internet searching.

In summary, Van der Sluis & Van Dijk (2010) provide a survey of research pertaining to children's information retrieval system use. From the literature, they identify four categories of issues that children face when using information retrieval systems: 1) children have an insufficient mental model of IR systems; 2) children encounter vocabulary problems; 3) children display chaotic search behaviour; 4) children struggle with making sound relevance judgements. Issues 3 and 4 are most relevant to our research.

### **3.3. Interfaces for Children's Information Seeking**

As discussed previously in this chapter, the adult-oriented systems children use in the home and classroom, do not suit their information seeking needs because they require complex knowledge about search and query construction and often provide results that do not answer children's information needs (Van der Sluis & Van Dijk, 2010). The standard response to this issue is the development of specialised child-centred information retrieval systems (Druin et al., 2003; Gossen et al., 2012a; Lingnau, Ruthven, Landoni, & Van der Sluis, 2010). The systems are often research-based prototypes and date visually very quickly and, naturally, do not receive on-going support akin to that of a commercial search engine.

Interface design research for children's information seeking has explored how interaction, usability, and visual design influences children's information seeking. We outline the pertinent research in these areas in the following three sections.

### 3.3.1. Web Interfaces for Children

A number of commercial information seeking providers have developed child-specific interfaces for information seeking on the Internet. In the early research, these resources were often referred to as *web portals* a term not common today when we would otherwise discuss *web or internet search engines*. Often search interfaces for children target very young children.

A number of researchers have studied these interfaces and discuss the successes and shortcomings of children's experiences with these interfaces. Large et al. (2002a) asked children to critique a range of web portals including Ask Jeeves For Kids, KidsClick, LycosZone, and Yahoo!igans! and offer a comprehensive list of visual design and information architecture suggestions based on these user critiques of these child-centred web portals of the time. Bilal undertook a series of investigations using Yahoo!igans! (2000, 2001, 2002b). In her 2001 article Bilal (2001) makes numerous suggestions for how Yahoo!igans! might be improved. For a number of reasons, these dedicated child-centred systems are not used in NZ classrooms today, and many (such as *Yahoo!igans!* and *Ask Jeeves For Kids*) are no longer available online. Chapters 4 to 6 provide the results of our own studies in what is used in NZ classrooms and what issues children face.

### 3.3.2. Digital Library Interfaces for Children

The Digital Library (DL) research (Crabtree, Twidale, O'Brien, & Nichols, 1997; Witten, Bainbridge, & Nichols, 2009) is a clear contributor to the related work for our research. The digital library research is vast and covers areas of patron use including searching, browsing, and e-reading as well as interaction and design for both adults and children.

Key researchers in children's digital library design and use are those of International Children's Digital Library (ICDL) (Druin et al., 2003; Hourcade et al., 2003; Hutchinson, Bederson, & Druin, 2006). The ICDL research has spanned the presentation and structural design of information, the interaction design of interfaces and the visual design of interfaces for children.

Comparison of physical library and digital library use is common in both the digital library and library science literature. Thorough work by Reutzel & Gali (1998) describes children's book search behaviours in a physical library and gives insight into strategy development and the potential for learning and research in the digital realm.

Additionally, this DL research can be used to guide the development of user interface design for information technology systems that support information seeking and searching outside of the digital library field.

### **3.3.3. Visual Design of Search Interfaces for Children**

Typically researchers recommend implementation of child-friendly visuals including colour, engaging graphics and animation (Large & Beheshti, 2005; Large et al., 2002a). Ergonomic considerations of typography, interactive elements, and usability features of interfaces for children are widely discussed. Investigations have also explored avatar guides (Gossen et al., 2012a). Additionally, researchers have proposed interfaces with simplified navigation systems and simplified presentation of search results lists through paged rather than scrolled information presentation (Gossen et al., 2012a; Hutchinson, Bederson, & Druin, 2005; Lingnau et al., 2010).

Some research that has focussed on the development of information seeking interfaces for children has been borne out of collaborative and inclusive design processes or participative research approaches. Bilal (2002a) included children in developing interfaces for search engines. Similarly, Large et al. (2002a) asked children to critique common search engines of the time, Yahoooligans!, Ask Jeeves for Kids, KidsClick!, and Lycos Zone. Druin (1999) also discusses the need to develop information resources *with* children instead of *for* children. Jochmann-Mannak (2010) compared children's search performance on four interfaces designed for children, with their performance on Google and found that the children did not perform better on these interfaces than on Google. A central tenet of the ICDL method has been the practice of inclusive design whereby the children are active contributors to the development and research process as partners rather than participants (Hourcade et al., 2003). Unsurprisingly, these interfaces often inherently implement the child-friendly recommendations that we discussed here.

## **3.4. Discussion**

We observed that while there is a wealth of research on children's information literacy and children's information problem-solving, a range of issues still need to be addressed. Both searching for information and using information require continued investigation. Issues of query construction, query reformulation, and information triage have not been completely resolved through technology intervention and further opportunities exist for tools that address these issues through new methods.

In Section 1.1 of this thesis we have argued that the speed of technology evolution has resulted in much of the research into children's information seeking becoming somewhat dated. It is apparent in our own review of the literature presented in this chapter that very few investigations of children's information seeking and information searching having appeared in the previous five years. This view is shared by Gossen (2015) who also argued the dated nature of studies involving children's Internet searching.

Many of the systems discussed in the literature have all but disappeared. Bilal and Ellis (2011) discuss children's use of Google, Yahoo!, Bing, Yahoo Kids!, and Ask Kids; the latter two are now defunct. Further, Bilal (2013) has investigated the reliability of Google's readability formula, a search engine feature which has again been removed from Google during the very undertaking of this thesis.

Specific children's internet search engines and digital libraries are often investigated and developed. Jochman-Mannek et al. (2010), compared children's search performance on four Dutch search engine interfaces designed for children, with their performance on Google. Gossen and colleagues (Gossen, 2013; Gossen, Low, & Nürnberger, 2011; Gossen et al., 2012a) have studied children's use of a range of search engines including child-specific search engines, and adaptive search user interfaces to study their use (2015).

Recent work in children's information seeking has predominantly focussed on reading and searching in digital libraries (Hilary Browne Hutchinson et al., 2013; Wu, 2015; Wu & Chen, 2016), and novel teaching of mathematics and programming using tablets, software and haptic devices (Beschorner & Hutchison, 2013; Hegedus, 2013; Pyykkönen et al., 2013), and the use of software and devices for the creation of digital media such as video, photography, and digital storytelling (Tsai et al., 2015).

We conclude that a clearer picture of the information seeking technology that children actually use for educational purposes and the issues that children encounter with these modern information seeking technologies is still required to inform our research. We therefore propose that tools are needed that are specifically aimed at encouraging good information practices for children. Those tools should assist children with the processes of inquiry-based learning such as the *question analysis*, *learning cycle* or *guided design* frameworks as discussed in Section 2.1.1.1.

### 3.5. Chapter Summary

This chapter identified the present issues for children's information seeking as reported in the information science literature. Further, discussion of methods of investigation typical for information science research with children is reported. Research that investigated information seeking in schools is highlighted and explorations of interface design research was presented. This chapter has shown that children experience issues at the information behaviour level as well as at the information seeking and information searching levels. The review of the literature has not made it clear which information seeking strategies children employ, how they construct queries, and if the strategies that are taught are effective for modern search engines. Few recommendations have been proposed, and few solutions have been deployed within the classroom. Open opportunities for research investigations exist. This strengthens our argument for a need for exploration of an interaction model for children's information seeking.

This chapter has begun to address Research Question 1 and 2 (see Section 1.2), exploring when and how children are interacting with information technology and resources and what issues they are experiencing when doing so.

**RQ1** seeks to uncover what information seeking technologies children are using. We observed here that the recent investigations of current internet search engine technologies is sparse and requires further empirical investigation.

**RQ2** is concerned with the issues encountered during information search. Numerous issues have been identified with children's information search by researchers globally and with a range of internet search engine and digital information technologies. Few recommendations have been proposed, and few solutions have been deployed within the classroom. The numerous issues presented in our review of the literature provides insight into the possibility for further investigation.

The following chapters will further triangulate answers for Research Questions 1 and 2.

## **Chapter 4.**

### **NZ Children's Information Technology Practices**

In Chapter 3 we observed that children's digital information seeking is an under-studied field. Furthermore, little is known about children's access to technology and information sources in NZ, and there is scant empirical evidence of their information search and information use for schoolwork or personal use.

To address this gap, we executed a survey investigating when and how children use information technology at school and in the home. We specifically sought to answer what technology children have access to, do they search for and use information in digital or in print sources, and what ages are appropriate focus years for our further research in children's digital information seeking?

The survey questionnaire was distributed to teachers and parents of children in 10 New Zealand primary and intermediate schools in late 2012 with an additional survey submitted to a rural school in early 2013. This chapter analyses the results of our survey and discusses its implications for further studies of children's information behaviour. Early versions of this chapter have been previously published (Vanderschantz, Hinze, & Cunningham, 2013; Vanderschantz et al., 2014a).

The chapter is structured as follows: our study method is described in Section 4.1. Section 4.2 details results of the survey conducted in suburban schools in the Waikato region of New Zealand, while Section 4.3 discusses the repeating of this survey with parents and teachers of a single rural school in the same area of NZ. We consider the findings of this survey (Section 4.4). Finally, we summarise the implications of this chapter with respect to the research questions for this thesis (Section 4.5).

This chapter continues to address RQ1 (see Section 1.2): *when and how are children conducting digital information seeking?*

## **4.1. Study Method**

Here we describe our participant recruitment and the materials that we used for this survey.

### **4.1.1. Participant Recruitment**

Principals of 27 suburban schools at a pre-high-school level in the Waikato region of New Zealand (located in the central North Island of NZ) were approached to take part in this survey during November and December 2012. Using the *Directory of Schools* (Education Counts, 2013), we estimate that the Waikato region has approximately 252 schools that can be classified as either, Full Primary, Contributing, Composite, or Intermediate schools (that is schools that are pre-high-school level in the New Zealand School System).

We initiated contact with principals via email and followed up with each principal by phone. Of these 27 schools that were approached, 10 schools (5 primary schools and 5 intermediate schools) agreed to take part in the survey. These 10 schools fell into the range of decile ratings between 4 and 9.

Approximately one teacher at each year level at each suburban school was approached to take part in the survey. We asked the principal to identify a teacher at each year level to be invited to participate. Teachers were explicitly informed that they could opt not to take part in the study. Teachers were also informed that they were not bound by their employer to participate in the study and that there would be no employment ramifications for participation or removal from the study at any time.

Principals were asked to choose teachers who fitted a standard model of their school environment rather than a class who had higher technology access than typical in their school. These “technology classrooms” are present in a number of the schools that we surveyed and to the best of our knowledge were not included in this survey.

If these teachers chose to take part, in turn, they selected three female and three male students in their class whose parents were invited to participate in the survey. The criteria for the teacher to select students in the class were at the sole discretion of the

teacher. We specifically encouraged a somewhat random choice by the teacher by requesting that a teacher does not bias their own choosing based on high or low technology use.

As we progressed this study, we were made aware of a school in the Waikato region that offered one-to-one tablet computer access to their students. This was identified as a unique opportunity to investigate the similarities and differences that are present in such a situation. Therefore, the principal of this Rural School in the Waikato region of New Zealand was approached to take part in this survey during March 2013 (Term 1 of the year following the suburban school survey study). At the time of the survey, this school catered to students at Years 1 through 6 with a roll of 12 students and a teaching staff of two teachers including the principal. A single teacher facilitated the learning for all 12 students at any one time. Due to the small size of this school we requested the principal to invite all teaching staff and all parents to participate in this survey.

Because we were working with so many different schools and required explicit ethical approval and formal written agreement by each school’s principal we did not develop a truly random function for the selection processes. Examples of the participant information sheets and ethical consent forms for the principal, teacher and parent can all be found in Appendix A.

#### 4.1.2. Sample of Responders

Table 4.1 details the sample of responders to this survey across years from parents and teachers at suburban schools.

**Table 4.1 Sample of suburban responders**

Year level	Parents	Teachers
Y1&2	33	7
Y3&4	23	6
Y5&6	32	7
Y7&8	58	12

146 parents of a possible 244 parents (60%) chose to respond to this survey while 32 of a possible 37 teachers (86%) also opted to return surveys (see Table 4.1).

To strengthen our investigation, and to ensure we have a picture of the situation in a range of publicly funded pre-high school level schools typical in New Zealand, we have also conducted our survey at a rural school in the Waikato region of New Zealand.

Differing from the Suburban Schools, Rural Schools in New Zealand typically have a much smaller enrolment and are far more geographically isolated than suburban schools. We have used the *Directory of Schools* (Education Counts, 2013) to estimate that approximately 7% (176 of 2503 schools) of the total number of New Zealand schools listed are Rural Full Primary, Contributing, Composite, or Intermediate schools with rolls less than 30 students. We also estimate that 9% (23 of 252 schools) are Rural Primary, Full Primary, Contributing, Composite, or Intermediate schools with rolls less than 30 students in the Waikato region of New Zealand.

Table 4.2 details the sample of responders to this survey across years from parents and teachers at the rural school.

**Table 4.2 Sample of rural responders**

	Y1	Y2	Y3	Y4	Y5	Y6	Y?	Y1-6
Parents	0	1	1	0	3	1	2	
Teachers								2

We received surveys from parents of children in Year 2, 3, 5 and 6 as well as two surveys where the year level of the child was not listed. We received surveys from both of the teachers at this school. Eight parents of a possible 12 parents (66%) chose to respond to this survey, and the two teachers (100%) also opted to return surveys (see Table 4.2).

### 4.1.3. Questionnaires

Two different survey forms were created, one questionnaire to be answered by teachers and one questionnaire to be answered by parents. The presentation and layout of these questionnaires can be found in Appendix A. These survey questions directed to the teachers and parents can be grouped under the following classifications:

- Access to Technology
- Resources for Completion of Schoolwork
- Information Sources
- Reading in print books & eBooks

We structure the results sections (Sections 4.2.1, 4.2.2, 4.3.1 and 4.3.2) of this chapter according to these four headings. The teachers were asked 13 questions about the teachers' knowledge of their student's technology use at home and at school (see Figure 4.1).

- 1) Please list what technology children in your class have access to at home that is used to complete work for your classes.
  - 2) Please list what technology children in your class have access to at school that they use to complete school work.
  - 3) Please list what technology children in your class use for entertainment at school.
  - 4) From your knowledge of pupils in your class this year:
    - a. Do you think children in your class read eBooks *for pleasure at home*?
    - b. Do children read eBooks *for pleasure in your classroom*?
    - c. Do you think children in your class read eBooks *for education at home*?
    - d. Do children read eBooks *for education in your classroom*?
  - 5) From your knowledge of pupils in your class this year:
    - a. What do you think *some* children in your class use to read for pleasure at home?
    - b. What do *most* children use to read for pleasure in your classroom?
    - c. What do you think *some* children in your class use to read for education at home?
    - d. What do *most* children use to read for education in your classroom?
  - 6) From your knowledge of pupils in your class this year:
    - a. What do you think *some* children in your class use to find information at home?
    - b. What do *most* children use to find information in your classroom?
  - 7) From your knowledge of pupils in your class this year:
    - a. What do you think *some* children in your class use to play games for education at home?
    - b. What do *most* children use to play games for education in your classroom?
  - 8) From your knowledge of pupils in your class this year:
    - a. Do *some* children use the Internet?
 

at home for pleasure	at school for pleasure
at home for education	at school for education
    - b. Do *most* children use the Internet?
 

at home for pleasure	at school for pleasure
at home for education	at school for education
  - 9) What does the school provide for in school use?
  - 10) What does the school *provide* for in home use?
  - 11) What does the school *require* for in home use?
  - 12) Do *most* children use a computer library catalogue to search for books at the school library?
  - 13) Have you set tasks (assignments/essays/projects/homework) this year where a child must find information from a source (book/Internet/eBook/dictionary/etc.) of their choosing?
- If yes please answer a. b. & c. below:
- a. approximately how many tasks in a given week ..... given term .....
  - b. what sources would a child have used to complete this task at school?
  - c. what sources would a child have used to complete this task at home?

**Figure 4.1 Questionnaire with questions for teachers**

The parents were asked 10 questions about their own use of technology at home and at work (see Figure 4.2) as well as 11 questions about their child's use of technology at home and at school (see Figure 4.3). Parents were asked to consider the questions in their questionnaire with reference to the child that brought home this questionnaire, not for all children in their home.

- 1) What technology do you have access to at home?
- 2) What technology do you use to complete work for your occupation?
- 3) What technology do you use for entertainment?
- 4) a. Do you read eBooks for pleasure at home?  
b. Do you read eBooks for pleasure at work?  
c. Do you read eBooks for your occupation at home?  
d. Do you read eBooks for your occupation at work?
- 5) a. What do you use to read for pleasure at home?  
b. What do you use to read for pleasure at work?  
c. What do you use to read for your occupation at home?  
d. What do you use to read for your occupation at work?
- 6) a. What do you use to find information at home?  
b. What do you use to find information at work?
- 7) Do you use the Internet?  
at home for pleasure      at work for pleasure  
at home for work      at work for work
- 8) What does your work provide for in work use?
- 9) What does your work provide for in home use?
- 10) Do you use a computer library catalogue to search for books from the public library?

**Figure 4.2 Questionnaire with questions for parents about themselves**

- 1) What technology does your child have access to at home?
- 2) What technology does your child use to complete school work?
- 3) What technology does your child use for entertainment?
- 4) a. Does your child read eBooks for pleasure at home?  
b. Does your child read eBooks for pleasure at school?  
c. Does your child read eBooks for education at home?  
d. Does your child read eBooks for education at school?
- 5) a. What does your child use to read for pleasure at home?  
b. What does your child use to read for pleasure at school?  
c. What does your child use to read for education at home?  
d. What does your child use to read for education at school?
- 6) a. What does your child use to find information at home?  
b. What does your child use to find information at school?
- 7) a. What does your child use to play games for education at home?  
b. What does your child use to play games for education at school?
- 8) Does your child use the Internet?  
at home for pleasure      at school for pleasure  
at home for education      at school for education
- 9) What does the school provide for in school use?
- 10) What does the school provide for in home use?
- 11) a. Does your child use a computer library catalogue to search for books from the school library?  
b. Does your child use a computer library catalogue to search for books from the public library?

**Figure 4.3 Questionnaire with questions for parents about their children**

This study was developed as an early exploratory study, and therefore some of the questions included in the survey have not been analysed in this thesis. These questions have deliberately been omitted from our reporting because they do not offer insight that is directly related to the hypothesis and research questions developed for our research.

This chapter does not report the results of questions pertaining specifically to children's technology use for entertainment or pleasure (Questions 3 & 7, Figure 4.3), nor are questions pertaining to technology utilization and access by the parents considered (Questions 1 to 10, Figure 4.2). We also only report teachers' observations of in-school use and parents observations of in-home use. While the results that we do not analyse in this chapter provide interesting insights and bear analysis at a later date, they are considered outside the scope of this thesis and have been negated to ensure readability of this chapter for the reader.

## 4.2. Suburban Schools Survey Results

We structure this section with the results of the suburban teachers results first (Section 4.2.1), followed by the results of the suburban parents results (Section 4.2.2). We present the results according to the classifications outlined in Section 4.1.3.

Questions that led to responses that have been deemed outside the scope of this thesis<sup>4</sup> have not been reported and are identified where relevant.

### 4.2.1. Suburban Teachers Results

We present here an analysis of the results of this survey of teachers understanding of their students. The results of the teacher survey are shown as year level composites of the responses. We created year level composites for all year levels because all Intermediate schools recruited had Year 7&8 teachers teach composite classrooms rather than streamed year level classrooms and some primary schools recruited had teachers at various year levels between 3 and 5 taught as composites also. For this reason, creating composites of the results of Years 1 and 2, Years 3 and 4 and Years 5 and 6 gave the clearest comparable data sets.

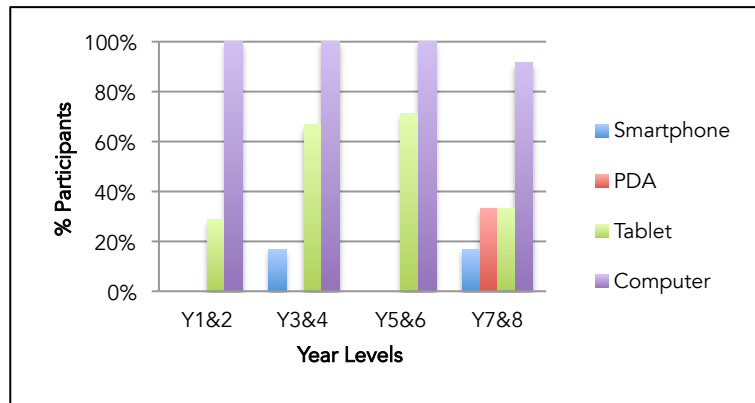
#### 4.2.1.1. Access to Technology (Suburban Teachers Report)

Children's technology access was addressed in Questions 1, 2, 3, 9, 10 and 11 of the Teachers Questionnaire (see Figure 4.1). We discuss here the results of Questions 2, 9, 10, and 11 as being most relevant to this thesis.

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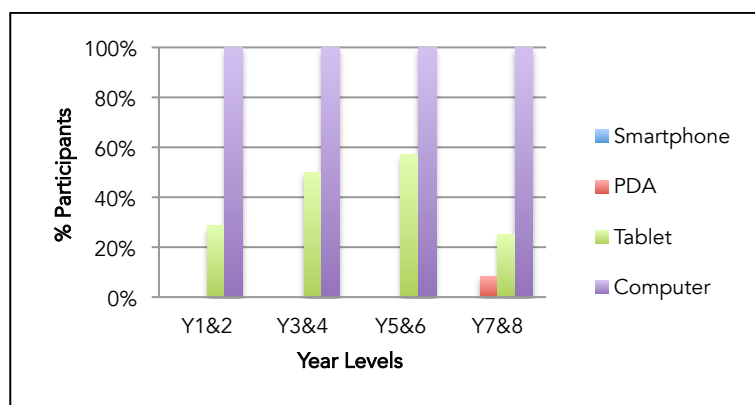
<sup>4</sup> The nature of this initial survey was broad in its design and encompassed data relating to children's information seeking in the home and the school in an effort to inform our future work in this area. All further studies in this thesis have focused on children's information seeking in the classroom based on the findings of this survey and therefore, detailed analysis of parents information seeking and technology access has been deemed outside the scope of this thesis as has ICT for entertainment and these are therefore, not discussed further in this chapter.

**Technology access for use at school (Q2):** Teachers reported a variety of technologies that children had available for use at school (see overview in Figure 4.4). Computer and tablet appear to be the most available technology at all year levels. PDA was also listed at Years 7&8 as being accessible compared to other year levels. In addition to the technologies listed here, a number of analogue technologies were also named by the teachers, such as audio, video, and photographic technologies. For this question teachers listed technologies freely based in the space provided on the questionnaire.



**Figure 4.4 Teachers reporting on technology that children access at school. n=31**

**School provided technology for in-school use (Q9):** Teachers at all schools reported computers and tablets were supplied at all year levels (Figure 4.5). Interestingly only at intermediate (Year 7&8) were PDA's (such as iPod Touch) listed. For Question 9 the teachers selected from a list of four options (Tablet, PDA, Smartphone, Computer). We do not to report technology distribution analysis in this chapter, however, we provide tabularised detail of the reported access to technology in Appendix F.



**Figure 4.5 Teachers report technology supplied by the school. n=32**

**School provided technology for in-home use (Q10):** Very little ICT was reported by teachers as being provided by the school for in-home use. At Year 1&2 and Year 3&4 it was reported by 14% and 33% of the teachers respectively that the school supplied

eBooks for in-home use. The only technology or resource listed by teachers for this question was eBooks.

**Technology required by the school for in-home use (Q11):** Question 11 furthers our inquiry into the schools requirements of in-home technology for education. 57% of the Year 5&6 teachers and 17% of the year 7&8 teachers listed computers as being required for in-home use by their students. 14% of Year 5&6 teachers also suggested that tablets (perhaps instead of computers) would be necessary.

#### 4.2.1.2. Resources for Completion of Schoolwork (Suburban Teachers Report)

Questions 7, 12, and 13 of the Teachers Questionnaire (see Figure 4.1) investigated children's resource use for schoolwork completion. Question 7 (What do *most* children use to play games for education in your classroom?) is not discussed here, as it is outside the scope of this thesis.

**Information sources for in-school task completion (Q13):** Teachers reported that student's at all levels use the Internet and Print Books heavily (Figure 4.6). There appears to be more use of the Internet than book use, and not all children that use books are likely to use the library catalogue to locate books for use. There is an increase in Internet and book use for tasks at Year 3 and above because children begin reading to learn compared to learning to read in these years. Library catalogue use is also not expected by teachers at Years 1&2.

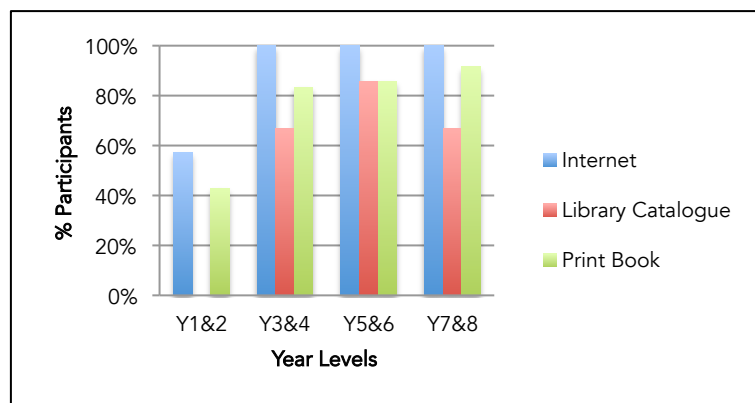
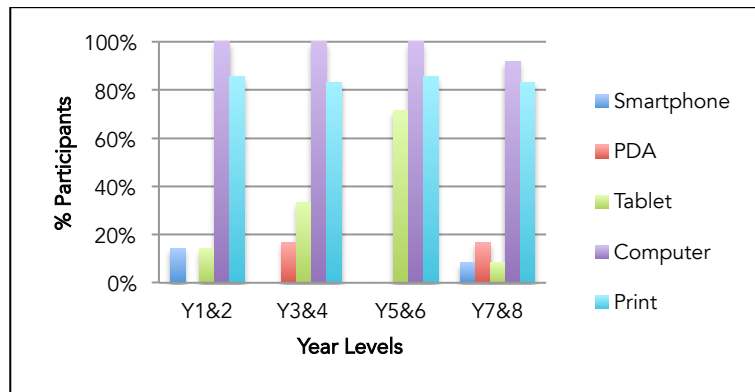


Figure 4.6 Teachers report technology used to complete a set task in school. n=31

#### 4.2.1.3. Information Sources (Suburban Teachers Report)

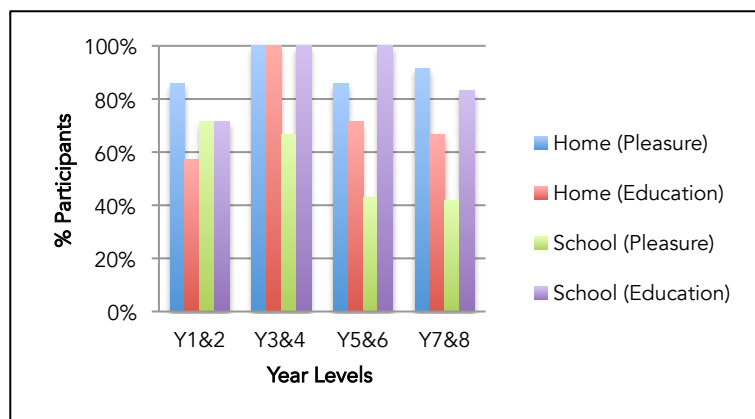
Questions 6, and 8 on the Teachers Questionnaire (see Figure 4.1) investigated information sources that children use.

**Technology for information seeking (Q6):** Teachers stated that most children predominantly use Print and Computer for information finding in the classroom (Figure 4.7). However, at Years 5&6, we can see substantial use of Tablets also.



**Figure 4.7 Teachers report technology used to find information. n=32**

**Purposes of Internet use (Q8):** At all year levels the teachers reported the children would use the Internet at home for pleasure more often than they would use the Internet at home for education (Figure 4.8). Year 3&4 was an exception, where teachers stated the Internet is used equally for pleasure and education. Other than at Year1&2 the reverse is thought to be true at school. Teachers reported that children use the Internet at school for education more than they will for pleasure.



**Figure 4.8 Teachers report Children's Internet use. n=32**

#### 4.2.1.4. Reading in Print Books and eBooks (Suburban Teachers Report)

Questions 4, and 5 on the Teachers Questionnaire (see Figure 4.1) investigated reading sources that children use.

**Reading in the classroom (Q5):** Teachers reported reading habits of children (see Figure 4.9), with high use of print books and some use of the computer at all year levels. Tablet use for reading is surprisingly high in Year 5&6 compared to other year

levels. PDA use for reading is only reported at Year 7&8, which is keeping with school supplied PDA access reported in Figure 4.5. No smartphone use is reported, and very low use of dedicated eReaders is reported.

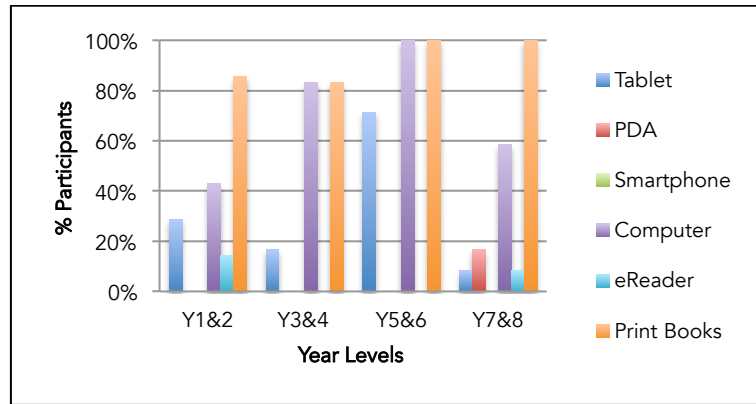


Figure 4.9 Teachers report reading for education at school. n=32

**Reading eBooks in the classroom (Q4):** Teachers reported eBook use by children when answering Question 4. In Figure 4.10, we see how little eBooks are used at school (note that the Y-Axis ends at 40%). Surprisingly teachers noted the highest use by children at Years 1&2.

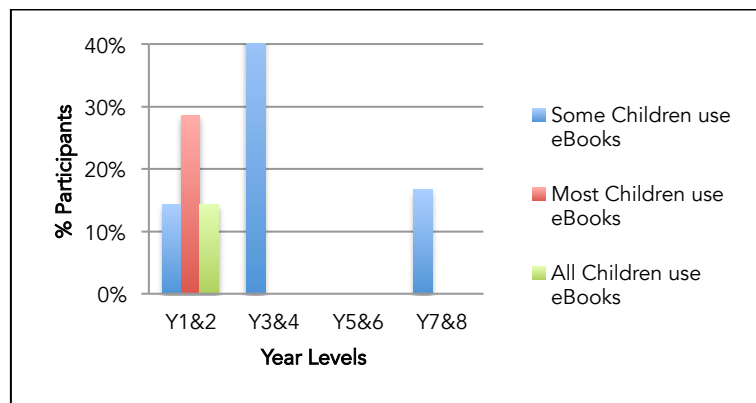


Figure 4.10 Teachers report reading eBooks for education at school. n=32

### 4.2.2. Suburban Parents Results

We present here an analysis of the results of the survey of parents understanding of their children’s technology use and information search. Due to the need to create composites of the data (see Section 4.2.1), we used those same composites for the year level data for the parent data. Please consult Section 4.1.2 to review the sample of responders to this survey.

#### 4.2.2.1. Access to Technology (Suburban Parents Report)

Questions 1, 3, 9, and 10 on the Parents Questionnaire (see Figure 4.3) investigated children’s technology access. We discuss the results of Questions 1, 9, and 10 as being most central to this thesis. Question 3 is not discussed as this pertains to entertainment technology use, which while interesting, is outside the scope of this thesis.

**Technology access at home (Q1):** When answering Question 1 parents reported a fairly even spread of access to technology by children in the home (Figure 4.11). There is some increase in technology use across all of the listed technologies as the year levels progress. Most interestingly, we don’t see a significant spike at any year level for any of the technologies listed. Smartphone use appears to be much lower in Years 3&4. Unsurprisingly, computer use is reported to be the most used technology.

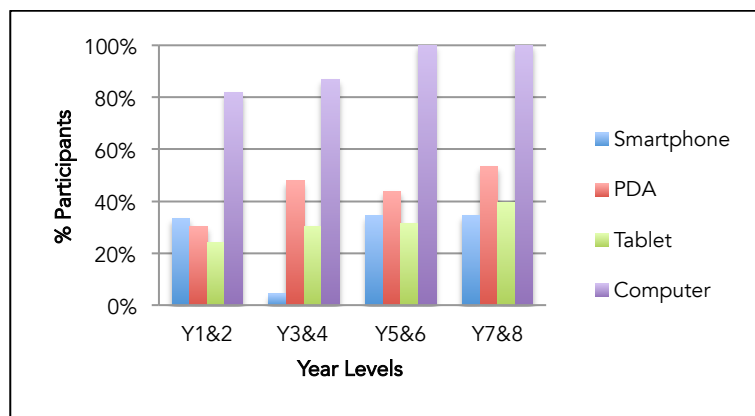


Figure 4.11 Parents report technology that children access at home. n=142

**School provided technology for in-school use (Q9), and School provided technology for in-home use (Q10):** Question 9 and Question 10 seek the parents insight into technology supplied by the school. Understandably, the parents listed much more technology supply for in-school use, which can be seen in Figure 4.12. Parents with children in all year levels reported computer use at very high concentrations. The next most used technologies reported were tablet computers and eBooks.

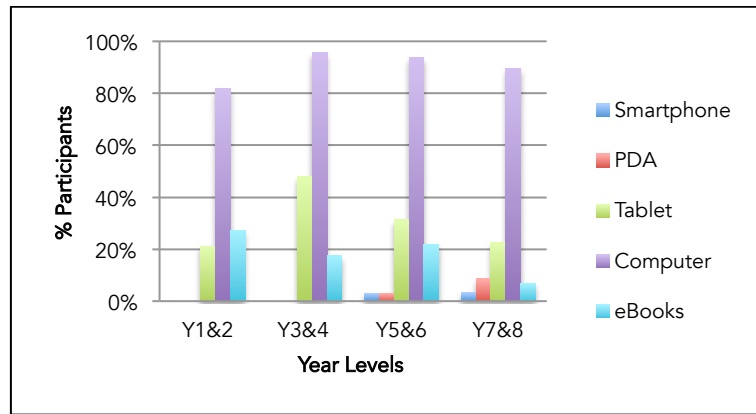


Figure 4.12 Parents report school supplied technology for in-school use. n=135

Unsurprisingly, technology supplied for in-home use is much lower reported. Note that Y-Axis for Figure 4.13 ends at 20%.

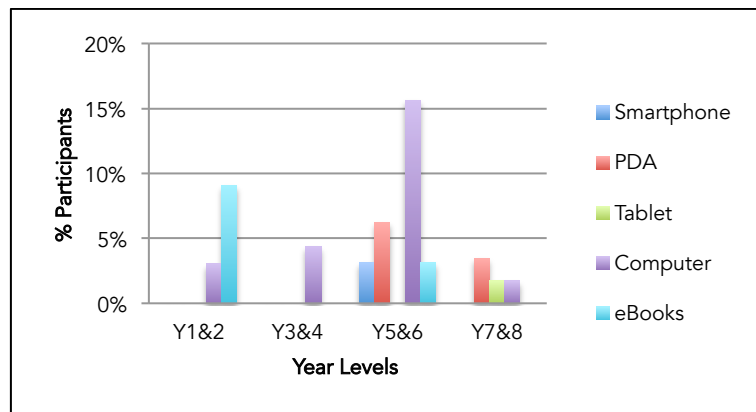


Figure 4.13 Parents report school supplied technology for in-home use. n=11

#### 4.2.2.2. Resources for Completion of Schoolwork (Suburban Parents Report)

Question 2 on the Parents Questionnaire (see Figure 4.3) investigated children’s technology use for schoolwork completion.

**Technology for completing schoolwork (Q2):** In answering Question 2, parents reported that children’s overall use of technology to complete schoolwork increases fairly steadily with each year level increase. Years 7&8 appear to have the highest technology use in all areas other than tablets (Figure 4.14).

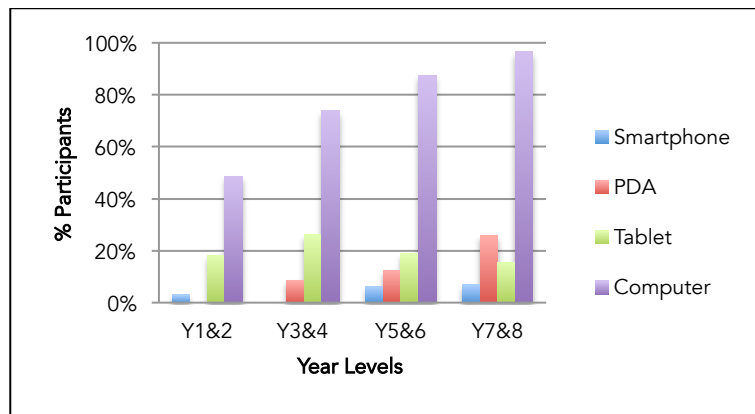


Figure 4.14 Parents report technology used to complete schoolwork. n=124

#### 4.2.2.3. Information Sources (Suburban Parents Report)

Questions 6, 8 and 11 on the Parents Questionnaire (see Figure 4.3) investigated information sources that children use. We discuss the results of Questions 6, 8, and 11 as being of interest to this thesis.

**Technology for information seeking (Q6):** When answering Question 6 parents responded fairly strongly that print and computers were the key tools for finding information. Quite some way behind was the tablet with the next most recurring use at home (Figure 4.15). At Years 5&6 and 7&8 the use of print for information search is diminished, while the use of technology is increased, showing that as the child ages, there appears to be an increase in the use of technology for information finding compared to the use of print.

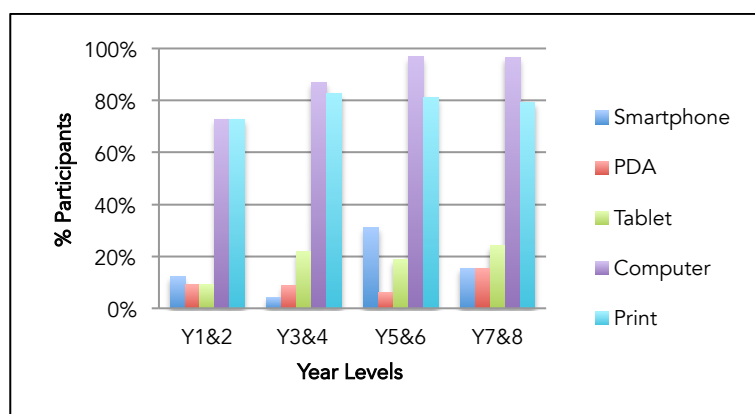


Figure 4.15 Parents report technology used to find information. n=144

**Purposes of Internet use (Q8):** There was high Internet use reported by parents for Question 8. There is an increase in use for both schoolwork and pleasure at Year 3&4 and above (Figure 4.16). Interestingly, there is still significant Internet use for both schoolwork and pleasure by the youngest children in our study.

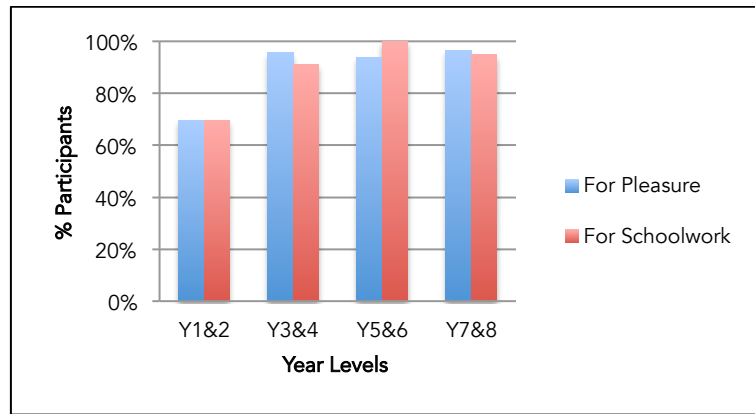


Figure 4.16 Parents report Internet use. n=142

**Public library computer catalogue use (Q11):** For Question 11 parents reported some use of the library catalogue during library use. There appears to be some increase in use at Years 5 thru 8, however, the number of parents who noted catalogue use is less than half of the entire sample. Note that the Y-Axis of Figure 4.17 ends at 60%.

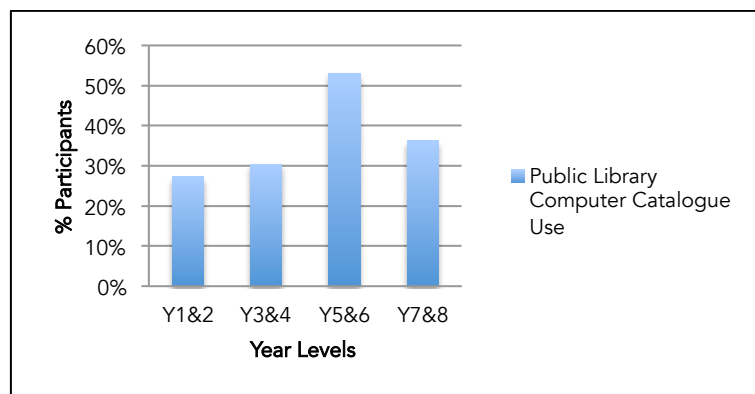


Figure 4.17 Parents report library catalogue use. n=90

#### 4.2.2.4. Reading in Print Books and eBooks (Suburban Parents Report)

Questions 4, and 5 on the Parents Questionnaire (see Figure 4.3) investigated children's reading habits. We discuss the results of both Questions 4 and 5.

**Reading in the home (Q5):** To investigate reading habits further, we asked parents about children's reading habits for both education and for pleasure. As seen in previous results in this survey, reading in print is reported often and followed most often by reading on a computer. Reading using smartphones, PDAs, Tablets, and eReaders is predominantly seen in less than 20% of the sample at each year level (Figure 4.18).

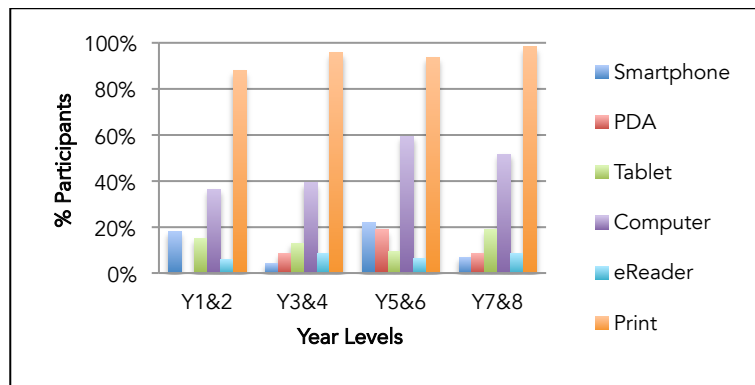


Figure 4.18 Parents report technology for reading for pleasure. n=146

We present also Figure 4.19 which indicates the parents responses to Question 5 (What does your child use to read for *education* at home?) This graph is very similar to Figure 4.18 with some increase in computer use at all levels, as well as some decrease in print use, reported at all levels except Years 5&6.

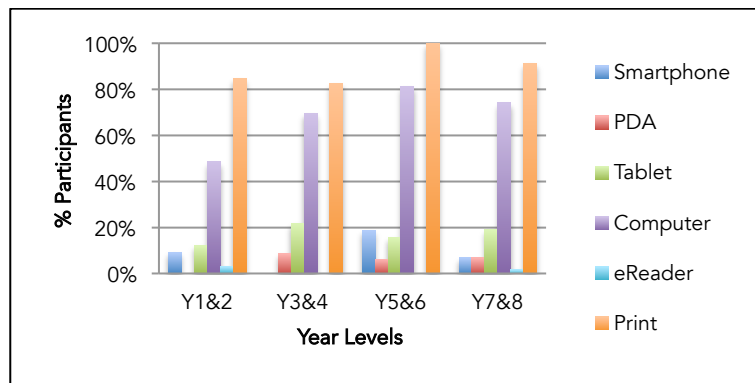


Figure 4.19 Technology for reading for schoolwork. n=142

**Reading eBooks in the home (Q4):** It appears that children are more likely read eBooks at home for pleasure than for education. In Figure 4.20 (note that the Y-Axis ends at 40%).

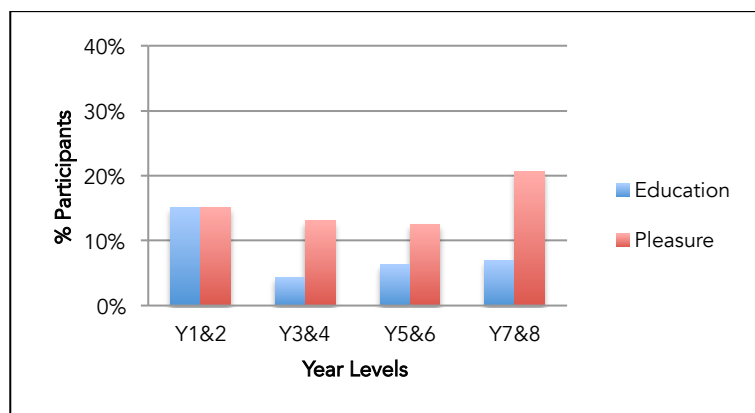


Figure 4.20 Parents report reading eBooks for education at home. n=142

We can see in Figure 4.20 that very low numbers of children's parents report their children use eBooks for either pleasure or education at home, with small increased

numbers of students at Year 7&8 more likely to read eBooks for pleasure than at any other level. Interestingly children as young as Year 1 and 2 are indicated in this study as using eBooks for pleasure and education at home.

### **4.3. Rural School Survey Results**

The survey conducted with parents and teachers of this Rural School is the exact survey carried out with Suburban Schools and described in Section 4.2 of this thesis. Differing from the Suburban Schools, Rural Schools in New Zealand typically have a much smaller enrolment and are far more geographically isolated than suburban schools. Due to the smaller school roll of a rural school, it is typical for a single teacher to conduct a composite of year levels spanning more than the usual two year levels seen in suburban schools. It is also not unusual for the teaching to be conducted by a single teacher with all year levels in a single classroom. This is the case for the school who took part in this survey where the entire school is facilitated as a single classroom across all of the year levels, Years 1 through 6.

The same two survey forms were answered by parents and teachers as was used in the public schools survey (see Section 4.2). Both teachers were invited to participate in the survey, and the parents of all 12 children were asked to take part in the survey. Where a family had more than one child at the school, the family was invited to choose to have one parent answer the survey for one child only or to have both parents independently fill in surveys.

We structure this section with the results of the rural teachers results first (Section 4.3.1), followed by the results of the rural parents results (Section 4.3.2). We present the results according to the classifications that we outlined in Section 4.1.3.

Questions that resulted in responses that have been deemed outside the scope of this thesis have not been reported and are identified where relevant.

#### **4.3.1. Rural Teachers Results**

We compare here the Rural School with the Suburban Schools surveyed in Section 4.2 of this chapter.

Due to the small numbers of students and teachers at this rural school we compare here composites of the results from primary schools (Years 1 through 6) and intermediate schools (Years 7 and 8) with the entire rural school (Years 1 through 8).

#### 4.3.1.1. Access to Technology (Rural Teachers Report)

As we noted in Section 4.2.1.1, Questions 1, 2, 3, 9, 10 and 11 on the Teachers Questionnaire (see Figure 4.1) investigated children’s technology access. We discuss here the results of Questions 2, 9, 10, and 11 as being most central to this thesis

**Technology access for use at school (Q2):** As can be seen from Figure 4.21, very little smartphone use was reported by teachers at suburban primary schools and intermediate schools. No smartphone use was identified at the rural school. No PDA use was identified at either the suburban or rural primary schools though was noted at suburban intermediate schools. The strong difference is the access to tablets at the rural school is substantially higher (100% access) compared to the suburban primary schools (55%) and intermediate schools (30%). This large amount of tablet use is because this small school has very recently invested in one-to-one tablet access for the 12 enrolled students and the two teachers.

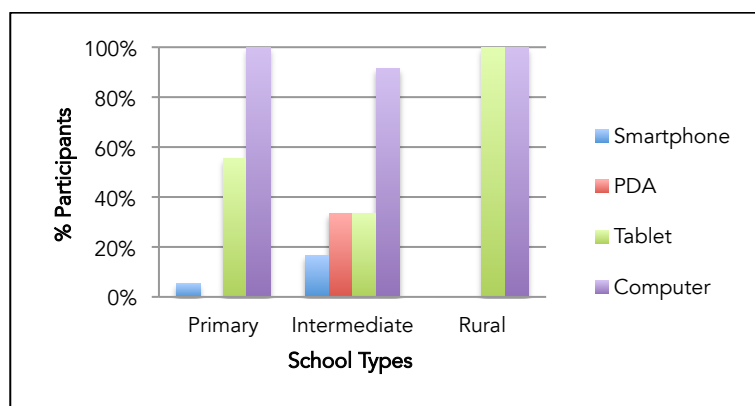


Figure 4.21 Teachers report technology that children access at school. n=33

**School provided technology for in-school use (Q9):** Again we see in Figure 4.22 that the significant level of supplied tablets at the rural school is unique amongst the schools surveyed.

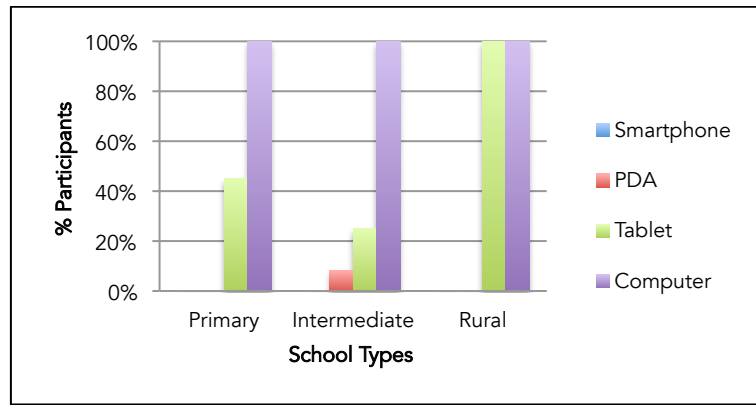


Figure 4.22 Teachers report technology supplied by the school. n=34

**School provided technology for in-home use (Q10) and Technology required by the school for in-home use (Q11):** With regards to the teachers’ answers to Question 10 (What does the school *provide* for in-home use?), and Question 11 (What does the school *require* for in-home use?) the rural school teachers reported no school supplied technology for in-home use, nor an expectation of any technology access in the home. This differs to the situation in the suburban schools where there was a very little expectation of access to computers at Years 5&6 and 7&8.

4.3.1.2. Resources for Completion of Schoolwork (Rural Teachers Report)

As we noted in Section 4.2.1.2, Questions 7, 12, and 13 on the Teachers Questionnaire (see Figure 4.1) investigated children’s resource use for schoolwork completion. Question 7 (What do *most* children use to play games for education in your classroom?) is not discussed here, as it is outside the scope of this thesis.

**Information sources for in-school task completion (Q13):** The teachers’ answers to Question 13 show very similar trends for all three schools. The results shown in Figure 4.23 suggest there is high Internet and print book use at all three schools.

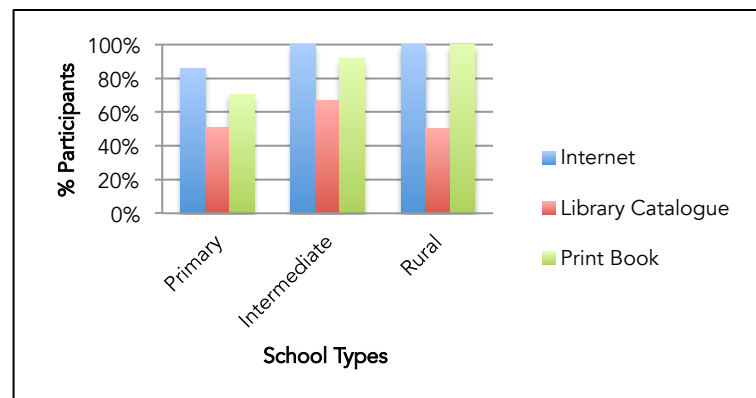


Figure 4.23 Teachers report technology used to complete a set task in school. n=33

#### 4.3.1.3. Information Sources (Rural Teachers Report)

As we noted in Section 4.2.1.3, Questions 6, and 8 on the Teachers Questionnaire (see Figure 4.1) investigated information sources that children use.

**Technology for information seeking (Q6):** Interestingly, even though we observe one-to-one tablet use at the rural school, the two teachers did not list tablets as tools for finding information (Figure 4.24).

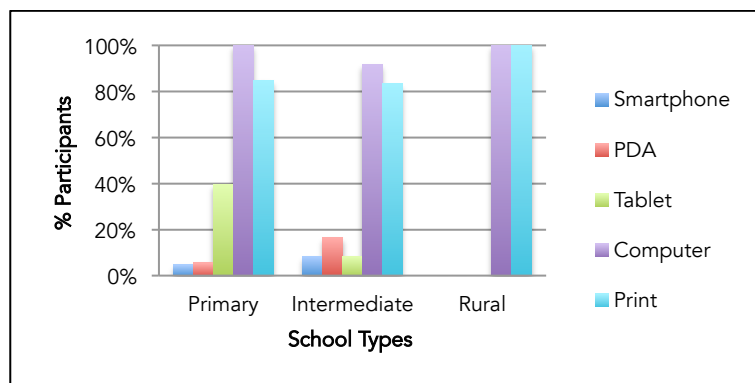


Figure 4.24 Teachers report technology used to find information. n=34

**Purposes of Internet use (Q8):** At all year levels in the suburban schools the teachers reported the children would use the Internet at home and at school for pleasure and for education (Figure 4.25).

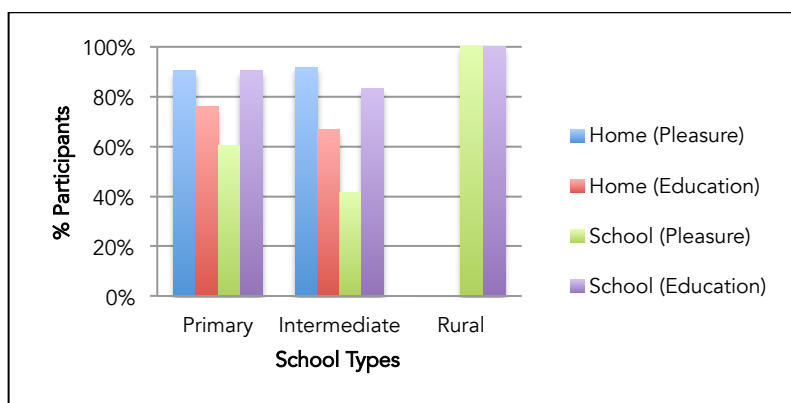


Figure 4.25 Teachers report Internet use. n=34

Uniquely, the rural school teachers did not list any Internet use at home by children. We believe this will be the case because of the limited Internet access available in some parts of rural NZ. This limited Internet access is confirmed in the response to the parent's questionnaire as discussed in Section 4.4.1.

4.3.1.4. Reading in Print Books and eBooks (Rural Teachers Report)

As we noted in Section 4.2.1.4, Questions 4 and 5 on the Teachers Questionnaire (see Figure 4.1) investigated reading sources that children use.

**Reading in the classroom (Q5):** In Figure 4.26 we see very little use of eReaders and PDA or Tablets for reading in the suburban schools and no use of these recorded by the teachers of the rural school.

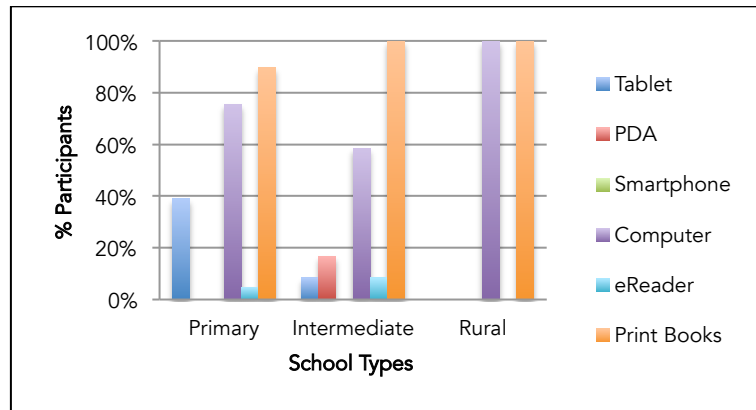


Figure 4.26 Teachers report reading for education at school. n=34

**Reading eBooks in the classroom (Q4):** Teachers reported eBook use by children when answering Question 4. In Figure 4.27 we see very little use of eBooks at school in the suburban schools and no use of eBooks recorded by the teachers of the rural school (note that the Y-axis ends at 30%).

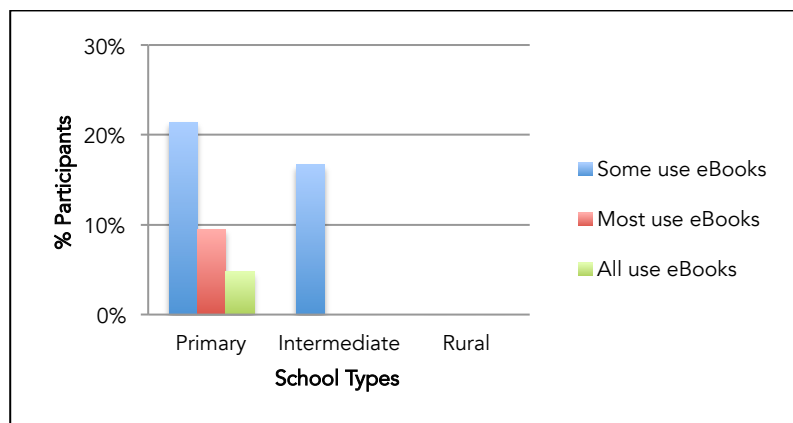


Figure 4.27 Teachers report reading eBooks for education at school. n=34

4.3.2. Rural Parents Results

We compare here the parent answers from the Rural School with the replies from Suburban Schools surveyed in Section 4.

#### 4.3.2.1. Access to Technology (Rural Parents Report)

Questions 1, 3, 9, and 10 on the Parents Questionnaire (see Figure 4.3) investigated children's technology access. We discuss the results of Questions 1, 9, and 10 as being most central to this thesis. Question 3 is not discussed as this pertains to entertainment technology use, which while interesting, is outside the scope of this thesis.

**Technology access at home (Q1):** When answering Question 1 parents reported a fairly even spread of access to technology by children in the home. The major difference between technology access at home for children who attend suburban schools compared to children who attend the rural school is that parents note much higher access to smartphones and PDA's at the home for the suburban schools children (Figure 4.28).

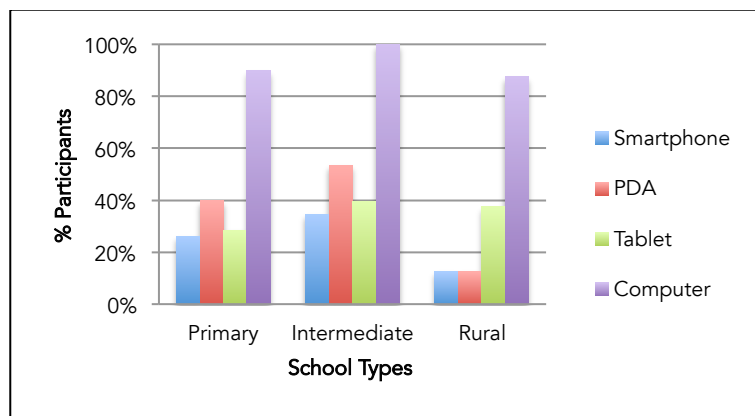


Figure 4.28 Parents report technology that children access at home. n=149

**School provided technology for in-school use (Q9), and School provided technology for in-home use (Q10):** Question 9 and Question 10 seek the parents' insight into technology supplied by the school. While the suburban schools supply very little technology for in-home use, it was reported by the rural parents that this school provides no technology for in-home use. Note that the Y-Axis for Figure 4.29 ends at 20%.

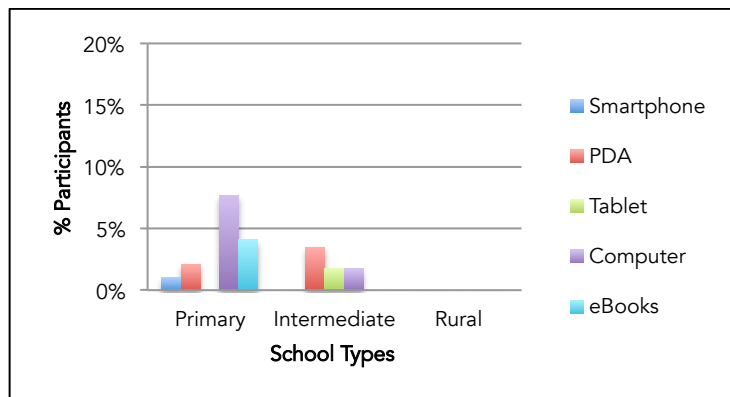


Figure 4.29 Parents report school supplied technology for in-home use. n=142

#### 4.3.2.2. Resources for Completion of Schoolwork (Rural Parents Report)

Questions 2, and 7 on the Parents Questionnaire (see Figure 4.3) investigated children's technology use for schoolwork completion. We discuss the results of both Questions 2 and 7 as being relevant to this thesis.

**Technology for completing schoolwork (Q2):** When answering Question 2 parents reported similar levels of computer and tablet use at primary school level. As was seen in Figure 4.28 children at the rural school do not have access to PDA or Smartphone, and thus, it is unsurprising that Figure 4.30 shows no PDA or smartphone use for schoolwork completion by rural school children.

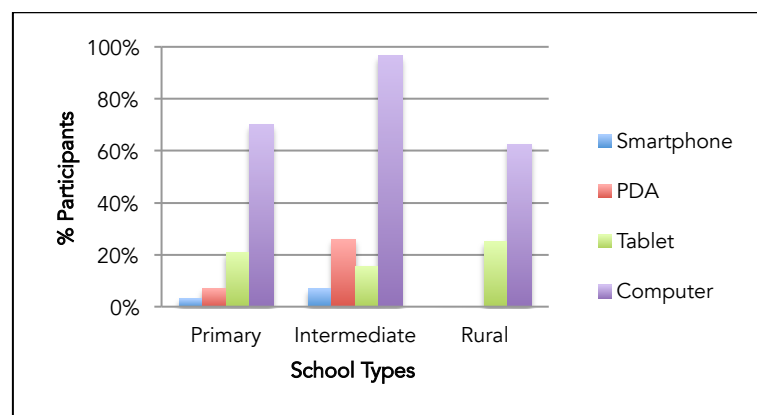


Figure 4.30 Parents report technology children use to complete schoolwork. n=129

#### 4.3.2.3. Information Sources (Rural Parents Report)

Questions 6, 8 and 11 on the Parents Questionnaire (see Figure 4.3) investigated information sources that children use. We discuss the results of Questions 6, 8, and 11 as being of interest to this thesis.

**Technology for information seeking (Q6):** When answering Question 6 parents responded fairly strongly that print and computers were the key tools for finding information. Computer use for information finding is reported as similar at both rural and suburban schools. Parents seem to consider that print is used much less than computers for information finding at the rural school. We see an increase in the reported use of Tablets for information finding compared to completion of schoolwork for the intermediate children and the rural children. Most notable in the comparisons that are shown in Figure 4.31 is that in the home technology is used more than print by both suburban and rural school children. Interestingly, the rural parents listed less use of print compared to suburban school parents.

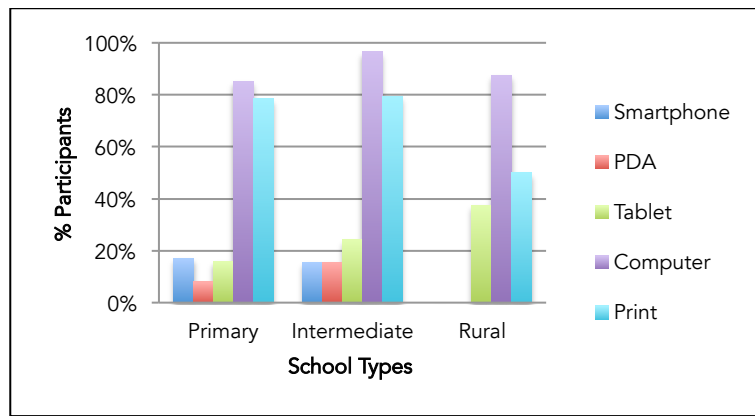


Figure 4.31 Parents report technology used to find information. n=151

**Purposes of Internet use (Q8):** There was high Internet use reported by parents for Question 8. The lower reporting of Internet use by the rural parents is likely due to the limited access to broadband Internet in rural parts of NZ. One of the eight parents who responded to the rural survey specifically answered the entire survey by marking the front page “sorry, we do not have Internet in our area.”

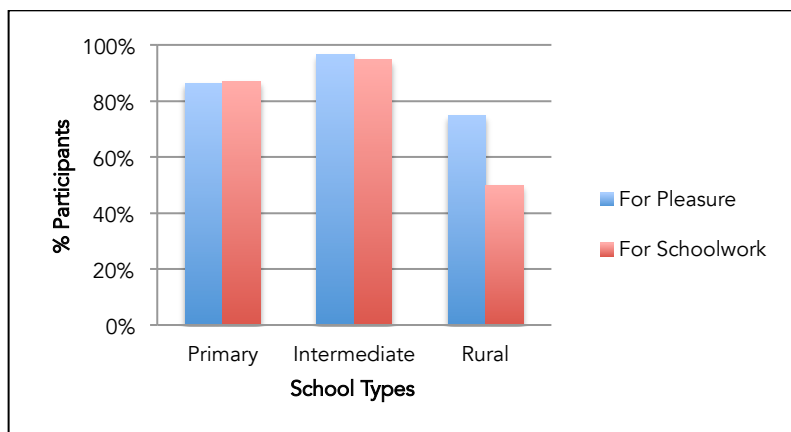


Figure 4.32 Parents report Internet use. n=149

**Public library computer catalogue use (Q11):** For Question 11 parents reported the very low use of the library catalogue during library use at all schools. Note that the Y-axis scale of Figure 4.33 ends at 60%.

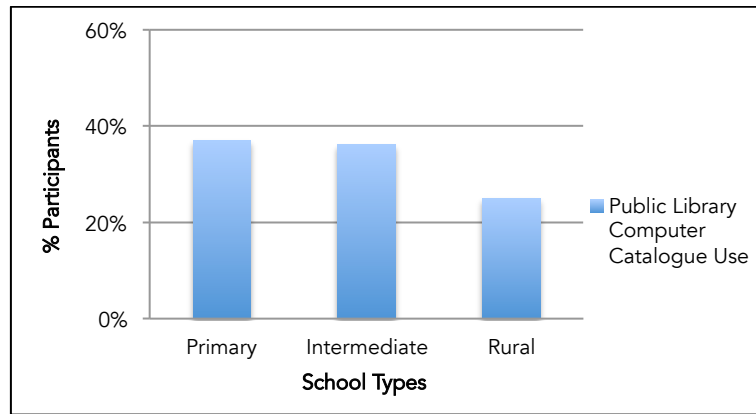


Figure 4.33 Parents report library catalogue use. n=89

4.3.2.4. Reading in Print Books and eBooks (Rural Parents Report)

Questions 4, and 5 on the Parents Questionnaire (see Figure 4.3) investigated children’s reading habits. We discuss the results of Questions 4 and 5 as being central to this thesis.

**Reading in the home (Q5):** To investigate reading habits further, we asked parents about children’s reading habits for both education and for pleasure. We present the findings of these two parts of Question 5 in Figure 4.34 and Figure 4.35 respectively. Reading in print appears to be the most used medium for reading both at school and home for education and pleasure. Next most used seems to be the computer. There is a reported increased use in the computer for reading for education compared to reading for pleasure.

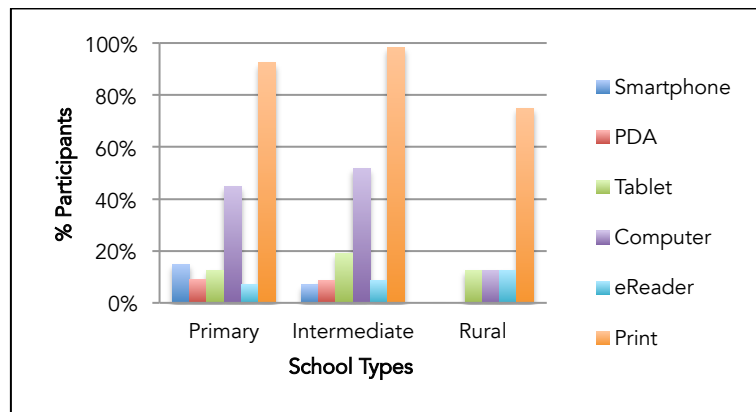


Figure 4.34 Parents report technology for reading for pleasure. n=153

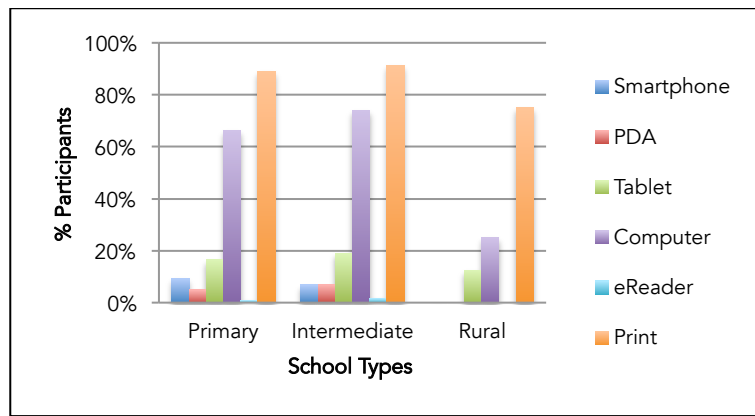


Figure 4.35 Parents report technology for reading for schoolwork (education). n=149

**Reading eBooks in the home (Q4):** As was seen in Figure 4.20, in Figure 4.36 (note that the Y-Axis ends at 40%) we see the numbers of children reading eBooks at home for pleasure or education is very low for suburban school children and for rural school students. Parents of rural school children consider their children as likely to be reading eBooks for pleasure as for education compared to suburban school students who were more likely to be reading eBooks for pleasure.

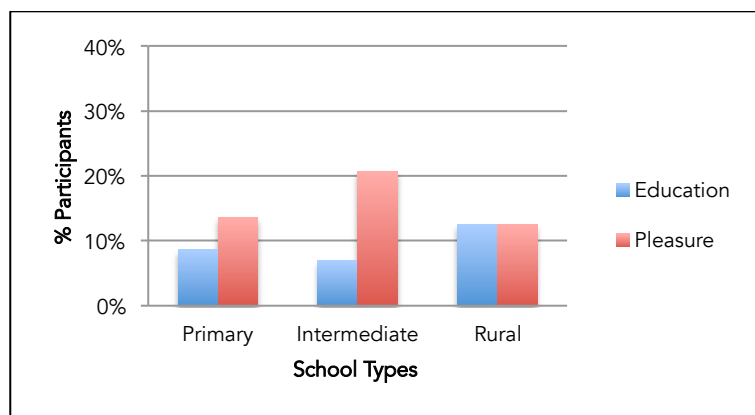


Figure 4.36 Parents report reading eBooks for education at home. n=148

## 4.4. Discussion

This section firstly considers the results of the rural case and their implications are reviewed. Finally, the implications of these findings regarding children’s information seeking is considered for the entire sample of this survey.

### 4.4.1. Considering the Rural Case

From conversations with the principal of the rural school, the researchers were aware that the school has access to both broadband Internet and wireless networking for the

students, and a well-resourced computer lab. As is noted in Section 4.3, the school supplies one to one tablet devices to the students and teachers for use at school.

One of the eight parents who responded to the rural survey specifically answered the survey "sorry, we do not have Internet in our area." This indicates that access to broadband Internet at home for students of rural New Zealand schools is likely to be limited. Factors of access to mobile devices and Internet resourcing for children living in rural or remote locations and attending rural schools is required in future research.

In our study, it was unique to see that 100% of the student body at this rural school had access to a tablet supplied by the school. Interestingly, however, the teachers did not list the tablet as being used to find information for a set task at this school. This is in contrast to the finding that approximately 40% of suburban teachers listed primary school children in suburban schools as finding information using a tablet device at school.

No other significant differences were observed between this rural school and the suburban schools, suggesting that generalizability is possible across these two types of schools in NZ.

At the time of conducting this study, we believed that continuing to work with this rural school would benefit our own and others investigations. The small roll and commitment to the collaborative investigation on the behalf of the school board, the schools parents and the principal create an opportunity to work on investigations in a close manner. Unfortunately, prior to the initiation of the follow-up study (discussed in Chapter 5), this school was closed by the Minister of Education pursuant to section 154 of the Education Act 1989 (New Zealand Government Parliamentary Counsel Office, 2016).

#### **4.4.2. Children's Information Seeking**

While this thesis seeks to investigate information technology use, we also wish briefly to consider the use of the printed medium for information search. At both primary and intermediate level for the schools surveyed, we found here increased use of technology for finding information at home and at school compared to print source use. This increase supports further study of tools for children's digital information search and supports the need for the development of systems that are immediately deployable in New Zealand schools and homes.

This survey suggests that while students in New Zealand are accessing eBooks in very small numbers, this is not yet being driven by teachers in a formal manner for information search or even for reading for pleasure or learning to read. This contrasts the findings of Digital Book World and PlayScience (Shuler, 2013) who report that that over half of all American children in their survey read eBooks. Shuler also reports that 85% of those children who read eBooks are doing so at least once per week. We, therefore, focus further studies presented in this thesis on digital information search on the Internet.

While we are not alone in considering children's use of technology, however, quantification of technology access is little reported. As we discuss in Chapter 3, related work in this area has predominantly focused on the use of technology by children for specific software applications including eBooks, digital libraries, and Internet use, and hardware such as iPads or computers (see Section 3.3). These studies have typically considered children's issues when using these various technologies.

Research has also examined the design of information seeking software, both for and with children (Druin et al., 2001, 2003), but do not quantify the access to these technologies that is expected by the designers and researchers.

While Bull et al. (2002) predicted portable wireless computing would be widespread throughout schools within a decade, a paucity of research has been conducted to confirm the extent to which these predictions have manifested. Our findings here stand alone in their attempt to quantify technology access by children in the home or classroom and should prove useful in assisting with identifying appropriate technologies to target at this point in time.

#### **4.4.3. Limitations**

We chose to engage participants in this survey by approaching local primary and intermediate schools<sup>5</sup> to work as partner schools in this survey. We opted to seek ethical approval to conduct this study with principals' permissions at the outset. This was a factor, which limited the number of responses possible to only schools and school principals that first agreed to participate. Additionally, we chose to conduct paper-based surveys so as not to disqualify parents who did not have access to the Internet or a computing device to respond. These two factors limited the number of reasonable

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<sup>5</sup> As we discuss in Section 2.2.1, New Zealand government-funded schools at pre-high school level (i.e. Years 1 through 8) are typically separated into primary schools (catering to new entrant Year 1 through Year 6) and intermediate schools (catering to Year 7 and 8).

responses that could be expected from a survey of this nature. However, the findings remain generalizable and usable for our purposes. See Appendix A for the ethical approval documents pertaining to this study.

This survey was conducted in late 2012 and an additional rural school surveyed in early 2013. Given the submission of this PhD thesis in 2016 the snapshot of the technology access and use by children found in 2012/2013 may be somewhat different to the situation that would be found in a snapshot taken today. This is evidenced by reports such as (Shuler, 2013) that reports that parents of American 6-9 year olds stated that 61% of their children were reading electronic texts daily, and 74% reading eBooks at least once a week. It is also reported by the Australian Library and Information Association (2015) that eBook lending in Australian public libraries has increased with nearly all Australian public libraries now lending eBooks, showing increases from 69% of libraries lending eBooks in 2013 to approximately 99% in 2015. At this point we cannot identify reports in the literature that indicate how this relates to children's eBook lending in public libraries or school libraries. Our survey is therefore a candidate for continued investigation and warrants being re-run in order to audit the changes that may have occurred in the subsequent years.

We have chosen not to report analysis of comparative technology access by children. We provide tabularised detail of the reported access to technology in Appendix F.

## **4.5. Study Conclusions**

The survey was developed to define the ages at which children used information technology in the home and in the classroom for information search as well as the comparative use of print or technology for information search. We now have indicative answers to these questions that we discuss here.

### **4.5.1.1. Children's Technology Access in the School and Home**

From our analysis of the results of this early study, we observe that children use a range of technologies including tablets, PDAs, smartphones and laptops/desktop computers both at school and at home. Therefore, information search solutions and further research in this area should not be constrained by a specific technology. We would argue that the availability and use of mobile technology across the age ranges suggests that these technologies should also prove of interest in future research.

While we observed that there is information technology utilization and access across the range of year levels surveyed, the later year levels do see a slight increase in their access and use of information technologies. For finding information teachers reported the very high use of tablets by Year 5&6 students while parents reported that Year 5&6 and Year 7&8 children were likely to use tablets, PDA and smartphones very highly.

This study has included investigation of information seeking technologies in both the home and the school. We reported high use of a range of technologies both in the home and the school, and our following studies could be conducted in either environment. We will focus our studies on the in-school use of information technology in the remaining chapters for consistency of the results presented in those chapters and due to the relative ease of participant recruitment compared to seeking in-home participants in the age ranges targeted.

#### **4.5.1.2. Children's use of Digital and Print Information Sources**

The observation that technology use seems fairly spread across all year levels does not assist with decision making for targeting of future investigations. However, our findings may indicate that age group targeting will allow for generalizability of results of future studies.

Unsurprisingly, children at all year levels are seen to have access to and be using computers most highly of the technologies listed by parents and teachers. Equally, print technologies are listed highly for finding information at all year levels. It can be inferred from the data that parents and teachers consider that print is used less than computers for finding information.

Given the higher numbers of parents and teachers describing technology access across the range of technologies discussed in this survey at 5&6 (9 and 10 years old) and Years 7&8 (11 and 12 years old) it is likely that these will be fruitful year levels to concentrate on with future studies.

#### **4.5.1.3. Appropriate Focus Years for Further Study**

Given the relatively high use of some of the mobile information technology devices such as Tablet in the home and the classroom, it is interesting still to see limited use of eBooks in the home and classroom. Reasons for this low uptake are unknown and bear further investigation. The low use of eBooks and library catalogue use, along with no discussion

of digital libraries or other digital documents by teachers or parents suggests that this thesis should focus on Internet technologies.

The higher numbers of responses of both parents and teachers at these year levels (see Table 4.1) indicates a willingness to participate in studies of this nature and suggests that these are suitable year levels to target with future research. For the studies that followed this and detailed in the following chapters we, therefore, considered age group selection based on the impact of comprehension or reading skill on the task alongside these findings.

## 4.6. Chapter Summary

This chapter offers a snapshot of the current situation of ICT use for information search in New Zealand classrooms and homes. We identified the specific technologies that are being used by children. We identified school-year-level bands where increases in technology use or technology access occurs. The data gathered showed that technology use for information finding was higher for children in years 5&6 and 7&8. This survey has also begun to answer our question of whether children search for information in print or using digital devices, however, presently we do not attempt to argue why they use a particular medium more than the other. Moreover, we identified some of the disparities present in the suburban and rural school situation in NZ. The results of our analysis lay the foundations for our research into methods of facilitating children's digital information seeking. Additionally, the insights presented in this chapter will aid researchers in related areas with the provision of concrete evidence of the use of specific ICT and information sources.

This chapter has further addressed RQ1 (see Section 1.2), exploring when and how children are interacting with information technology and resources.

**RQ1** seeks to discover the ages at which children are using information technologies. To inform the development of the studies discussed in the chapters that follow we sought evidence of year level ranges where ICT is available and used for information seeking. The three compelling reasons for focusing our future studies on years 5&6 and 7&8 are: the higher use of technology for information seeking observed in this study; coupled with evidence from the literature that explores children's cognitive development; and the expectations of educational ability at these ages. The results of Chapters 5 and 6 will further confirm if these education bands are appropriate for our studies for this thesis.

RQ1 also seeks to expose where children are using these technologies. Clarification of where the technology is used allows for the development of studies that are conducted within the appropriate environmental spaces. Our study shows that a range of technologies including tablets, PDAs, smartphones and laptops/desktop computers is available and used by children both at school and at home across the range of year levels that we surveyed. Further, we observed that children in all schools surveyed were most likely to use either a computer or print source to find information. Highlighted in our survey was limited Internet and technology access experienced by some children in the home, particularly in rural areas. The findings of this survey will assist with the development of appropriate future studies.

## Chapter 5.

### Children's Perceptions of their Internet Search

Chapter 4 has given insight into the range of technologies that children use to search for information in both formal educational settings and in their daily recreational activities. Questions remain regarding: when children search for information on a given topic; how they go about searching for and retrieving information; what their information seeking strategies can tell us about the development of search interfaces for children's digital libraries, search engines, and information repositories; and what children perceive as difficulties or advantages when searching for information.

To work through these questions, we conducted a two-part interview study with New Zealand primary school and intermediate school children and teachers. The present chapter focuses on the interviews carried out with children while Chapter 6 discusses the interviews carried out with those children's teachers. This chapter specifically addresses children's information search and use of information search tools within a New Zealand child's educational pursuits.

The chapter is structured as follows: we describe a semi-structured interview that we conducted with children in the Waikato School District of New Zealand in late 2013 (Section 5.1). Our analysis provides a working process of children's online searching for information in NZ classrooms (Section 5.2), from which we describe how children search for information and identify issues encountered by children during their information seeking (Section 5.3 to Section 5.5).

This chapter and the next continue to address RQ1 (see Section 1.2): *when and how are children conducting digital information seeking?* Further, these two chapters begin to address

RQ2: *what are the issues children encounter when using digital information seeking technology?*

Early versions of parts of this chapter have been previously published (Vanderschantz, Hinze, & Cunningham, 2014b).

## **5.1. Study Method**

We conducted a series of semi-structured interviews with children at two of the primary schools and one of the intermediate schools that participated in the study detailed in Chapter 4. These interviews explored how children perform a search task, what issues children perceive they have with searching, what sorts of information they are looking for, who is setting these search tasks, and how children are prepared for these search tasks.

Each of the interviews took approximately 20 minutes to complete. Interviews took place in the classroom with the teacher present in the room. The interviews were audio recorded, and handwritten notes were also taken. A combination of audio and field notes was used for the analysis reported in this chapter. Audio from the recording was not always reliable or able to be accurately transcribed due to the boisterous atmosphere common in modern NZ classrooms. Interview answers were analysed based on a combination of audio that was transcribable as well as written field notes. These interviews took place in the final school term of 2013.

### **5.1.1. Participant Recruitment**

When developing a study in which age and cognitive ability are influencing factors, a particular age range or developmental level must often be targeted. In Section 4.5.1.3 we began to discuss our findings regarding an appropriate age-range to target for our investigations. Additionally, in Section 2.1 we discussed Jean Piaget's stages of cognitive development and Demetriou's cognitive developmental milestones. Taken together, these two theories suggest that children at 12 or 13 years old and older can be or can become effective problem solvers, and thus, younger children will require further assistance with problem-solving. We, therefore, hypothesize that there is a need for solutions to assist these younger information users. This study and those that follow, therefore, focuses on children at Piaget's *concrete-operational stage* and early *formal-operation stage* or at Demetriou's *Logical Necessity* phase – children who are 9, 10 and 11 years old. For this reason, we targeted children who were in year levels Year 5 through Year 8 for this and all remaining studies in this thesis.

Participants in our present study included boys and girls from two NZ primary schools and a single NZ intermediate<sup>6</sup> school. Our goal was to identify a sample of male and female children being taught by a range of teachers at more than one school within the given year levels of Year 5 to 8.

Two primary school principals, and one intermediate school principal, in the Waikato School District, gave their permission to have their school take part. We refer to the schools as Schools A, B, and C, which, are rated as Decile 4, 5, and 9, respectively.

Each principal identified three Year 5&6 or Year 7&8 teachers who were invited to take part in the study. Teachers were explicitly informed that they were not bound by their employer to participate in the study and that there would be no employment ramifications for participation or removal from the study at any time. To the best of our knowledge, all teachers who were invited to become involved in this study chose to participate. Student participants were drawn from the classes of teachers who agreed to take part in the study. Student participants were given parental ethical consent forms to take home (see Appendix B). No children whose parents did not give consent participated in this study.

Because we were working with so many different schools and required explicit ethical approval and formal written agreement by each school's principal we did not develop a true random function for the selection processes. Participant information sheets and ethical consent forms for the Principal, Teacher, and Parent can be found in Appendix B.

### **5.1.2. Participants**

Following the procedure detailed in Section 5.1.1, we gained permission to interview 12 students at School A and 10 students at School B, distributed across 7 classes over the two schools (four classes from School A and 3 classes from school B). These 22 students comprised 8 Year 5 (3 male and 5 female; 9 and 10 years old) and 14 Year 6 (6 male and 8 female; 10 and 11 years old). At school C, we gained permission to interview 3 Year 7 (2 male and 1 female; 11 years old) and 9 Year 8 students (4 male and 5 female; 11, 12 and 13 years old). We, therefore, interviewed a total of 34 students across three schools and 4 year levels.

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<sup>6</sup> As described in more detail in Section 2.2.1, primary school in New Zealand typically includes Year 0 through 6, and an intermediate school typically includes Year 7&8 students.

Table 5.1 shows the age, gender and year level of each of the interviewees to assist the reader when interviewee quotes or paraphrasing is offered later in this chapter. Throughout this chapter, we refer to individual students by an identifier indicating gender, age, and a unique letter identifier, i.e., F10A is a 10-year-old female who is in Year 6.

**Table 5.1 Students who participated in interviews**

ID	Age	Gender	Yr. 5	Yr. 6	Yr. 7	Yr. 8
F10A	10	F		✓		
M9A	9	M	✓			
F11A	11	F		✓		
F10B	10	F	✓			
M10A	10	M		✓		
F9A	11	F	✓			
F11B	10	F		✓		
M10B	10	M	✓			
F11C	11	F		✓		
M11A	10	M		✓		
F10C	10	F		✓		
F11D	11	F		✓		
F10D	10	F	✓			
F9B	9	F	✓			
F11E	11	F		✓		
M10C	10	M	✓			
M11B	11	M		✓		
M10D	10	M		✓		
M11C	11	M		✓		
F10E	10	F		✓		
F10F	10	F	✓			
M10E	10	M		✓		
F12A	12	F				✓
F12B	12	F				✓
M12A	12	M				✓
M12B	12	M				✓
M11D	11	M			✓	
M12C	12	M				✓
M11E	11	M			✓	
F12C	12	F				✓
M12D	12	M				✓
F13A	13	F				✓
F11F	11	F			✓	
F13B	13	F				✓

The classes at all three schools have a typical range of 24 to 27 students per class. Thus, 4 students from each class would have given us an approximate sample size of 15% of each class (we obtained a sample size of approximately 12.5% of our potential population).

Figure 5.1 details the distribution of ages of the interview participants while Figure 5.2 gives the distribution of year levels of the participants in these interviews.

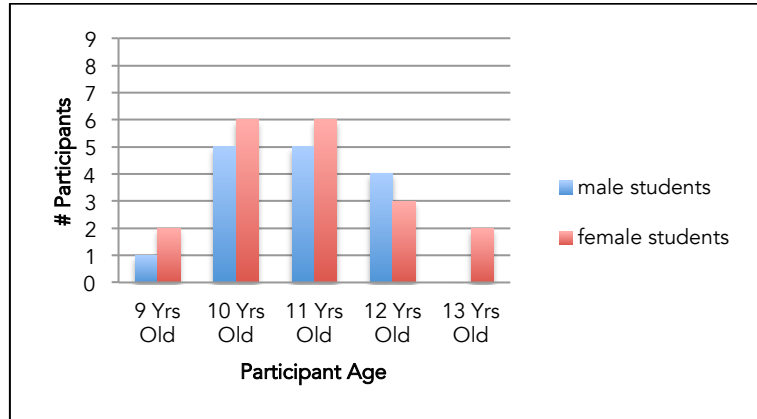


Figure 5.1 Distribution of ages of participants

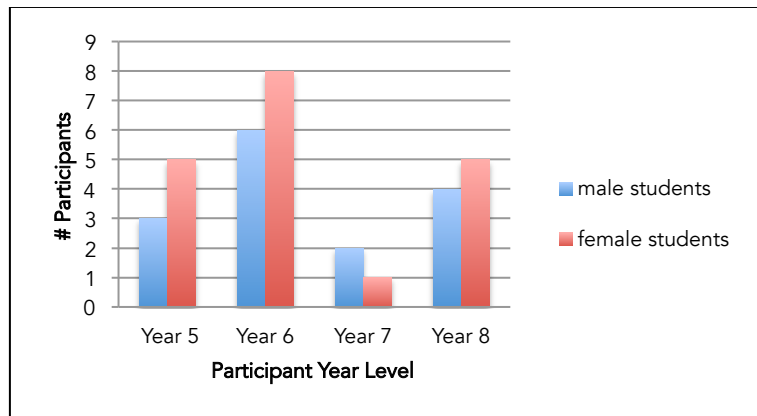


Figure 5.2 Distribution of year levels of participants

### 5.1.3. Interview Questions

After gathering demographic information, the researcher prefaced the interview by saying: “My questions relate to the most recent task that your teacher set where you searched for information on a topic.” The interview questions and their probes are shown in Figure 5.3. Not all students were asked each probe.

The presentation and layout of the researcher's field notes document can be found in Appendix B<sup>7</sup>.

- 1) What topic did you investigate?
- 2) Did your teacher set the topic of investigation or did you choose the topic to investigate?
- 3) Where did you investigate this topic:
- 4) Did the teacher or librarian teach you about how to investigate this topic? What?
- 5) What resources did the teacher or librarian tell you to use?
- 6) What resources did you use?
- 7a) What was hard when *searching* for digital information?
- 7b) What was easy when *searching* for digital information?
- 8a) What was hard when *using* digital information?
- 8b) What was easy when *using* digital information?
- 9a) What was hard when *searching* for printed books?
- 9b) What was easy when *searching* for printed books?
- 10a) What was hard when *using* printed books?
- 10b) What was easy when *using* printed books?
- 11) Can you describe your process when searching using computers or iPads etc.?
  - What did you do next?
  - How did you do that?
  - What did you type?
  - How did you choose from the result list?
  - What do you do when you visit a page?
  - What if you can't find information?
  - How do you change your search terms?
- 12) Can you describe your process when searching using printed material or books etc.?
  - What did you do next?
  - How did you do that?
  - What if you can't find information?
  - Probes as appropriate
- 13) Do you prefer printed information or information on computers?
- 14) How did you submit a result for this task?

**Figure 5.3 Children's interview questions**

These interview questions can be grouped as follows:

- Information Seeking in Classrooms (Q1, Q2, Q3, Q4, Q5, Q6 & Q14)
- Senses of Difficulty or Ease Experienced During Search (Q7, Q8, Q9, Q10)
- Preference for Print or Digital Information (Q13)
- Children's Computer Search Behaviour (Q11)
- Children's Book Search Behaviour (Q12)

We structure the results sections (Sections 5.2.1 to 5.2.5) of this chapter according to these five headings.

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<sup>7</sup> Examination of the field notes form (Appendix B) will show that some questions have check boxes for the researchers benefit. These pre-defined options printed on the field notes sheet were not shown to the interviewee nor used as prompts.

## 5.2. Results

We report here the results of our interviews with New Zealand school children about their information search experiences. We present the results according to the classifications that we outlined in Section 5.1.3. Questions that led to responses that have been deemed outside the scope of this thesis have not been reported and are identified where relevant.

### 5.2.1. Information Seeking in Classrooms

Questions 1 to 6 and Question 14 (see Figure 5.3) were designed to give an overview of information seeking in classrooms.

#### 5.2.1.1. What Types of Tasks are Children Undertaking?

23 of 34 students interviewed stated that they selected their own search topic for investigation from a larger topic area or "big idea." In 7 of 34 cases, the teacher initiated the investigation that the student discussed. In only four cases did a student discuss a topic that they themselves had initiated.

The types of topics that students described when answering this question were: my culture, kitchen chemistry, historical events, celebrities, environmental issues, global or galactic studies and human rights investigations.

Children presented the results of their investigations in a range of ways, including speeches (6), essays (10), slideshows or slide show presentations (5), posters (8), dioramas (2), written in homework books (1) and as a student-constructed book (1). We are missing data for one student.

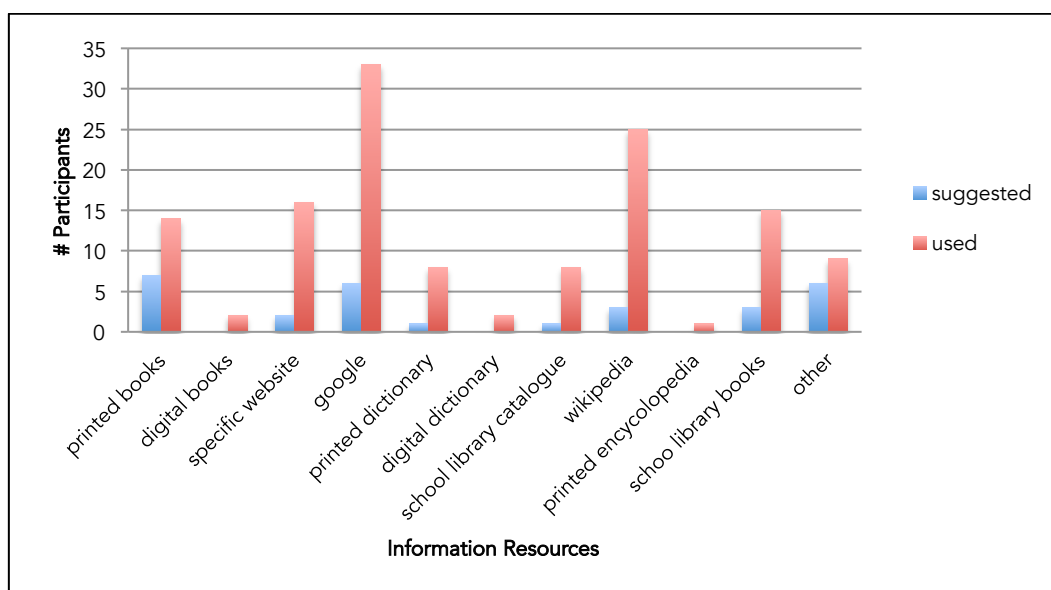
#### 5.2.1.2. Where are Students Undertaking these Tasks?

The majority of the students reported that they conducted much of their information seeking both at home and at school (20). Seven students reported conducting their information searches only at school while seven reported conducting their searches at home only. When reporting information seeking at school, 25 students described doing so in the classroom, and nine reported conducting their investigations in the school library. One student [F11D] reported using the public library as well as conducting research at home and the school library and classroom.

### 5.2.1.3. What Resources are Children Using?

15 students recalled being advised by their teacher to use specific resources. This is not to suggest that the teachers only recommended resources in 15 instances, simply that 19 of the children did not recall any recommendations for the particular search topic that they were discussing. However, students did state that when they approached the teacher with questions or for guidance that the teacher was able to offer feedback and advice to assist them with their searches when required.

Figure 5.4 lists the information resources that children described using and being recommended by their teachers or a librarian.



**Figure 5.4 Information resources described by children**

When comparing recommendation and use of digital and print sources and tools, we find that Google and Wikipedia were most frequently used. Digital information sources were described by the students in twice as many instances as print sources were. Scarce use of digital books or a digital dictionary and no use of digital (commercial) encyclopaedias was reported. Printed books and school library books constitute the most used print resources reported by the children. No child used a children's search engine.

Four female students [F12C, F10A, F11F, F11B] also described parents as a resource that they had used when conducting information searches. Two of these four students also listed parents as a resource that a teacher had suggested for this information search topic. The public library [F10B], a public library catalogue [F11D] and a card catalogue [M11C] were three further resources that children listed as being used during this information

search topic. Laptops and the school ICT suite were also listed as resources that they had utilized by two of the participants [M11D & F10A].

#### 5.2.1.4. Instruction or Training

17 children described training or instruction about information search processes and strategies having been given by teachers or librarians this year and 13 children described training in previous years. Seven children reported being taught to use Keyword searches or to reduce questions and sentences to Keyword or Topic searches by removing the "small" words such as "a", "and", "the". Three children described being taught to use question or sentence searches. A further six children stated they had been taught Internet and Google use such as how to enter a search and how to select or use information and websites. One child (1) described the Reading Level filter in Google. Suggested or trusted websites including Wikipedia, Google, and BBC Kids were listed by three children as having been taught. Triangulation of information sources was described by three children. Two children were able to detail how they were instructed to use search operators including "+", "and", and the use of quote marks when searching.

Finally, five children mentioned having been taught book search techniques by librarians and teachers. These book search techniques included the use of the spine of a book for call numbers, using "quick find" (the school library OPAC), and the book features such as the index and table of contents.

## 5.2.2. Difficulty or Ease Experienced During Search

We asked the children what was "hard" and what was "easy" when searching using computers and using books.

### 5.2.2.1. What Children Find "Hard" When Searching Using Computers

The children described five distinct difficulties in searching for information on computers: creating search queries (15), selecting an appropriate website from a search list (10), spelling search terms correctly (8), and understanding the language used in search results (1) and confirming the information that they find is correct.

#### Query Construction

Almost half of the students (15 of 34) reported difficulties in identifying appropriate search terms or knowing how to construct a query. M11A offered: "[it's] hard to find the right thing to type in."

## Spelling and Language Level

The difficulty of knowing how to spell a search term was also a common complaint; “I can't spell well so that can get in the way. I am a bit of a slow typer” [M11C].

The language level of websites and the terminology used in the descriptions and website titles presented in search engine results page (SERP) was discussed by one student. F10E stated that she sometimes struggled to read the content of some websites and therefore, she chooses a reading level setting of “Basic” or “Intermediate” using Google’s “Advanced Search” filters. Eight children described the Reading Level Filter, for assisting with filtering Google searches for content that is focused on children’s reading and comprehension abilities.

### Information Triage (Identifying a Potentially Relevant Website from a SERP)

Children found it difficult to judge relevance from the site summaries presented by Google; for example, “some don’t give the answer you are looking for. They tell you something different, something related [but tangential] and lead you in the wrong direction” [F11C]. If the child doesn’t spot a relevant site then she or he may conclude that the information can’t be found online: “sometimes there are no websites so [I] have to go to books. It says website not found, or people don't have an interest in it so didn't make a website for it” [M11B].

### 5.2.2.2. What Children Find “Hard” When Searching Using Books

Approximately half of the children (18 of 34) noted difficulties identifying and locating a relevant book in the library. Children cited a range of issues, including problems in understanding of the library geography and the library catalogue (Dewey Decimal) conventions [M11B], in using the catalogue [F10C] and in identifying catalogue cues on spines of books [M11B]. Language level was mentioned by two students as particularly challenging when reading and finding information in printed books. M9A simply stated that books have “heaps of words” while F11B said that “reading the adult text [is hard].” Only one student [F10E] described the language level of websites and digital content as proving difficult for her at times. No child described having language level or reading issues with both digital and printed sources.

Children seemed to believe that books might not have the information they needed; M10E stated that there is only a “limited number of books,” while F10E suggested that “sometimes [I] can't find the right books – library [might] not have [it] or someone else has it” and M11C stated “if [you are] looking for something quite specific it can be hard

'cause they might not have the books," and finally M11B concluded "sometimes there are no books on a topic." F10C stated, "books don't always have what you are looking for."

Children also noted that searching shelves can be hard; M10C complained that there "can be too many books in a big library, but there can be lots of good information in lots of books" and F9B stated that "[books with the] same title but different authors is confusing. Not having a book I am looking for [likely because it is on loan]. Fiction vs. nonfiction is confusing and knowing which area of the library is which is confusing." Using the spine of the book on the shelf can also be an issue; M11B stated that "non-fiction numbers can be hard to remember and hard to find on the spine," while F10D noted "if lots of books [it can be hard]. So you have to search on the research computer, and it gives a number or letter. It's easier looking for letters than numbers."

The physical library appeared to the children to offer less support in determining relevance than is available online. Specifically, children identified a lack of synopses in library catalogues "[I] have to really look to find the books that will have my information" [M9A]. They found it harder to spot a relevant book on a physical shelf than to identify a relevant website in search results: "looking at the shelves—are the books relevant? Catalogue does not give a synopsis" [F11D].

### 5.2.2.3. What Children Find "Easy" When Searching Using Computers

Approximately two-thirds of the children interviewed (24 of 34) were able to describe aspects of searching for digital information that they found easy. Paramount was the seeming simplicity of asking a question and getting an answer; "sometimes the answer you want comes straight up" [M10D] and "I get an answer straight away – starting out is easier, getting specific information is hard" [M10C]. How to use a search engine (where to type a query, what to click to open a search result etc.) is well understood by these 9- to-13-year-olds. F10A stated, "typing in the question" was easy while M9A said, "searching the information using the search box and clicking the links" is easy.

Children also noted the wealth of information available online: "it's easy when lots comes up" [M11B] and compared to working with printed material, online searching is "fast, not needing to read or look at the chapters of a book. [websites] usually give[s] the answer to my question" [F11A].

#### 5.2.2.4. What Children Find “Easy” When Searching Using Books

17 children were able to identify an aspect of using the library or searching for and using printed books that they found easy. However, 3 children stated specifically that there was nothing easy in the library, or they did not use the library while 14 children could not identify something easy.

The catalogue was described as easy; “the catalogue [returns] more relevant search results [than Google]. Only gives books with [my keyword] in the title, no irrelevant search results” [F11D]. F10D stated that for her, “searching in the library is easy if the librarian is there to help.” M10C described his ease of use of the library because he was able to “find the section with all the animal books, then you have to find the book you need.”

One student appreciated the relative stability of print in comparison to digital sources, stating, “a print book is always there—I don't need to find the website again” [F10C]. F12B also noted during the conversation that a difficulty when using the Internet was that it could be difficult to keep track of resources and information found. She stated that “when you find something on the Internet sometimes you can't find it again. In a book, when you have it you have it forever.” Managing information is a difficult task at the best of times and children too noted this and perhaps, therefore, there is a way to ease this for them within the search engine itself.

Much like the use of parents as an information resource, three children also noted that the librarian is a useful information resource in a library. F13B “The librarian can help, tell you were types of books to look for are. She can give you other ideas; search terms etc. She might identify other books that might help too.”

Some of the features of information search in print that children identified are slightly mistaken and would likely result in search issues for these children. For example, M9A stated that he would “look around the library for the letter that the topic starts with ‘H’ for Halloween.” The school’s library uses the Dewey Decimal system, and it seems that the child was confused about how books are arranged and the meaning of the book identifiers. Similarly, F10C described using the catalogue as easy because she can “type title or author or keyword.” Of course, this will not work when searching for unknown books or authors, such as typical in nonfiction searches similar to those described during these interviews.

### 5.2.3. Digital Compared to Printed Information Seeking

We asked the children if they had a preference for print or digital information (Q13). Children interpreted this question as inquiring about finding or using information. 14 children described searching for information using computers as being easier while only four children preferred searching books for information. The reasons for preferring computers included "the computer has the latest stuff. The computer is easier for looking for and finding information" [F9A], and the Internet has "more information than the library" [M10E]. The reasons for preferring books included "it's easier to find information in a book. You can use the Table of Contents in a book, too." [F10D]. One of these four children who had stated a preference for finding information in a book described the positives in both media, and also the shortcomings of her (preferred) books; "Books are easier. Books are factual, but not all websites are factual" followed by, "but, the Internet has everything, I don't have books about particular things" [F11B].

While more children preferred searching for information on computers than print, a further eight children expressed a preference for reading in books rather than reading on a computer screen; the reasons given included "it's harder to read on screen. It's more natural to read a book" [F11D]; "It's easier to read in print. The computer has weird fonts" [F11A]; and "I prefer books 'cause I enjoy reading. I do a lot of reading for fun" [M11C]. One of these 6 children [F10A] stated she preferred "reading for a while in a printed book because the computer hurts my eyes" but "I prefer to search for information using the Internet because it is easy, quick and fast."

The remaining eight children could not give a preference, often stating so explicitly. In future interviews, we would instead ask specifically about search preferences (on screen compared to in print) and seek insight into this aspect of information behaviour.

#### 5.2.3.1. Comparison of Ease and Difficulty Using Books and Computer

Although we didn't ask the question "what is easier, print or computer?" we infer from the answers students gave to a range of our questions some of the perceived strengths of computers compared to printed information sources. One 10-year-old girl stated "the computer is easier because you know what to type in and what you want to find out. But in books, you can't type it in, and not all books will have the information you want" [F10C]. This perception was common among all age groups; F12A stated "You can't search for them [books], you have to go and actually look for books. Titles don't always reflect what it is about. It might say it's about sustainability, but it's not at all."

Using and searching for books was often considered harder and more time consuming. M10B described that in the library “you have to find the letter [of the Dewey Decimal system]. The answer might not be on the first page [of the book],” while F11B described “searching the library [can be hard] – not all libraries have a computer.” M11D noted that “It could take a while finding the right book about what you want. [Using the Internet] can be easier than finding books.”

Three children listed the accessibility of digital information as being of advantage compared to printed information. For example, M11A stated “the computer is easier to find information because I have access to it. I don't usually have easy access to printed information books.” M11D also noted that “Laptops and stuff are just easier to access - they are around more.”

Even at this young age, some children had a preference for reading from a printed source rather than a computer screen, for example, F13A noted that “Books can be photocopied easily, and you are not looking at a screen. You are not looking up; you are looking down, and you can use or sit at different angles.”

F11C also prefers the computer: “You have to go through heaps of books to find one answer that you are looking for. Mainly two things on the computer to get the same information.”

Even when our question asked what was easy, we received negative comments about physical book collections from two students; F11C stated “I don't think it is easy to find printed books”, she continued, in answer to the question of what is hard when using books “on a computer heaps of things [pause thinking] you can understand, but in a book it's harder to understand.” F10A stated when asked about the ease of searching for books “I don't look for books in the library for information. The public library and school library don't really have information on kings and queens for my speech.”

#### **5.2.4. Children's Computer Search Behaviour**

We asked children about their search processes. In having these processes explained to us, we discovered a relatively consistent explanation of the search processes when children are searching for books or digital documents. We share snippets from four of the conversations with children about how they search for information on a computer here.

One such explanation by M9A was:

I searched it up on Google. You put what you want to find out in the searching box and just enter it. All you need to do is click on it and write in the words you want to use ... If I don't know much about it (the topic), it's quite hard but if you do know a little about what you want to like search up that is easy. The more I know about a topic, the easier a search box is. I have to describe the item (topic) well.

**Researcher:** What did you type in?

You can type a whole question, but it can be really confusing if it is really long, though. So if it is a really long question try to shorten it down. Then Google doesn't have to think so much. You can write down the whole question or words; you've just got to describe it quite well.

**Researcher:** What did you do next?

You click the links to websites. Then you can look at what you want to look at.

**Researcher:** Did you find the information you were looking for?

Halloween has heaps of stuff about it, so it was quite hard to keep the information I have but shorten it down to different words...

Another conversation with F10A was:

I would usually just go to the computer, and if I don't find anything there I would go to the library... I just search up what I want to find out, and if it comes up, I would write it down in my own words. But if it doesn't come up I would usually just go to the library...

**Researcher:** How do you search it up?

I just if it was Kings and Queens of Ireland, I would put in 'what are some of the kings and queens of Ireland' ... I would just search up a question and if it comes up with an answer ...

**Researcher:** Where are you typing your question?

It would usually be Google ...

**Researcher:** How are you choosing the website to visit?

I would just find the best answer by looking at one of the ones that sound interesting... reading the titles ... cause it would usually have my question in it

**Researcher:** What if it doesn't have your question in one of the titles?

I would search up something different. I would search up 'kings and queens'.

**Researcher:** Do you just read the title?

Under it, there is some more information.

**Researcher:** Do you read that every time?

Only sometimes.

**Researcher:** But not often?

Not really.

**Researcher:** When you click on one of these links to find out more information what do you do?

When I get to that website I just read the paragraph of the information and if I like it I would put it into my own words. But if I don't like it or if it isn't really telling me the answer I would go to a different website.

**Researcher:** So you would just read the first paragraph?

Yeah, I would just read the first paragraph.

**Researcher:** What if the information is not in the first paragraph, do you keep reading?

I would just go down to the next paragraph and read some of it.

F13A discussed searching as follows:

You go onto Google Chrome or one of the user things. I use Google search usually because I find it easier to use. You type in the Google Search box. And just click enter and it comes up with it.

**Researcher:** What do you type in?

Um, what you are looking for.

**Researcher:** How do you type that?

Is that the whole sentence?

No just keywords.

**Researcher:** How do you know what keywords to use?

You know, you see what the main words are in the sentence.

**Researcher:** It comes up with a list doesn't it, what do you do?

You look at the title and see what best fits with what you want. And the background information below the title because there is usually about a paragraph.

**Researcher:** What do you do then?

It loads, and I read down it and see what year it is.

**Researcher:** How do you read down the page?

Top to bottom.

**Researcher:** And you read it word for word?

Yep, usually.

**Researcher:** And you scroll if you need to scroll?

Yep.

**Researcher:** Then what do you do if you have read that page?

I usually go back and find some more information.

**Researcher:** What happens if you have to change your search?

I will then click on a new tab and do another search.

**Researcher:** How do you change the keywords if the first ones weren't right?

I click in the search box and rewrite them.

**Researcher:** Do you enter brand new keywords or do you change the ones you have?

I enter new ones. I rewrite it.

Finally, M12D discussed his experiences searching:

So I normally like to use Safari or Google Chrome for searches. They are the fastest and easiest to use. So I go into them and type into them the keywords.

**Researcher:** Where do you type the keywords?

Into the search bar.

**Researcher:** Is that right at the top?

In Chrome, it is where the Google writing is in the page. And with Safari, it is usually at the top.

**Researcher:** So you type in keywords?

Yeah like 'water' or 'recycling plastic bottles' or you can type in 'what happens to bottle water' or something like that.

**Researcher:** When you have searched, and you have got a list of results, what do you do then?

Well, first I look at the title of the website. Sometimes at the start of the research project I look at Wikipedia because I know that that is precise so after I have looked that up I probably look at other websites and things like 'recycle NZ' I think it is one of the websites I looked at.

**Researcher:** You look at the title to make your decision?

The title and then I looked at what was written underneath it to see if it looked like something that was interesting.

**Researcher:** When you have chosen one of those to click into, what do you do?

So I click into them, and I look at the page, read through it, see if it is very interesting I print it out.

**Researcher:** How did you read it?

I sort of skimmed through it looking for certain keywords.

**Researcher:** Did you scroll the page or just look at what was on screen?

I scrolled it if it was long.

**Researcher:** What did you do then?

I read through them in more detail.

**Researcher:** So do you look around that website or go back to Google?

After I have read that page through more thoroughly, if I have not found something proper to work with I go back, and I look at another website to compare it.

**Researcher:** Another website from the Google list?

Yep.

**Researcher:** What happens if your search didn't find something worth looking at or you needed to change your search?

Well, I looked up something else, with other keywords.

**Researcher:** Would you change all of the keywords?

It depends what I am searching for; I was searching for 'what goes into a landfill' most often and 'certain types of plastics' so I changed certain keywords, but I don't really know any examples.

**Researcher:** What happens if you have found information that is too broad.

I would thin it down; I would add another keyword to the search, something like 'in New Zealand' or something like that.

We model the digital search process in Figure 5.5. From the interviews, we identify four processes (indicated as 1 to 4 in Figure 5.5) that children engage in and three decisions (indicated as A, B, C in Figure 5.5) that are central to children's search tasks when using computers (see Figure 5.5).

Searching for information on computers begins with a new search in Google by entering either a question, a full sentence describing the information need, or a set of keywords (Figure 5.5, Process 1). From here children described the need to make a decision regarding identifying a page to visit (Figure 5.5, Decision A). The children then described selecting a search result in one of five ways (Figure 5.5, Process 2). Once the children have clicked through to a page, the task then requires the location of information (or an answer) on the page visited. Children described three ways in which they sought information on a page within a website (Figure 5.5, Process 3). Once the child deemed that they had completed the use of that page a decision was necessary as to if the page answered their question or not (Figure 5.5, Decision B). If the child felt they had answered the question, they next needed to decide if they had confirmed the answer with multiple sources (Figure 5.5, Decision C). If they had confirmed with a suitable number of sources, the search would likely be considered finished. If the child required further confirmation, they would conduct a new search or select from their previously generated search results list a new page to visit. If a child had not answered their information search on the page, they had chosen they would either conduct a new search or adjust their search terms. Children described using new keywords or a new sentence to adjust their search terms if this was required (Figure 5.5, Process 4).

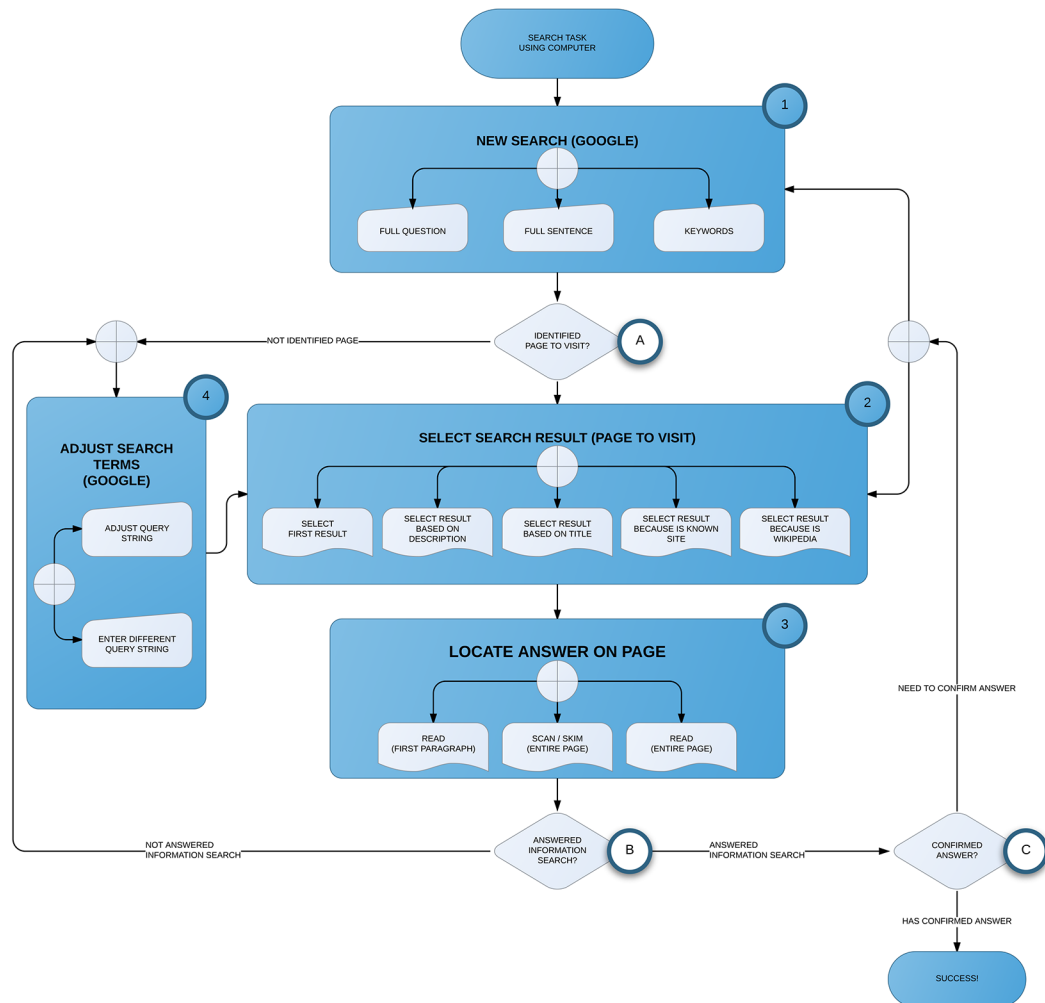


Figure 5.5 Process model of children's computer search behaviour

#### 5.2.4.1. Starting

The children tended to describe using a hardware system to find information rather than a software tool; e.g., one student suggested that “the first thing I do is I go to my book, and I write about the title of the topic, and then I go to a computer, or iPad, or NetBook and I get some information” [F11A]. It became evident that when children described using a computer, they were, in fact, describing using a web browser and search engine. Children only referred to using a digital library catalogue to perform a search when they were specifically asked about finding books. None of the children mentioned using eBooks (or CD-ROM encyclopaedias) or software (other than a web browser) for finding information on a computer. Children seemed to consider Google as synonymous with a web browser. For example, when specifically asked “what do you type in and where do you type it in?” an 11-year-old girl replied, “at my house, I type it into Safari, and at school, I type it into Google” [F11A]. Further, when asked, “what is Safari?” she responded with, “it’s a thing for Apple computers, and it’s just another way to find the,

um, to search up" [F11A]. When further asked, "do you type it into the box in the middle of Safari or the little box right up the top of Safari?" she responded, "I use the box right at the top." We are aware that the first screen that a student sees when opening a web browser at F11A's school is www.google.com. We thus assume that when she searches "Google" at school, she uses the Google search in the web page rather than the browser plugin for the Google search engine such as she describes as "Safari at home."

32 of 34 children explicitly listed Google as the search engine that they used, while the remaining two did not name a search engine.

#### 5.2.4.2. Query Construction

Process 1 in Figure 5.5 illustrates the three ways children described using Google searches. 18 children stated they would use verbose searches, a full sentence (8) or full question (10) within Google while 20 children search using keywords. Four of those children stated they would use both the verbose search and keyword search, but could not describe when one would be more appropriate<sup>8</sup>.

#### Query Qualification and Refinement

Children described methods they use or had been taught which aid the construction or reconstruction of queries. We consider these methods of *query qualification* (*Query Qualifiers*) and *query refinement* (*Query Refiners*). While the numbers of students that noted these methods were low, the numbers of students participating in this study was also low, therefore, the significance of these methods bears discussion here.

M10A noted that he had been taught that using the addition of "for kids" or "for children" at the end of a search can be helpful in assisting with searches that are targeted at children. F10D notes use of the word "facts" or "interesting facts" is a technique for constructing a search query that she uses. Children also described search queries using the words "about", "information", "info", "important" and "interesting" as ways to *qualify* their search topics and thus we term these *Query Qualifiers*.

Children also discussed creating natural language queries with punctuation. M10B discussed using a question mark to identify to Google when he wanted to find the answer to a question.

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<sup>8</sup> The number of children who reported using a particular method within each of the four processes (query construction, search results list triage, in-page triage, adjusting search terms) described may not total to 34. Some children listed more than one method of conducting a process, while other children were unable to list methods for conducting the procedures required for certain processes.

F12A, M11D, M11E, and M12A discussed the Google Basic Reading Filters (now defunct) as tools for refining the search results returned by limiting these to websites with a language level appropriate for their needs, and thus we term these *Query Refiners*.

#### 5.2.4.3. Search Results List Triage

Process 2 (Figure 5.5) illustrates how children described choosing from the search results list they were presented with after an initial search. They described five methods for selecting from a search results list. 14 children chose the very first website in the SERP list, and 18 children made a decision based on the description text below the link title while nine children stated that they used the title of the link to make a choice.

Seemingly 16 children were not triaging at all because they were using a Google search to locate a predefined website. Six children searched Google for a known website, such as BBC Kids, while ten children stated that they searched Google looking for the Wikipedia entry that related to their search.

#### 5.2.4.4. In-Page Triage

Process 3 in Figure 5.5 summarizes how children described locating an answer or finding information on a page. When searching a page for information, eight children stated they read only the first paragraph, 14 children read from the top to the bottom of the page or until they found what they wanted, and 12 children scanned or skim read the page. Three children described using headings to scan the page for the content they were interested in. Seven children did not discuss their habits when using a web page to answer an information need.

#### 5.2.4.5. Adjusting Search Terms

Process 4 in Figure 5.5 illustrates how children described adjusting search terms. To understand this process, children were specifically asked by the researcher the probe to Question 11: "What if you can't find information?".

Children described adjusting a query string in four ways:

- 10 children stated that they changed their search terms [keywords] or shortened sentences to search terms [keywords],
- 6 children adjusted their original sentence or changed their search terms [keywords] to using a sentence as the query string,
- 3 children described adjusting the question or entering a question instead of a sentence,
- 2 children stated simply that they created a new search.

The children struggled with describing strategies for refining searches. It was tough for children at this age to describe what they did when a search was not providing the answer to them. For example, one 11-year-old boy stated, "you may have a couple of options like you could look up one thing and then you ... you, I don't know, type in a different thing, you have to start again and go back and then put in something else that may have something to do with the search ... you just kind of, um, go on and see what happens" [M11A].

Only one student mentioned the related search terms, "at the bottom it says 'related searches' I might try something there" [M11E].

When asked how they modify their search terms, many of the remaining 13 students were only able to respond with "I don't know." These responses clearly point to a need for education and support in effective query refinement.

## 5.2.5. Children's Book Search Behaviour

Children seemed less able to articulate clearly their process with searching for printed information; their search processes for finding books, and finding information in books, was often described in far less detail than given when asked about searching on a computer. One student stated, "I don't look for books in the library for information" [F10A], indicating that she used books in the library for reading for pleasure but not for searching for information to answer a question.

We share snippets from four of the conversations with children about how they search for information on a computer here.

One such explanation by F13A was:

You go onto the school library computers and is *Fast Find* on the left side, and you just type in, and you don't need the correct spelling it just comes up with suggestions about it.

**Researcher:** So when it comes up with a list of books what do you do then?  
You can click on it, and it shows you what letter or number it's under in the library.

**Researcher:** And then what do you do?

Then you go to the letter or number, and you look under it, and it's in alphabetical order by the second letter.

**Researcher:** And then what do you do?  
You get it out and read it.

**Researcher:** How do you read the book

You sit on the sofas and read it

**Researcher:** Do you read it cover to cover?

Yes

Another explanation by F12C was:

I will either look for myself, you know go through every section, like the aisles, etc., and then I will usually, if I am doing that way it will take me a bit of a while, and when I get to a section, and there is a whole bunch of books on a topic, then I will look at which book will have the most detail. If I find a few books that I think will be good then I will look at them and look at what is there and then I will have to, if it's good, then I will have to read through that, but if it's not I will just put it back. But instead of me searching like I can ask somebody, and every now and then if they don't understand what subject you are looking for it can be a bit harder to find the book that you want in the amount of time that you might have.

Another explanation by M12B was:

I would look on Google to see if I could find a book or a book review. I would then go to my local library and see if I could find something that either resembles that or is that book.

**Researcher:** So you have that book name from Google how would you find that book?

I would go to the library and research if that books was available.

Sometimes I would do that at home, so I could go to that library to find it.

**Researcher:** So you would type in the book title?

Yup.

**Researcher:** What if you didn't know the book title?

If I know a definitive author I would go by that, I might let's say I was researching rain; I would type in rain and see what there was on rain.

**Researcher:** And so what happens? You get a list like Google?

Yes, you get a list, but it's a more refined list because they are all books and whether they are all available and all the information you need.

**Researcher:** So what do you do from there?

I would decide, I would do it in a relevant order for what I am looking for, I would decide what is the most useful for what I am looking for.

**Researcher:** And then what do you do?

I would find it, I would borrow it from the library, I will read what I can, and I will reference correctly so I can go back to it at any later date and I will put it into whatever I am doing.

**Researcher:** How do you find that book?

Usually, it will have a library number, and you can go and find the appropriate library number because libraries have it all in a logical order.

And once you have found it you take it to the library and borrow it.

**Researcher:** So you take the library number and do you just look for that book?

Sometimes I would make a list of all the relevant books and then do the referencing and the reading.

**Researcher:** Do you look at the books at the library or do you take them out?

Sometimes I might look at them and flip through and look at an example page and go okay this is worth the effort and then get it out of the library then.

We model the book search behaviour described by children in Figure 5.6. From the interviews, we identify two processes that children engage in and two decisions that are central to their search tasks when searching for information in books (indicated as 1 and 2 in Figure 5.6) and two decisions (indicated as A and B in Figure 5.6). All children described searching for a book as beginning with a new search in either a school or public library. The children described one of two methods (Figure 5.6, Process 1) for locating books in a library.

From here children described the need to make a decision whether a book exists that serves further investigation (Figure 5.6, Decision A). The children then described locating information in a book in one of five ways (Figure 5.6, Process 2). Once the children have analysed the content of the book(s) often at the shelves, the final decision was to consider if the children had answered their information search (Figure 5.6, Decision B). Differing from the information search on the computer, there was no discussion of a need to confirm sources when using printed material. Additionally, children did not seem to have mechanisms to adjust a book search should they reach the conclusion that they could not locate a book to further the search. Nor did children have strategies for when they were unable to answer their question with the books they did identify as potentially relevant.

Should the children conclude, they could not answer their search tasks using printed books they were likely to seek assistance from a parent, librarian, or teacher, or seek information on the Internet.

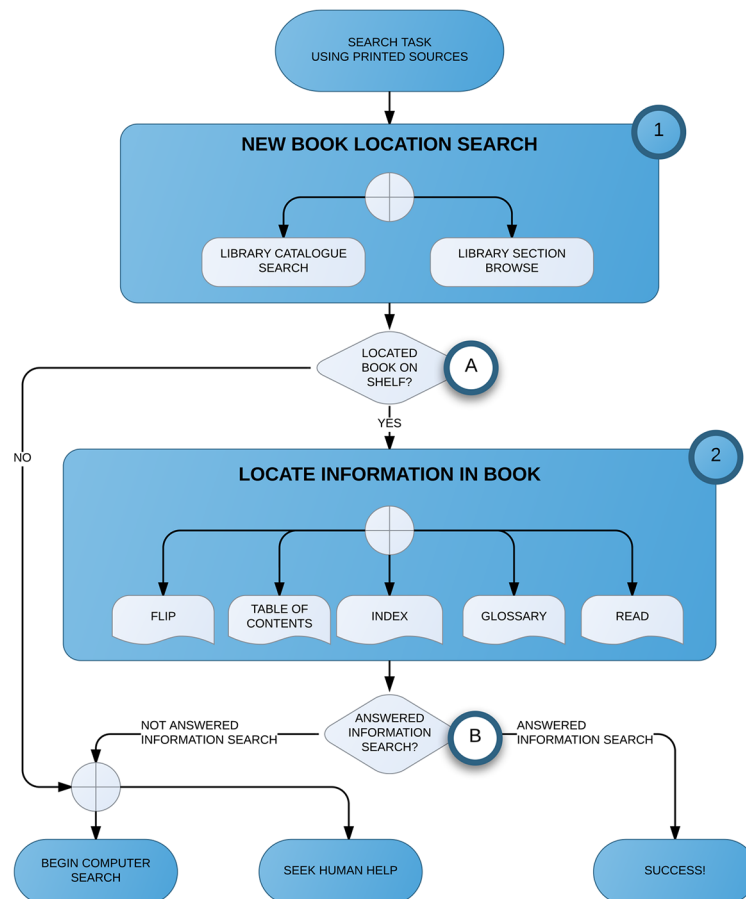


Figure 5.6 Process model of children's print search behaviour

### 5.3. Discussion

We discuss in this section the relationship of our findings to existing literature along with outcomes of note with regard to children's information seeking in New Zealand classrooms.

Children discussed having conducted open-ended investigations using a range of information sources. This is in line with pedagogies that follow Socio-cultural or Constructivist theories (typical in New Zealand). Students often defined sub-research questions within a topic area set by the teacher which is similar to the types of projects that Penny Moore (1995) described in her research with NZ children almost 20 years ago.

#### 5.3.1. Loss of Structured Search Strategies for Print Material

According to our interviews, children used both computer and printed information sources, while Moore's (1995) work only included children searching for printed information. Moore concluded that students had a simple rule for finding information; "think of a question, identify its keywords, look up the subject index for a Dewey

number, go to the shelves and find the answer in the exact form it is wanted” (1995, p. 28). We find that our interviewed students could not describe such a strongly structured approach to finding information in print. This suggests that 20 years on, children do a worse job searching *in print* than they did in Moore’s observation studies.

Children are also less likely to persevere with a print-based search that is not succeeding than with a computer-based search that is not succeeding. If a search for print-based information is not succeeding, children will seek adult intervention or begin an Internet search. Children were unable to define methods for adjusting print-based search strategies that resulted in continuing a print-based search without intervention. When searching using printed documents and books compared to searching on the computer, children are likely to seek adult intervention more often or sooner in the process.

Even though our study did not focus on reading but rather on search strategies, children indicated a preference for reading on paper vs. reading on screen. Our own research (Hinze, McKay, Vanderschantz, Timpany, & Cunningham, 2012) observed a similar preference in visitors to tertiary academic libraries. In both studies, similar arguments were used to describe limitations of access to information, quality of information and comfort of reading in print.

While there are some insights from children’s interactions with print material that can suggest improved interfaces for children’s digital collections (e.g. Cunningham, 2011), it appears that more substantial gains to the children themselves will come from research targeted at improving the digital information seeking experience rather than targeting better support for search in print collections.

### **5.3.2. Structured Search Strategies for Online Information**

For the children interviewed, it seemed that digital search was often understood to be synonymous with searching the Internet (in particular, using Google). These interviews clearly indicate the significant use of Google and no use of dedicated children’s search engines, digital libraries, eBooks or digital encyclopaedias.

We have no data for why these children do not use child-centred tools. However, it remains questionable if these tools would have changed the overall results, as Jochmann-Mannak (2010) found that children did *not* perform better when using search tools specifically designed for children. We, therefore, argue that, rather than developing

dedicated children's search tools, an enhanced Google search user interface may better serve children's needs.

The children described in great detail their strategies when searching for information using a computer (Figure 5.5), which was more detailed and structured than that for print material. Similar to Moore's simple rule for finding print information, our interviewed children seemed to follow a process for finding digital information: think of a question, identify an appropriate search query, enter this into Google, assess the search results list for the answer in the exact form that it is wanted and proceed to the web page that contains the information in the exact form that it is wanted. As we discuss in more detail below, the process that the children followed in searching for digital information aligns fairly closely to Kuhlthau's (2004) Information Search Process (ISP) model.

However, while the children do claim to follow a structured process, separate elements within the process need improvement for some students. When the children select a search result from a Google search results list, children claimed to analyse the presented list for information to make a decision, but many claimed simply to select the first entry in the list. Such lack of selection strategies may result in slow search or selection of lower-quality results. Similarly, when locating an answer on a web page, several children described reading only the first paragraph, while others claimed that they skimmed or read the entire page. If the answer to the student's question is not in the first paragraph, they are likely to dismiss the page altogether and therefore, miss valuable content during their search and should they read the content word for word the process is liable to be slow and tiresome.

The children in our study identified three major difficulties with constructing searches, identifying relevant information in search results lists, and finding the information contained in web pages.

### **5.3.3. Process Models for Children's Information Seeking**

From our interviews, we developed two flow diagrams, describing the children's search strategies when working with digital (Figure 5.5) and print (Figure 5.6) documents. Our models align with Kuhlthau's (2004) ISP model, in which she identifies *initiation, selection, exploration, formulation, collection and presentation* as the six phases of an information search. Our interviews aimed to elicit some insight into all six phases of the ISP. However, our models of children's information search refer predominantly to the

*exploration* and *collection* phases of Kuhlthau's model. Kuhlthau's work additionally considers the emotions and feelings associated with each phase of the search process.

We do know from these interviews that in Year 5&6 and 7&8 classes there is some self-selection of topics to investigate by children and some freedom for children to explore their information search inside and outside the classroom. All children in our interviews described beginning the selection process by using the computer rather than book searching. Thus, NZ children and teachers in these year levels undertake some of the procedures required in the *initiation* and *selection* stages of Kuhlthau's model.

The interviewed children described difficulties in the *exploration* stage with constructing search queries at the outset of an information seeking problem. M9A discussed this need to explore a topic "the more I know about a topic, the easier a search box is. I have to describe the [topic] well." Children explored the search space to assist themselves in developing search terms. Adjusting search terms was difficult for many of the students to describe, with 13/34 unable to describe how they go about adjusting an unsuccessful search term.

*Formulation* was described by the children when they detailed browsing, skimming, and reading search results lists and web pages. It was during the exploratory and formulation phases that children were developing and refining their queries—and finding these stages difficult. The children understood the importance of relevance checking in the *collection* stage; specifically, they discussed the need to check sources and confirm answers using more than one website.

The *presentation* mode of the information was dictated by the assignment and involved a range of outputs including traditional essays, and speeches, as well as slideshows, posters, and dioramas.

The majority of the issues raised by students in our interviews and much of what our process models describe fall within Kuhlthau's *exploratory* and *formulation* stages. Further research of these middle two phases of information seeking by children is required so that we might best support query construction and query refinement as well as link selection from search results lists and document triage. This additional research assists to prove our own models and explore further Kuhlthau's model used with younger children.

Even though the ISP model of information seekers focussed originally on adults and high school students, we found it also applies to younger children such as the primary school students interviewed in our study.

#### **5.3.4. Limitations**

Our models at this early stage in our research are indicative and reflective. These models must be considered with reference to our small number of participants and the interviews with children that rely on children's recollections of their search strategies. In Chapter 8, we begin to test these models through contextual inquiries during children's information search. Further work beyond this thesis will investigate methods including log analysis of children's information searches as well as the use of these models to predict the search strategies of further groups of children.

We discussed here that Google is the most referred to search engine in New Zealand schools and by New Zealand children. This is offered up by the children and teachers in their responses to questions 3, 5, 7, and 8 (see Figure 5.3 and Figure 6.1). While we did not seek specific insight into the search engines that children used we believe that these interviews are indicative of the majority of New Zealand children using Google as their search engine of choice and equally that very few if any, New Zealand students use a children's search engine.

We used a non-targeted, non-probability sampling procedure when selecting participants for this study due to ethical procedures of our institution and the need to ensure that we do not incur undue difficulty for our research partner schools. In so doing we believe we have still gained a fair cross section of responders to our interviews. Due to the reasonably small numbers of students interviewed in this study we have not attempted to analyse the results presented according to age ranges, year level ranges or genders as statistical significance would not be reportable.

#### **5.4. Study Conclusions**

Here we discuss the finding of this study and their implications for research pertaining to the development of information search interfaces that serve children.

### **5.4.1. Constructing Searches**

Children stated that they struggled with knowing what would make a good search query for their needs and how to identify ways to improve search queries that they had tried. Research has shown that adults conduct few query reformulations or subsequent searches (Spink & Jansen, 2004) while older children appear to reformulate search queries regularly (Bilal, 1998; Bilal & Kirby, 2002). Solutions that support and assist with query formulation and reformulation are not broadly implemented for children or adults in current search engines or digital libraries.

Given the number of children who reported using full sentences or questions, the affordance of natural language queries supported by Google is clear. Further assisting children to recognize when natural language is an effective query process and what to do when natural language searching fails may be necessary for search engines. Research is needed into interfaces that assist with formulating appropriate natural language and keyword queries, as well as support for finding synonyms or alternate query terms and query strings when an initial search attempt fails.

Correct spelling of search queries was again found to be difficult for children (e.g., Druin, 2009). We did not gain information about if and how the children used Google's spelling suggestions. Druin et al. (2009) suggest that the reason that Google's semantic search suggestions do not assist children presently is because children are looking at the keyboard when typing and therefore, do not see the query suggestions. Solutions that solve this disconnect will help here also.

### **5.4.2. Identifying Relevant Information within SERPS**

Children stated that they selected web pages from a search results list based on the location of the item (i.e., selecting first in the list), the item being a known website (such as Wikipedia), or the title or description containing search terms from their search query. More clearly highlighting search terms within the search results list or the resulting web page (such as seen in Google books) will benefit children when they triage search results lists.

Children also reported seeking answers on Wikipedia by conducting a search in Google and scanning the search results list for the Wikipedia entry.

Likely the simplest solution here would be the additional education in search practices, including the use of Search Operators, Advanced Search functions or the inclusion of such features into the search engine interface.

### **5.4.3. Finding Information on Web Pages**

Children described reading an entire web page, skimming web pages or only reading the first paragraph of a web page in hopes of finding answers to their information needs. Surprisingly, no children reported searching within websites using either browser search functions or site search engines. Highlighting of search terms within the result pages would help in identifying the target information.

### **5.4.4. Browsing vs. Searching**

Some researchers suggest to support children's information need by browsing rather than search (e.g., Bilal, 1998; Bilal & Kirby, 2002; Large, 2005). Only four of the 34 interviewed children described browsing for information in print books. They particularly liked the consistent location of books in the library and their ability to go directly to a known shelf or library section to find books that might answer their questions. Browsing interfaces for children's digital information seeking might particularly support the students who preferred browsing for print books.

When asked about ease of search in print and digital media, only six students described using the library catalogue for finding print books, while 15 students named the ease or efficiency of Google for searching. Our findings support those from Spink et al. (2010), who reported the importance of query-based search. Therefore, we argue that browsing interfaces for digital content would best be coupled with a query-based interface, and not stand alone.

We have not found enough evidence in this interview to warrant exploration of browsing based interfaces in our own research.

## **5.5. Chapter Summary**

We conducted a series of semi-structured interviews with children in Years 5&6, and 7&8 of primary and intermediate schools in the Waikato district of NZ. From these interviews, we confirmed that searching for information really is hard for children. Problems arise in creating initial queries and in query refinement, and the causes of these difficulties are

unclear to the child. Indeed, in some cases, it is not clear to the child whether the problem can be rectified by herself/himself, or whether the issue is external (a predicament beautifully summed up by one child's statement that: "sometimes the Internet reads the question wrong" [F10E]).

If a search is unsuccessful, the children are uncertain as to whether they are simply not looking hard enough, or whether the material simply doesn't exist. As we observed in this chapter, perhaps not only does the Internet "read the question wrong," but so, too, does a library catalogue. These difficulties are compounded by the fact that children are still learning to make relevance decisions and to construct searches effectively.

Though these children also search for print material, they were not able to articulate their strategies as well as with digital search. The children clearly have less insight into the organization of print collections than of digital information (though the latter is itself subject to misunderstandings).

This chapter has further addressed Research Questions 1 and 2 (see Section 1.2), exploring and confirming the issues that children encounter when using existing information search systems.

**RQ1** seeks to understand the ages at which children are using information technologies. Based on the findings of Chapter 4 and our understanding of human development discussed in Section 5.1.1, we targeted children in Years 5 to 8 in this study. The children's ability to answer the questions of our interviews and the identification of information search and behaviour issues which are addressable by our work further supports the targeting of this year level band for our studies.

RQ1 also aims to illuminate where children are using these technologies. The findings of this interview have detailed when and where children are interacting with information technologies, and the common use of computers for Internet search at schools provides evidence for future observation studies in the classroom and school.

Further, RQ1 addresses the technologies that are used by children for information search. Our study reports how children are searching for information in library books and on the Internet with specific discussion of library practices and computer library catalogues as well as significant discussion of the Google search engine and experiences of success and frustration when searching the Internet.

**RQ2** is concerned with the issues encountered during information search. The children in our study identified three major difficulties with (1) constructing searches, (2) identifying relevant information in search results lists, and (3) finding the information contained in web pages.

The children discussed managing information and information search tasks to be difficult. The findings indicate that investigation of ways to ease children's information search planning, information management, and information triage within the search engine itself is of consideration to this thesis.

We presented a model that visualises the process that children describe about their information searching using a computer. This model provides further insight into what issues children encounter and when in the information seeking process they encounter these issues.



## Chapter 6.

### Teachers Observations of Children's Internet Search

Chapter 5 reported on the initial part of this two-part interview study conducted with children at primary and intermediate schools in New Zealand. The current chapter reports on the interviews carried out with teachers. We interviewed NZ primary and intermediate school teachers to seek reports of teachers observations of how children are conducting information searches during the children's education. Our interview questions were designed in such a way to allow comparison to the findings of our interviews with the children. This chapter and the previous one together begin to identify areas of need for the investigation of children's information search.

The chapter is structured as follows: we describe a semi-structured interview that we conducted with teachers in the Waikato School District of New Zealand in late 2013 (see Section 6.1). Our analysis provides a working process of children's online searching for information in NZ classrooms (Section 6.2), from which we describe how children search for information as well as identify issues encountered by children during their information seeking (Section 6.3 to 6.5).

Both Chapter 5 and Chapter 6 continue to address RQ1 (see Section 1.2): *when and how are children conducting digital information seeking?* Further, these two chapters begin to address RQ2: *what are the issues children encounter when using digital information seeking technology?*

#### 6.1. Study Method

We conducted a series of semi-structured interviews with teachers at the same two primary schools, and the intermediate school that participated in the study detailed in Chapter 5. These interviews explored how children perform a search task, what do

teachers perceive as difficulties or advantages that children will encounter when searching for information, what sorts of information teachers expect that children are looking for, who is setting these search tasks, and how children are prepared for these search tasks.

Each of the interviews took approximately 30 minutes to complete. Interviews took place in the teachers' classroom or in a space in the school selected by the interviewee. All interviews took place during the school day and therefore, the school was in operation while the interview was taking place. The interviews were audio recorded, and handwritten notes were taken. A combination of audio and field notes was used for the analysis reported in this chapter. Audio from the recording was not always reliable or able to be accurately transcribed due to background noise. Interview answers are analysed based on a combination of audio that was transcribable as well as written field notes. These interviews took place in the final school term of 2013.

### **6.1.1. Participant Recruitment**

Our interview series was conducted in the Waikato School District, which is located in the central North Island of NZ. Two primary schools and one intermediate school took part in our study, with the permission of the principals. These three schools (here and in Chapter 5 referred to as School A, B, and C), have decile ratings of 4, 5 and 9, respectively. Thus, the two primary schools targeted in this study fall into the middle of the decile spectrum, while the intermediate school has a rating tends towards the higher end of the spectrum.

We requested that principals invite interest from three teachers at each school who teach at Years 5&6 at primary level or Years 7&8 at intermediate level<sup>9</sup>. Teachers who taught Years 5&6 had students between 9 and 10 years old in their classrooms while teachers who taught Years 7&8 had students who were between 11 and 12 years old. The teachers all self-selected for inclusion in our study. The teachers were explicitly informed that they were not bound by their employer to participate in our study and that there would be no employment ramifications for participation or removal from the study at any time.

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<sup>9</sup> See Section 5.1.1, the sample procedure for our interviews with children for more detail as to our chosen targeted interview participants.

### 6.1.2. Participants

As described in Section 6.1.1, the teachers self-selected for inclusion in this study after an open invitation by the school principal. We received only female teachers in our sample; this is not surprising and is likely very close to the actual distribution, as the proportion of male teachers at this level in schools is very low at these, and all, New Zealand primary and intermediate schools. We interviewed 10 teachers in total, four from School A, and three from School B and C respectively.

The demographic information about these teachers is listed in Table 6.1. The first column displays the unique ID's we use throughout this chapter; the second column lists the number of years teaching reported by each teacher, and the third and fourth columns indicate if the teacher works with children at Year 5&6 or children at Year 7&8.

**Table 6.1 Teachers who participated in interviews**

ID	Years Teaching	Yr. 5&6	Yr. 7&8
T1	10		✓
T2	14		✓
T3	15		✓
T4	7	✓	
T5	25	✓	
T6	11	✓	
T7	10	✓	
T8	6	✓	
T9	18	✓	
T10	10	✓	

No requirements were set when selecting teachers who were willing to participate. However, it is positive that we have interviewees with a range of teaching experience in the sample. We feel that this is a fair cross section of teachers at these year levels in New Zealand schools with teaching experience ranging from a minimum of 6 years to 25 years to draw from when answering our questions.

### 6.1.3. Interview Questions

After gathering demographic information, the researcher prefaced the interview by saying: "My first questions relate to the most recent task that you set where a student had to search for information about a topic." The interview questions and their probes are shown in Figure 6.1.

The presentation and layout of the researcher's field notes document can be found in Appendix B. Examination of the field notes form (Appendix B) will show that some questions have check boxes for the researchers benefit. These pre-defined options printed on the field notes sheet were not shown to the interviewee nor used as prompts.

- 1) What types of topics did the students choose to investigate?
- 2) Where did the students investigate this topic?
- 3) What instruction or training did the students receive on how to investigate this topic?
- 4) What resources did you expect the students to use to investigate this topic?
- 4a) What percentage of students used the following resources?
- 5) What issues did you notice children having when *searching* for digital information?
- 6) What issues did you notice children having when *using* digital information?
- 7) What issues did you notice children having when *searching* for printed books?
- 8) What issues did you notice children having when *using* printed books?
- 9) Do you have further observations regarding children's search for and use of information?
- 10) Can you describe the process when searching using printed material or books etc.?
- 11) Can you describe the process when searching using computers or iPads etc.?
- 12) What previous instruction or training did the students receive on how to investigate a task?
- 13) Do you have plans for further instruction or training on how to investigate a task?
- 14) How did the student submit a result of this?
- 15) What future topics will you set this year for investigation?

**Figure 6.1 Teachers interview questions**

These interview questions can be grouped into the following classifications:

- Information Seeking in NZ Classrooms (Q1, Q2, Q3, Q4, Q12, Q13, Q14, Q15)
- Issues and Successes During Search (Q5, Q6, Q7, Q8)
- Preference for Print or Digital Information (Q9, Q10, Q11)

We structure the results sections (Sections 6.2.1 to 6.2.3) of this chapter according to these three headings.

## **6.2. Results**

We report here the results of our interviews with teachers about their observations of children's information search practices. We present the results according to the classifications that we outlined in Section 6.1.3. Questions that led to responses that have been deemed outside the scope of this thesis have not been reported and are identified where relevant.

### **6.2.1. Information Seeking in Classrooms**

Questions 1 to 4 and questions 12 to 15 (see Figure 6.1) were designed to explore children's information seeking as facilitated by these teachers.

#### 6.2.1.1. What Types of Tasks are Children Undertaking?

We sought to identify the kinds of topics that children investigated and the environment where children investigated them. The teachers reported a range of subjects that the children had just completed investigating or that they were currently working on. These topics spanned the curriculum and included; identity and culture, Labour Day, science, environmental issues facing New Zealand, historical events, celebrities, and human rights. All 10 teachers stated that these investigations were teacher-initiated topics of inquiry with four teachers indicating that students chose sub-topics for specific investigation.

Children were able to present the results of their investigations in a range of ways, including speeches, typeset essays, blog posts, slideshows or PowerPoint presentations, posters, dioramas, and written in homework books.

#### 6.2.1.2. Where are Students Undertaking these Tasks?

All of the teachers (10) expected that all of their students would investigate these topics in the classroom. Nine of the teachers also noted that the children would conduct parts of their investigation in the school library, and eight of the teachers stated that children would also investigate their topics at home. Five teachers also suggested that very few of their students would have explored the subject in a public library.

#### 6.2.1.3. What Resources are Children Using?

Teachers expected their students to use a range of resources to complete the most recent inquiry task. All 10 teachers expected that some of the students in their class would use printed books and school library books and Google. T8 suggested, "I expected them to use Google as their first port of call." Only T4 considered that some of her students would have used eBooks.

Five teachers thought that students would have used the library catalogue to conduct a search. Five teachers stated that their students would have used a dictionary during the last inquiry task. However, only one teacher [T4] thought that students would have used a digital dictionary such as [www.dictionary.com](http://www.dictionary.com).

Five teachers considered that their students would have used [www.wikipedia.org](http://www.wikipedia.org), yet only two teachers thought that their students would have used a digital encyclopaedia (other than Wikipedia), and only two teachers thought that their students would have used printed encyclopaedia.

To follow up on the teachers' expectations of resource use, we asked the teachers to estimate the level of use of by their class of 11 resources listed by the researcher. The results for this question are recorded in Table 6.2 as percentages of the class according to the estimation. Use of Google appears to be the most commonly highly used resource by students in the classes of all 10 teachers. This suggests that while teachers noted the use of some of these resources in the previous question, the actual numbers of use may be very low and may not be consistent from classroom to classroom. We assume this is to do with the emphasis placed on the resources by the teacher or parent of the students as well as to the access to these resources and the differing level of understanding by students and parents alike.

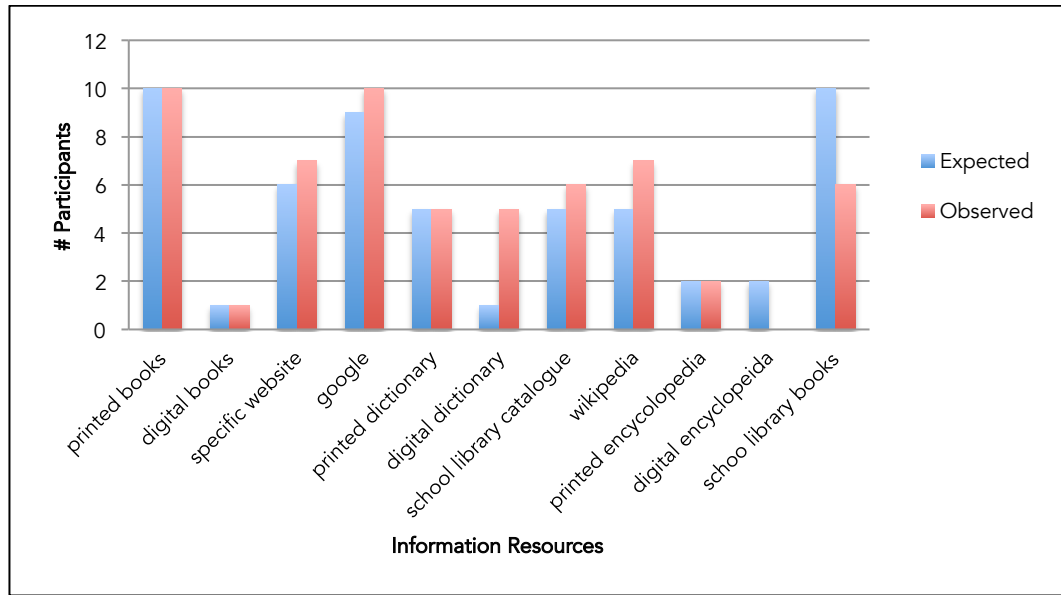
Teachers stated that their knowledge of what students used was due to class observations by the teachers (10), cited references (2), copies of found resources submitted by the students (3), individual teacher and student discussion (8), and written evidence of resources by students (2).

**Table 6.2 Estimated percentage of class using specified resources**

	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
<b>Printed Books</b>	10	17	5	100	50	25	30	70	90	20
<b>Digital Books</b>	0	7	0	0	0	0	0	0	0	0
<b>Specific Website</b>	10	0	0	100	100	100	80	30	0	30
<b>Google</b>	100	100	90	100	100	100	100	100	100	60
<b>Printed Dictionary</b>	0	80	0	50	30	0	60	60	0	0
<b>Digital Dictionary</b>	0	40	5	50	0	0	20	50	0	0
<b>School Library Catalogue</b>	50	7	0	100	0	100	5	50	0	0
<b>Wikipedia</b>	20	30	90	50	70	0	70	50	0	0
<b>Printed Encyclopaedia</b>	0	0	0	0	40	0	0	0	90	0
<b>Digital Encyclopaedia</b>	0	0	0	0	0	0	0	0	0	0
<b>School Library Books</b>	0	17	0	20	0	80	70	100	95	0

In Chapter 5 we asked children what resources teachers suggested the children use in their investigations and what resources the children actually used. This can be seen in Figure 5.4. In the present chapter, we asked teachers what resources they expected children would use in their investigations and what resources they noted children to use. Table 6.2 details the percentage of children in each teachers' class that the teacher estimated used a particular resource while Figure 6.2 details the teachers' expectations of resource use compared to their observations of resource use. According to Figure 6.2, the teachers expectations compared to their observations appear to be fairly consistent. The discrepancy was predominantly with the use of Digital Dictionaries being much more

highly used than teachers had expected and school library books being much less used than teachers had expected.



**Figure 6.2 Teachers expectations of resource use compared to observation of resource use**

**6.2.1.4. Information Resource Access**

Students at all three schools had access to a small number of desktop computers in the classroom, and bookable class sets of one-to-one laptop and tablet devices, weekly class visits to a computer suite, as well as computer suite access during lunch periods. This multitude of internet-capable devices were regularly used by students of all 10 teachers for conducting Google searches, copying, pasting and printing information for the students’ inquiry tasks. Where relevant, these devices are also used for the creation of the presentation devices of the inquiry tasks (i.e., poster creation, essay typesetting, etc.).

All three schools had school libraries with full time or part time librarians. The libraries were used for regular weekly class visits and were also available outside of scheduled visits for student use. All three school libraries have a digital library catalogue (OPAC) that is accessible by the children. Teachers also selected relevant books from the school and public libraries for in class resources for students during inquiry tasks. Teachers, however, did not consider the traditional library, digital library catalogue, and printed book resources were as regularly used by students for information search needs compared to Google.

No teacher reported the use of Digital Libraries or child-specific search engines.

#### 6.2.1.5. Instruction or Training

When asked about specific training given to students this year, T10 said it was “not enough, in my opinion. I think I probably needed to teach them a little bit more about search engines and Google and that. Be more specific. But, it's learning, even with 10 years teaching experience you think, ‘oh I should have done that!’”

##### Teaching to the Standards

Teachers noted that they must teach to the standards and the curriculum, which often does not allow time for teaching content that is outside of the scope of the curriculum. T8 noted “we as educators could come up with specific search friendly things that should be taught within the curriculum. The problem is it doesn't really fit anywhere within the curriculum.” While search skills are not specifically a part of the curriculum, information search skills are taught as a part of the larger literacy competencies of the curriculum as well as during library or ICT Suite sessions. T10 suggested that digital information literacy and search skills likely needs specific integration into the NZ Curriculum within the ICT or Literacy units.

##### Instruction Given

All 10 teachers discussed having given specific search instruction and training during the current search topic and in previous topics this year. When answering this question the teachers often offered quite a range of answers for this question with many tools and techniques noted within each answer. For example, T5 stated “I do a big focus on keywords, because if they haven't got keywords, that's a problem. I focus on spelling, if they can't spell the keywords that limits their search, even though [the search engine] does offer suggestions, I think that is one glitch that lower readers have. Their keyboard skills can be a problem because if they are doing capitals or gaps or can't put punctuation in the computer doesn't like some of that.”

The teachers described teaching Keywords [T6, T8, T9], Triangulation of information sources for confirmation of truthfulness [T1, T6, T9], Omission of “small words” (i.e. pronouns and conjunctions) [T1], how to use Google [T1, T3, T5, T7] or Google Advanced Search [T3] and necessary for two of the teachers was asking and identifying a quality question [T8, T9]. Knowledge of quality sources for future use was mentioned by teachers [T2, T5, T6] as was an introduction to resources that show children how web searches can be inaccurate.

T10 described teaching the use of *Query Qualifiers*, such as “for kids” or “for children” at the end of a search query. This technique was described as a method for focusing the content of returned searches to websites that are written with children in mind. Similarly, three teachers, [T3, T9, & T10] described encouraging the use of the (now defunct) Google Basic Reading Level Filter to return websites at a reading level appropriate for the child who is conducting the search.

The teachers also discussed reading and literacy skills such as skimming and scanning being taught during this year as part of the work completed during information search tasks.

Year 7&8 teacher T2 noted to the contrary of Year 5&6 teachers: “I don't need to teach about reliable information anymore [i.e. triangulation of information as described by other teachers in our study]. But, it is very important to me that by the end of the year they have a bank of good quality known sites, that they know the power of an internal search engine, not just an external search engine.”

Teachers described teaching this myriad of functions, sources and techniques of information problem-solving and information search through in-class modelling<sup>10</sup> of search behaviour, one-to-one instruction and guidance as well as class activities and worksheets in the classroom, library or ICT suite.

#### Requirements of Information Seeking Instruction and Training

The teachers seemed to feel that there was room for improvement with their own knowledge and what they were able to teach the children about information search. T8 stated, “as a teacher you are trying to facilitate the learning, but how far do you let them go down the wrong track? Knowing that it's not actually going to help them without destroying their self-confidence.”

Teachers also described needing to know how best to teach these skills; T2 stated, “as a teacher, I think there is more I could do. I need to know what I can do better. I have a gut feeling for things I could do in the future, such as keyword searching instruction, I am not sure how I would teach that.”

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<sup>10</sup> Modelling, in the context of modelling a digital action, is a term used by teachers to describe the act of instructing through explicit step-by-step digital-tool use on a projector or large screen.

## Self Confidence and Perceived Self-Competence

Teachers were also concerned that their own search expertise might be limited. The teachers felt that having resources available to themselves outlining teaching plans for information search as appropriate to the NZ curriculum would be helpful. T8 offered insight into what might be useful to her in resources for teaching web searching: “I think it needs to be age appropriate. Something that is designed as children go through the years, and through stages of intellectual development [i.e.] by year six you should be able to skim and scan and this is how you should teach it. Or this is a tool that you use to teach it.”

A further concern to the teachers was the pace at which information technology progresses and the difficulty for individuals to keep up to speed with the changes and processes for successful information search. T1 described the fact that she used to need to teach “a lot of ‘who’ / ‘why’ / ‘when’ / ‘where’ / ‘what is’, [information problem identification techniques] but now Google is so good that doesn't seem to be a problem. They [the students] still seem to get to their result.”

Being aware of the changes in information search practices can be difficult for teachers who must also remain abreast of curriculum requirements and modifications, as well as the myriad of technologies and techniques that become a regular part of society and education. T1, who has ten years of teaching experience, continues, “when I first started teaching this, I had to teach keywords, but that doesn't seem to be a problem anymore.”

### **6.2.2. Issues and Successes Observed During Search**

Questions 5 to 11 explored the information seeking processes and issues compared to successes that teachers have observed during inquiry and search tasks. We discuss here teachers responses related to both searching in print and searching on screen. This differs to Section 5.2.2 where we explored with children their senses of ease or difficulty with search processes.

#### **6.2.2.1. Snapshot of Children's Search Processes as Observed**

When given a topic of inquiry, children look for information in digital format first. None of the teachers suggested that children would use books as the first port of call for information searches.

Teachers did not consider digital libraries and library catalogues were used for information searches by children. Two of the Year 7&8 teachers went so far as to suggest

that children did not use the digital library catalogue as often as they should. Even the older children were considered to be more likely to skim the shelves when they were looking for a non-fiction book than to search for resources in the library catalogue. The teachers described regular weekly school library sessions and in-class supply of books selected by the teacher for use during information search around the topic at hand. And yet, all teachers listed Google as the primary tool for information seeking. T10 said "they are one tracked. So they are only Google. So they think, 'oh I will Google it.' That's the thing now, you don't say 'let's search for it,' you say 'let's Google it!'"

Teachers considered that their students search skills, and information literacy was still very limited, even at Year 7&8. Search strategies, identification of information problems and information needs prior to searches and successful query construction were all noted issues for children conducting inquiry tasks. Teachers considered that children's level of understanding of print literacy was equivalent to their digital literacy. However, generally, teachers reported the wealth of information and the access to resources was greater for digital information than for print information and thus the increased use of digital information in New Zealand classrooms and information search tasks.

It was generally considered that children did not choose to search print resources for information unless directed to do so. T10 stated: "they don't want to use [printed information] as much as they want to use a computer. It's harder because they can't copy and paste it. They actually have to handwrite it." She continues, "books don't look as cool and fun and as exciting as a digital device. So if I say to the kids 'Okay we are going to look this up, who needs a computer?' [T10 gestures with her hand in the air]. 'Who is going to look at the books, only a few'."

#### 6.2.2.2. Frustration

Teachers also noted that frustration with searching the Internet is prevalent for students. Frustration for children is caused by: search query construction, spelling issues, difficulties with the language level of websites, search query reformation and triaging of information.

#### Query Construction

A fundamental issue surrounding query construction is the student's ability to develop research questions and lines of inquiry. Teachers did not consider children to have effective skills in developing and identifying information problems. T8 describes this

stating, “your biggest problem with construction of a search is ‘does that child understand what a question is and how to recognize an answer?’”

When a child does not identify clearly their information problem, they are likely to use very broad searches in the hopes of finding information that they will be able to shape to serve their purposes. Teachers stated this was counter to what they considered best practice for children. Teachers were looking for children to be able to identify their problem before conducting a search and searching with intent and purpose with well-constructed search queries rather than the scattershot approach that teachers observed in these types of broad keyword searches.

When an information problem has been identified constructing sound queries is the next issue that teachers identified. T10 stated, “they type in the whole question; they have no concept of breaking it down to key ideas.” T2 suggested that: “[some students will use] keyword searching, some will still be putting questions and sentences.” Further to this, T1 espoused “Google seems to be making us lazy. We used to think about the “and” and the “or”, but now we don’t.”

T5 discussed further difficulties for query construction relating to the focus of a query, “if they [the students] narrow it too far they can miss vital information too. It’s a lot of skills that we as adults have that they need to learn. For example, ‘what is important and what is not important?’.”

#### Spelling and Language Level

T5 noted that if children cannot spell the search queries or have difficulty with keyboard use, then their search abilities are severely limited even with search engine suggestions. This is compounded by the capacity to read the information presented in the search results lists and the resulting websites. The teachers noted that successful search requires support and guidance from an adult (teacher, librarian or parent). T2 stated, “[children] will just keep hitting [a web search] with combinations of keywords. They will link from one text to another. That can be time consuming – it’s rather random. There is a lot of drop off [student frustration, resulting in search abandonment] if they do not get an answer.”

#### Information Triage

Teachers noted issues that children encounter when triaging and interacting with searches. Children struggle with the content of websites, and SERPs that contain text with

a reading language level that is above that of the individual student conducting the search. Having enough time to read and comprehend the content of the web pages and SERPs was an issue for children. Both the reading level and the time factors are barriers to success and may lead to frustration, abandoned searches or searches that result in poor responses to the inquiry task when a child does not have an identified information problem or question for which they are attempting to respond.

The children's ability to determine their search questions and information needs were also identified as proving an impediment to successful information triage. All ten teachers discussed the importance of identifying their information needs and developing lines of inquiry and topic questions before approaching an information search.

Teachers discussed a need to clarify the entire information search process for children so that they will fully understand the fundamentals of successful investigation strategies. T1 stated: "we need to teach the children to visualize what they are doing when they are searching." Visualizing the process was described as detailing or modelling the step by step process of identifying a problem before searching, identifying query constructions for search, and recognizing an answer to the information problem when they found one in the search results.

T3 stated: "if they [the students] have been given something set to research, they generally know what to search for. If they have to come up with the questions themselves they usually go with the easiest question." This greater understanding of information problem-solving and information search is something that teachers considered a requisite for being taught in this day in age, yet is not part of the New Zealand curriculum presently.

#### 6.2.2.3. Collaborative Search

Children at this age are very collaborative in their learning within the New Zealand curriculum. Collaborative learning methods filter through to their information and web searching. It is common for an information seeking session to involve discussion of the problem with a teacher, peer or parent. Additionally, children will often work together when searching for information or searching for information sources. Working together might entail sharing a computer, working together in a library, or co-reading a book.

The children were reported to also be likely to seek answers to questions rather than information on a topic. T6 informed the researcher that "most children rely on asking a

question. They would prefer to sit down and ask for help from a parent or teacher.” She continued, suggesting that children “would prefer to have someone help them with a search. A few of them would have the confidence to go off on their own and do a search, but most of them would prefer to have someone help them with the keywords, and what is appropriate. A peer is sufficient not necessarily an adult or parent or expert.”

Teachers did note that information searches may be conducted by way of email, telephone conversation, and in-person interview should the exercise and information problem allow for such a method of inquiry.

#### **6.2.2.4. Adult Intervention**

Teachers also discussed the importance of parents during information searching and inquiry in the home. Teachers considered it standard practice for their students to work in close collaboration with parents to gain modelling and assistance with search practices and search queries when conducting inquiry tasks at home. Information resources and digital libraries that accept questions as search parameters as effectively and efficiently as Google at present will likely be of significant benefit to children during their inquiry tasks.

Teachers noted that students who are more successful Internet searchers are often those who have had quality information seeking strategies modelled for them, both at school by teachers and librarians, and at home by parents, guardians and older siblings. Students who have access to parents with computer and information literacy skills and who use computers in the home for tasks other than computer gaming are noticeably more proficient Internet searchers and information literate members of the class. Children whose parents are not proficient with computers and indeed parents who are wary of computers or unsure of what computers can do, are often much more limited in their search skills and query construction abilities. Teachers noted that children would often claim computer proficiency, however, teachers pointed out that this proficiency with use of computers for games and consumption of entertainment does not translate to proficiency with search and information literacy or information problem-solving.

#### **6.2.2.5. Child-specific Search Engines**

The children interviewed in our related study (see Chapter 5) and the teachers we interviewed here, did not note use of child-specific search engines.

T7 suggested: "a kids Google would be awesome." She continued: "there are children's search engines but they are too narrow. Kids Google would maybe have their search results come up, and it might have a reading age, and if they click into it, it might have an icon that pops up which says: 'how are you finding this information?'; 'is this too tricky'; 'do you want a simpler version'; 'is this too simple, do you want a harder version'; 'do you want more information'; and you [the user] could just select the options."

Three teachers [T3, T9, T10] discussed the advanced search tools, including the basic reading level filter offered by Google. The Reading Level Filter that is available in Google (at the time of the interviews, but now defunct) is a tool that allows a searcher to specify search engine results at one of three reading levels (Basic, Intermediate, Advanced). While no other search engines were listed by teachers in this study or children in our related study (see Chapter 5), at the time of writing this chapter we are unaware of a similar feature in either of the other two major search engines, Bing or Yahoo.

Teachers discussed how they encourage the use of this Reading Level Filter in Google to assist with finding information that the child could understand, or that was positioned at the children's reading level. T10 specifically said, "you know we have got the advanced search, but why does it need to be hidden away? Why can't it just be there?, 'okay, I want to find this out, I can click okay, or I can click this reading level, etc., etc.'"

T9 also discussed the need for search engines and the resulting websites to be well designed for young readers. "Websites cluttered with ads hinder them [the students] finding information. Visual presentation of information is needed for this young audience. Bold / spaced / clear, easy language is necessary." She continued suggesting "a Google demo or step by step search function that is always present would be useful for children." It was also discussed that systems that aid children more specifically may be helpful, but these would need to be built into Google, rather than a browser designed specifically for children which do not get used in these New Zealand classrooms.

### **6.2.3. Preference for Print or Digital Information**

When given a topic of inquiry, the teachers suggested that children look for information in digital format first. All of the teachers suggested that children would use the Internet as their primary information search resource given the choice. T10 stated: "they don't want to use [printed information] as much as they want to use a computer. It's harder because they can't copy and paste it. They actually have to handwrite it." She continues,

“books don't look as cool and fun and as exciting as a digital device. So if I say to the kids ‘Okay we are going to look this up, who needs a computer?’ [T10 gestures with her hand in the air]. ‘Who is going to look at the books?’, only a few”.

We asked teachers about children's use of, and search for, printed information in Questions 7 & 8. Teachers listed issues that children encounter when using printed information that included: lack of spelling and search assistance or knowledge of how to search using the OPAC (3), finding and using the Dewey Decimal number (3), locating books on the library shelves and availability of books in the library (4), and utilizing the book features such as tables of contents and index's (2).

T10, who teaches Year 5&6, described issues with catalogue and call number use, “they all want to use the computer search. They don't have any concept of the Dewey Decimal system. You couldn't say to a kid, go and look for this, it's in the 700's, go and find it. All they do is they go and type it in and then go and find it (the specific book) on the shelf.” She continues: “they will probably type in the entire question.”

Teachers at all three schools described the location of books in the library as an issue. T5, who teaches Year 5&6, described the use of the library by her students: “often in the school library, there won't be anything that they are looking for. What's there is there, and that's it. They [children] don't use the catalogue as often as they should. I think we have a very experienced librarian, and so they go to her, and she gives them good advice.” Confirming the statements of T5, T7, who again teaches Year 5&6 at a different school, stated: “the books were issued out, or they were old. They may have been too young or too old for them [the children] too, the ones that were available.” The issues with availability were also described by T1, who teaches Year 7&8 discussed the “limited resources when the whole school is working on the same topic” as a common problem in the library.

T2, who teaches Year 7&8, summed up the reasons for children's lack of library skill and use stating: “it's just not happening. Cause it's easier to use [computers]. They have got digital tools. It's [the digital tool] just there. The digital feels like it's really good quality. When you look at websites like National Geographic they are short, sharp, precise articles, they are all at a level these kids can comprehend.” T10, who teaches Year 5&6, believes “maybe kids have been a little bit drip-fed. I will go and find the books for them and have them in the classroom. Rather than them go and find the books.” She continues, suggesting that “library skills are not taught anymore - specific library skills.”

When answering Question 8, T10 considered that “libraries to me are becoming a little bit more redundant because I don't think libraries are going to be there in the future. A library on a computer. Not that I think that is a good thing necessarily, I just think that is what is going to happen. Why have a room full of books on a shelf when they can be all in this little device that could be in your pocket? I'm not against it, but I know there will be a lot of people that will.”

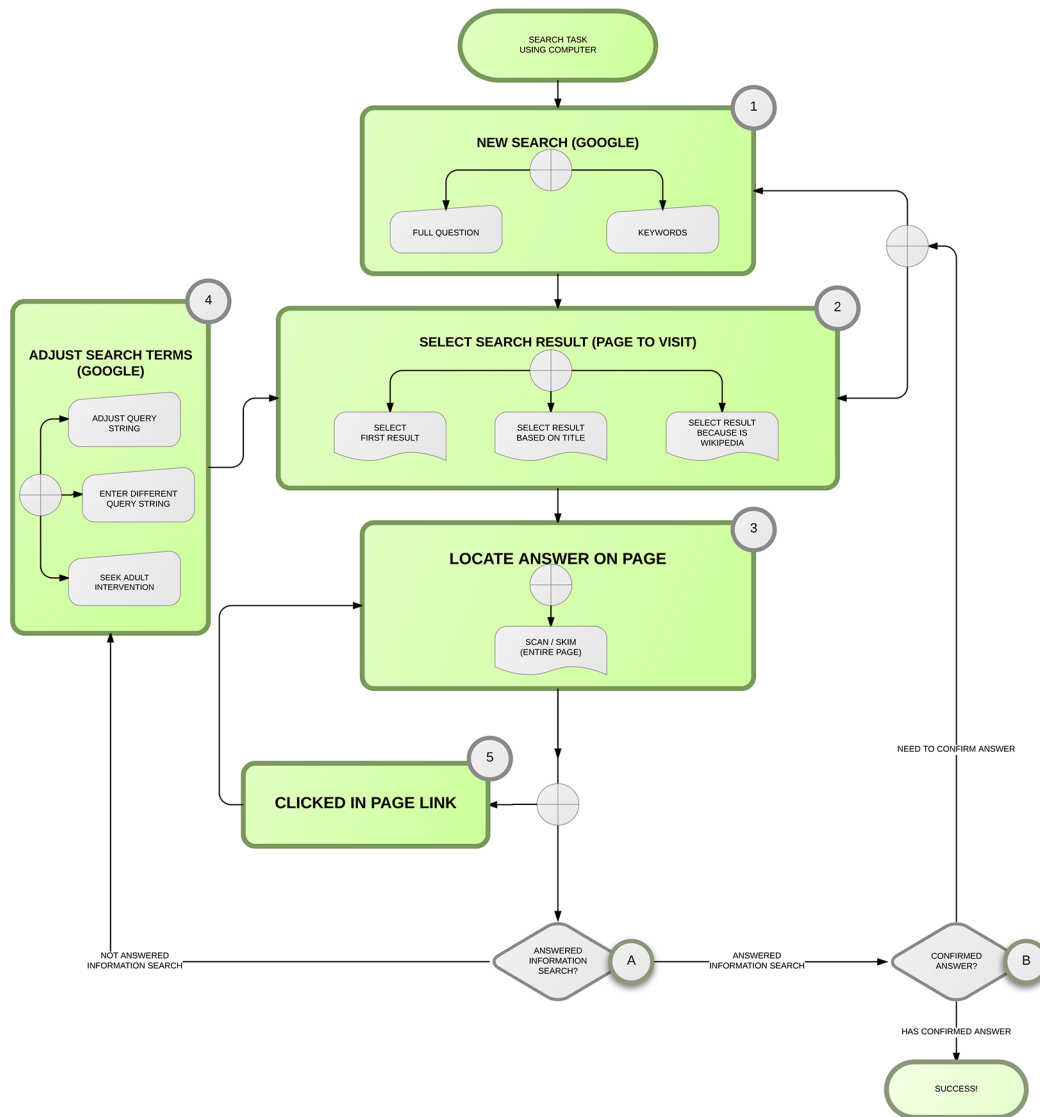
### **6.3. Discussion**

These results provide useful insights for researchers and educators alike as they provide first-hand observations of the regular habits of young information seekers in New Zealand classrooms. The recollections of the personal observations and insights of teachers are likely more astute than that of the young person themselves and will be weighted with the teachers personal pedagogies and teaching philosophies.

We discuss in this section the contributions of this chapter and any relationship to existing literature that exist at the time of writing this thesis. We describe children's search processes through the development and discussion of two models or flow diagrams that illustrate the process that children undertake when searching for information on the computer.

#### **6.3.1. A Model of Children's Computer Search Behaviour as Observed by Teachers**

We offer here a model of children's computer search behaviour as observed by teachers (see Figure 6.3), which generally follows the process outlined by T3 who expected students to “go to Google, do a search, go to the top thing that comes up, if it is useful, they will cut and paste to use it later. Then they will go to the next thing and do the same thing again.” This teacher also stated “they put in very, very broad searches. They are not skilled at using keyword searches, making it more specific to what they want. And sometimes that is a lack of understanding what they actually need.” Finally, this teacher also noted, “they generally start off broad, [to] refine, they generally make it a question.”



**Figure 6.3 A model of children's computer search behaviour as observed by teachers**

From the interviews, we identify five processes (indicated as 1 to 5) that children engage in and two decisions (indicated as A, B) that are central to the search tasks of children when using computers as observed by teachers (see Figure 6.3).

Teachers described searching for information on computers beginning with a new search in Google by entering either a question or a set of keywords (Figure 6.3, process 1). Children are then required to select a search result, which teachers report is done in one of three ways (Figure 6.3, process 2). Once the children have clicked through to a page, the task then requires the location of information (or an answer) on the page visited. Teachers expected that the children would complete this by skimming and scanning the text, likely from top to bottom of the page within a website (Figure 6.3, process 3). Once a child has completed their interaction with a page a decision is necessary regarding if the question has been answered (Figure 6.3, decision A). If the child is satisfied with the

answer copied from the page a second decision is required regarding triangulation and confirmation of the answer using multiple sources (Figure 6.3, decision B). If the student has confirmed their answers with a suitable number of sources, the search would likely be considered completed. If the child required further triangulation of their sources the teachers expected that students would conduct a new search or select from their previously generated search results, list a new page to visit. At Decision A, if a child had not answered their information search on a chosen page teachers expected the children would either conduct a new search, adjust their search terms, or very likely abandon the search in lieu of adult intervention (Figure 6.3, process 4). Teachers described children's ease of distraction by games, in-page links, and tangents that may result in an infinite loop. Process 5 shows the potential for the student to delve deeper into the rabbit hole, losing track of time and losing sight of the task at hand.

### **6.3.2. Comparing the Model of Children's Computer Search Process as Self-reported**

Our related interview study (Chapter 5) proposed a model of children's information search processes using a computer. The model suggested in Figure 5.5 was based on children's self-reported recollections of their own processes during information search. We offer that model as a comparison to the views of children's computer search behaviour that we have depicted in the present chapter in Figure 6.3.

As we explain in more detail in Chapter 5, children described a model that contained three points of decision (labelled as A, B, and C in Figure 5.5) and four processes (labelled as 1, 2, 3, and 4 in Figure 5.5). Children described beginning a new search by constructing one of three types of the search query using Google (see 1 in Figure 5.5). A child would then decide (Figure 5.5, decision A) if they could identify a page to visit from the SERP (Figure 5.5, process 2) or would adjust their query (Figure 5.5, process 4). The child would select a search result page from the SERP in one of five ways, most often reported was choosing the first entry or search for a specific web page (i.e. Wikipedia) from the SERP. The child would then locate their answer on the page by reading the first paragraph, skimming or scanning or reading the entire page (Figure 5.5, process 3). At this point, the child would be required to decide if the information search had been answered (Figure 5.5, decision B). The child would then either adjust queries (process 4 in Figure 5.5, decision C) or decide if the answer requires confirmation (Figure 5.5). If confirmation was required the child would revisit the previous SERP

(Figure 5.5, process 2) or conduct a new Google search (Figure 5.5, process 1). If no confirmation needed the information search would be considered completed.

It seems from the description given by teachers that the robust model that was provided by students (Figure 5.5) to describe Internet search is a fuller picture than that observed by teachers. Our model as garnered from observations is not a significant deviation from the model proposed in Chapter 5. However, the model developed in this chapter based on teachers observations does differ in the listed methods outlined in Processes 1-4 as well as the removal of Decision A and the introduction of Process 5. We use the remainder of this section to discuss the similarities and differences in reporting by children and teachers when describing children's computer search behaviour.

#### 6.3.2.1. Query Construction

Children and teachers agreed that Google was the primary source of digital information search. In Process 1 (Figure 5.5) children described using full questions, full sentences or keywords while teachers in our interview suggested children would use natural language questions as the very first query in most circumstances (Figure 6.3).

Teachers observed students using keyword searches only if the keywords had been clearly identified in the inquiry task or problem sheet, otherwise, using broad natural language question queries. T10 reported about the beginning processes of students' searches, "these kids, seriously, they turn on their computer 'ok I'm going to go look for this.' What do they do? They go 'Okay I'm going to look for Google'. They type their question in. They don't think about eliminating the smaller words."

Correct spelling of search queries was again identified to be difficult for children (e.g., Druin, 2009).

#### 6.3.2.2. Search Results List Triage

Teachers did not discuss the depth of triage that children discussed. Process A Figure 5.5 is not included in Figure 6.3 because teachers did not discuss a decision at this point. Teachers reported that children are moving directly from a query to selecting a result from the SERP.

Teachers in our interview study stated that children are likely to a) click the very first link in a SERP or b) read only the titles of the top few SERP entries or c) scour the SERP for Wikipedia (see 2 in Figure 6.3). Teachers did not mention selecting a result based on a

description or known website, both of which were referred to by children in Chapter 5 and labelled as 2 in Figure 5.5.

#### 6.3.2.3. Locating an Answer

While children in Chapter 5 cited three ways that they locate information on a page (see 3 in Figure 5.5), our teachers discussed that students would skim and scan a significant portion if not the entire page looking for their answer (see 3 in Figure 6.3). We assume the teachers considered this would be the method of information consumption as half the teachers described teaching skimming and scanning this year.

#### 6.3.2.4. In-Page Link Use

Teachers noted that students were easily distracted and would link from one web page to another in a sporadic tangential search. Teachers suggested students may not go back to a SERP, instead needing to re-enter or begin a new query after some time surfing deeper into the Web on a whim. Teachers noted that children would suffer from distraction by information that appears related, and equally by content that is off topic such as games and content of extra-curricular interest. This is included in Figure 6.3 as Process 5, yet was not a feature of that was discussed by children in our related study and does not appear in Figure 5.5.

#### 6.3.2.5. Adjusting Search Terms

Adjusting search terms was something that teachers felt students lacked confidence and ability. Children described adjusting search terms or entering new search terms during Process 4 in Figure 5.5. Additionally, teachers in this study described the need for input from teachers, parents, and peers to successfully adjust searches (see in 4 Figure 6.3). T10 noted a common occurrence in her classroom "No, it's not on here Mrs. T.' It's amazing, 'no it's not here' so I have to go, 'right, let's break this down again'." T3 added to this by stating: "most children rely on asking a question. They would prefer to sit down and ask for help from a parent or teacher. They would prefer to have someone assist them with a search." This need for adult intervention mirrors the findings of Moore (1995). While we have improved technologies and provided digital resources that are superior in many ways to the resources Moore investigated, we still require interventions that assist in clarifying the information problem-solving process needed for successful navigation of the information environment that the children are working within.

#### 6.3.2.6. Confirming Sources

Teachers listed confirming sources as necessary for students and something that they specifically taught this year. Yet, while they felt students should be confirming sources as part of their processes, teachers were sceptical as to if this is happening. T4 and T7 specifically noted that students regularly do not confirm the validity or the currency of sources, nor do students fully comprehend the content they are reading or citing. Students in Chapter 5 claimed to confirm sources when searching. The decision to confirm sources is found at Decision B (Figure 6.3) and Decision C (Figure 5.5).

#### 6.3.3. Overcoming Frustration

From our interviews, we found that a significant barrier to successful web searches by children include issues surrounding confidence and frustration. We, the author of this thesis, have experienced this frustration ourselves, and so too have the teachers in our study. T8 stated, “even myself when searching, I become overwhelmed sometimes by the amount that you receive back.” Triage is made more difficult for children as the language of websites and website descriptions in search engine results pages (SERPs) are often not written with a children’s audience in mind. The wider use of Google Reading Filters and implementation of such filtering in DL’s and competing search engines is likely to improve children’s information search success through delivering content at a language level appropriate for the user. Additionally, as proposed by Bilal (2013), the improvement of Google Reading Filter may still be required.

Students may also lack the persistence needed to triage information and web pages. This persistence is even more necessary for the triage of SERP’s and web pages that result from poor query formation.

Query reformation is a difficult task (Bilal & Kirby, 2002; H.B. Hutchinson et al., 2005), as is knowing when a query reformation is necessary. A DL that offers related searches in the form of search reformations or refinements would serve children and teachers in this way. Additionally, improving the visibility of Related Searches in search engines and the addition of these to DL’s is likely to assist with helping users, including children, to evaluate their searches and to reformulate searches successfully.

T2 notes “when they [students] hit a first roadblock, having strategies to move past that is important. Some of them [have strategies, but otherwise] that first roadblock has a significant [negative] impact on their motivation.” T3 also stated, “Google searches can

be frustrating and can feel futile if the search is not working." Further, T8 suggests there is a need for students to develop the skills required to search with persistence; "so it's teaching them [the students] to refine searches and have patience."

Both children and teachers experience frustration while searching. Those teachers are likely to have difficulty effectively teaching search practices, especially when they feel bound to teach to the standards or the curriculum. We argue that resources for teachers that guide how to successfully teach or visualize the information search process are needed. Equally, systems such as educationally suitable DL and internet search engines that visualize this process will prove beneficial for young information seekers and teachers alike. This supports Chen et al. who noted in 1997 that "teachers may need help designing search strategies and ferreting out items that are appropriate for their curriculum" (1997, p. 657). It seems that almost 20 years on we still require tools for New Zealand teachers to assist them to teach information literacy in the Google age. Enhancing Google to visualize the steps of a complete information search may be one method of visualizing the information search process for students.

Only one teacher felt that a kid's search engine was necessary. However, they specifically referred to a "Kids Google", rather than an alternative vendor. T7 stated: "a kid's Google would be awesome! There are children's search engines, but they are too narrow. Kids Google would maybe have their search results come up, and it might have a reading age, and if they click into it, it might have an icon that pops up which says 'how are you finding this information?' 'is this too tricky' 'do you want a simpler version' 'is this too simple, do you want a harder version' 'do you want more information', and you could just select the options." These ideas from T7 may be implementable in a future Google, however, are clearly candidates for Digital Library integration due to the nature of the post-SERP suggestions for improvement of information pages and documents. However, it seems from T7's comment that search engines for children can be "too narrow" that a DL would need to contain good quality information from multiple sources and must cater to a range of reading and comprehension levels, rather than a source that is "dumbed down" or "kidified".

Additionally, education systems must recognize the change in learning needs of students today and the future that they are moving into. As T8 astutely noted, "probably one of the biggest issues facing education in NZ at the moment is that we are getting pushed

towards knowing stuff, rather than investigating, even though society and the way the world is moving tells us that people who are successful can investigate and are creative.”

#### **6.3.4. Digital Compared to Printed Information Seeking**

Children appear to be less competent information seekers when using printed sources. Teachers even suggested that children “turn to books for pleasure and leisure, not for information” [T2].

When children were specifically encouraged to search using, printed sources teachers noted: “some of the books didn't have all the information [the students] wanted, the books were generic and had shallow information, so [the students] would go onto the Internet” [T8].

It seems from the interviews with teachers that children’s print information search skills are diminishing; yet, the perceived value of print information is also diminishing in today’s educational environment. Teachers noted that books relevant to many of the inquiry tasks in NZ classrooms often become out of date very quickly or simply are unavailable when students and educators require them. The language in the books is often not at the children’s reading level, or the information is too shallow for the educational purposes. T8 stated: “things go out of date pretty quickly. Especially when you think about something like human rights. So if you were looking at statistics from 20 years ago, they are all irrelevant, they had their place twenty years ago, but things have changed.”

#### **6.3.5. Limitations**

We used a non-targeted, non-probability sampling procedure when selecting participants for this study due to ethical procedures of our institution and the need to ensure that we do not incur undue difficulty for our research partner schools. In so doing we gained a sample that included no teachers in their first or second year teaching. Should targeted sampling procedures have been used, it may have been interesting to include an interviewee in their first or second year teaching to assess if anything in current teacher training practices impacts any of the views expressed in these interviews. It is of note that we expect that there would be little impact in teacher education relevant to this particular interview as the insights sought are about the children’s use of technology, not the technology instruction practices.

Our models are both indicative and reflective and must be considered with reference to the small number of participants, interviews with children that rely on children's self-reporting, and observations and recollections. Though small numbers should not be widely generalised, these contexts are both real and legitimate investigations into children's information search practices in today's classrooms. We propose future work to test these models through a combination of contextual inquiries during children's information search in New Zealand schools. Log analysis of children's information searches in New Zealand schools will also be used to understand the generalizability of these models further. Future studies will seek to explore the utilization of these models to predict the search strategies of further groups of children.

While teachers' observations and the model developed from interviews with teachers (Figure 6.3) differs from the model developed from interviews with children (Figure 5.5), we do not believe that either model is necessarily incorrect or disproves the other. Perhaps the model described by the children is their belief of what should happen rather than what does happen or the inconsistencies are as cognitive psychologists have warned, due to our own memories being fallible (D. L. Schacter, 1999). We believe the further research we outline in this section will lead us to understand if one model is more correct or if the truth lies somewhere in between.

## **6.4. Study Conclusions**

It was generally considered that children did not choose to search print resources for information unless directed to do so. When given a topic of inquiry, the teachers suggested that children look for information in digital format, and the Internet would be the primary information search resource for children.

Teachers considered that their students search skills, and information literacy was still very limited, even at Year 7&8. Children's ability to identify their search questions and information needs were also identified as proving an impediment to successful information triage. All ten teachers discussed the importance of children identifying their information needs and developing lines of inquiry and topic questions before approaching an information search. A fundamental issue surrounding query construction is the student's ability to develop research questions and lines of inquiry. Teachers did not consider children to have effective skills in developing and identifying information problems.

Teachers noted issues that children encounter when triaging and interacting with searches. Children struggle with the content of websites, and SERPs that contain text with a reading language level that is above that of the individual student conducting the search. Search strategies, identification of information problems and information needs prior to searches and successful query construction were all noted issues for children conducting inquiry tasks.

When we consider the model of children's computer search processes as described by the children in comparison to the model described by the teachers, we find very similar processes identified by the children and the educators alike. The children were able to describe the process in some more depth than the teachers, presumably because the children were recounting their own actions, while the teachers were recounting the actions of others.

## **6.5. Chapter Summary**

Specific issues encountered during information search as observed by teachers are detailed and allow for further investigation into the needs of children. We observed in this chapter that issues of motivation, frustration, and strategies for overcoming barriers need to be addressed. This requires not only interface development but also resources and support for educators. These resources would support the teaching of information search strategies to children in schools. Investigation of how current interfaces for both children and adults can be improved to support current practices and taught best practices may also provide fruitful and satisfying web search experiences for teachers and students alike.

From the interviews described in this chapter and the previous, we see that Google is the desired first investigation tool for children in these classrooms. Further understanding of what Google offers that a book, library or digital library does not provide is required. Tools that support the complete inquiry process being implemented as common features of mainstream search engines, rather than specifically developed as children's search engines, are likely to be well received by teachers. Enhancements to common search engines that serve to facilitate query construction, query refinement, and triage is required.

This chapter has further addressed Research Questions 1 and 2 (see Section 1.2), exploring and confirming the existing systems that serve children's information needs

and the issues that children encounter when using these systems to search for information.

**RQ1** seeks to detail the ages at which children are using information technologies. Based on the findings of Chapter 4 and our understanding of human development discussed in Section 5.1.1, we targeted the teachers of children in Years 5 to 8 in this study. The teachers described children's information search practices and identified issues encountered during information search.

RQ1 also seeks to expose where children are using these technologies. The findings of this interview study have detailed when and where children are interacting with information technologies, and this will assist with the development of appropriate future studies.

Further, RQ1 addresses the technologies that are used by children for information search. Our study reports how children are searching for information in library books and on the Internet with specific discussion of library practices and computer library catalogues as well as significant discussion of the Google search engine.

**RQ2** is concerned with the issues encountered during information search. The teachers in our study confirmed what children described (see Chapter 5) as the three major difficulties with (1) constructing searches, (2) identifying relevant information in search results lists, and (3) finding the information contained in web pages.

We explored a model of how children search for information by comparing what children and teachers describe about children's information searching using a computer. This provides insight into what issues children encounter and when in the information seeking process they encounter these issues.



## **Chapter 7.**

### **Visual Analysis of Internet Search Engines**

From our interviews with children (Chapter 5) and teachers (Chapter 6), we learned that children search for information using internet search engines (ISE's) as their primary information source. In this chapter, we analyse contemporary internet search engines to assess how their design may influence the search practices of children. We aim to identify and define common features of these ISE's and search engine results pages (SERP's). We also attempt to show the effects of query construction on the visual presentation of information in a search engine results list. The findings of this study will assist with the development of future studies for this research through identification of features of search engines that would best serve children or would exacerbate issues that children encounter. Additionally, the findings of this study will assist in providing visual guidelines for the design and development of internet search engines for children.

This study was performed to assist with the development of future studies for this research through identification of features of search engines that would best serve children or might exacerbate issues that children encounter. These results will help identifying which ISEs should be further investigated and for which ISEs to study children's interactions with them in detail. Additionally, the findings of this study will assist in providing visual guidelines for the design and development of internet search engines for children in future chapters.

The chapter is structured as follows: we describe the lab-based study setup for analysis of the visual design of search engine results pages (Section 7.1). We report on conventions found across the search engines and then assess the visual presentation of information in the SERPs (Section 7.2). We discuss our findings and draw conclusions for the design of

search interfaces that are supportive of children’s digital information seeking (Section 7.3). These findings influence design of our interaction model for children’s information seeking described in Chapter 9.

This chapter continues to answer our second research question (see Section 1.2): *what are the issues children encounter when using digital information seeking technology?*

## **7.1. Study Method**

This study was conducted as a lab-based study in August 2014. A series of information search queries was executed on Google, Bing, and Yahoo! internet search engines (ISEs). Because children-specific search engines are rarely used in NZ classrooms, these were not included in the study. In addition to using Google in its standard setting, all queries were also executed on Google with the Google Reading Level Filter set to ‘basic’. For simplicity, we refer to the Google system with this setting as a separate search engine, and henceforth distinguish the following four search engines: Google, Google-BRLF, Bing, and Yahoo!.

### **7.1.1. Topic of Investigation**

It is typical for inquiry tasks in New Zealand classrooms to begin with a “big idea” or concept from which the children investigate a series of self-identified sub-topics or sub-ideas. We aimed to replicate this process by choosing an appropriate topic of investigation to structure this study around. We chose the topic of Mount Everest, as this relates to the New Zealand curriculum areas of geography, social sciences, and history.

### **7.1.2. Query Enhancement**

New Zealand children are taught two distinct query construction strategies for conducting their information searches (see Chapters 5 and 6). We have termed these *Query Qualifiers* and *Query Refiners*, which are subsets of what we term *Query Enhancements*. Query Qualifiers are broad search tools, which include the use of query extensions such as *facts*, *for kids* and *about*. Query Refiners are tools for refinement or reconstruction, which include the use of query extensions or refinements such as the addition of further topic words or the use of natural language queries or tools such as the Google Basic Reading Level Filter (Google-BRLF). Children also self-reported using questions with and without question marks as well as full sentences with conjunctions.

Table 7.1 lists the types of query qualifiers and refiners that we identified from these interviews.

**Table 7.1 Query qualifiers and refiners**

Broad Search (Query Qualifiers)	Refined Search (Query Refiners / Reconstructions)
Keywords / Topic Words	Keywords / Topic Words
Facts	Full sentences
For Kids	Questions (with a "?")
Facts for Kids	Questions (without a "?")
Kids	Google Advanced Search – Google-BRLF <sup>11</sup>
About	

When developing appropriate queries to test, we applied Query Qualifiers and Query Refiners to our search concept of “Mount Everest”. This provided us with the list of Query Qualifiers and Query Refiners shown in Section 7.1.3.

### 7.1.3. Query Construction

To study the factors that influence the presentation of search results and the impact this will have on children’s ability to use SERPs we tested multiple variants of each query listed in Table 7.2.

**Table 7.2 Basic construction of search strategy to test**

Broad Search (Query Qualifiers)		Refined Search (Query Refiners / Reconstructions)	
A	Mount Everest	D	Mount Everest height
B	Mount Everest facts	E	What is the height of Mount Everest
C	Mount Everest for kids		

The list of queries that was generated for testing is shown in Table 7.3. The queries were constructed in a way that replicates typical search strategies of children in Years 5 to 8 of NZ schools. We manually entered each of the queries into each of the four search engines and recorded screenshots of the results as they appeared in the viewable browser area (see browser setup described in Section 7.1.4).

In addition to query enhancements (query qualifiers and query refiners), we considered the effects of; capitalisation, abbreviation, keyword vs. natural language (natural sentences and questions), and punctuation as well as search operators such as ‘and’ and ‘+’ (see the third column Table 7.3).

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<sup>11</sup> The Google Advanced Search using the Basic Reading Level Filter was identified and is listed in Table 7.1 as a Query Refinement strategy. For this study all searches were conducted using the Google-BRLF to enable comparison to searches using Google, Bing and Yahoo.

**Table 7.3 List of queries constructed for testing**

ID	Search Query	Construction Consideration	Qualifier / Refiner
A1	Mount Everest	Capitalisation / Spelled out	Broad Initial Keyword
A2	mount everest	Spelled out	Broad Initial Keyword
A3	Mt Everest	Capitalisation / Abbreviation	Broad Initial Keyword
A4	mt everest	Abbreviation	Broad Initial Keyword
B1	Mount Everest facts	Capitalisation / Spelled out	Facts
B2	mount everest facts	Spelled out	Facts
B3	facts mount everest	Spelled out / phrase order	Facts
B4	Facts Mount Everest	Capitalisation / Spelled out / Phrase order	Facts
B5	mt everest facts	Abbreviation	Facts
B6	facts mt everest	Abbreviation / Phrase order	Facts
B7	facts about mount Everest	Natural language	Facts
B8	facts and mount everest	Search operator and / Phrase order	Facts
B9	mount everest and facts	Search operator and / Phrase order	Facts
C1	mount everest for kids	Spelled out	For Kids
C2	Mount Everest for kids	Spelled out / Capitalisation	For Kids
C3	mt everest for kids	Abbreviation	For Kids
C4	for kids mt everest	Abbreviation / Phrase order	For Kids
BC1	mount everest facts for kids	Natural Language	Facts / For Kids
BC2	mount everest kids facts	Phrase order	Facts / For Kids
BC3	facts about mount everest for kids	Natural language / Phrase order	Facts / For Kids
D1	mount everest height	Spelled out	Keyword Refiner
D2	mt everest height	Abbreviation	Keyword Refiner
D3	height mount everest	Phrase order / Spelled out	Keyword Refiner
D4	height mt everest	Phrase order / Abbreviation	Keyword Refiner
D5	mount everest and height	Search operator and	Keyword Refiner
D6	height and mount everest	Phrase order / Search operator and	Keyword Refiner
D7	mount everest size	Spelled out	Keyword Refiner
D8	size mount everest	Phrase order	Keyword Refiner
D9	mount everest and size	Search operator and	Keyword Refiner
D10	size and mount everest	Phrase order / Search operator and	Keyword Refiner
D11	mount everest + size	Phrase order / Search operator +	Keyword Refiner
D12	size of mount everest	Natural Language	Keyword Refiner
D13	height of mount everest	Natural Language	Keyword Refiner
E1	what is the height of mount everest	Natural language	Question Refiner
E2	what is the height of mount everest?	Punctuation	Question Refiner
E3	what is the size of mount everest	Natural language	Question Refiner
E4	what is the size of mount everest?	Punctuation	Question Refiner
E5	how big is mount everest	Natural language	Question Refiner
E6	how big is mount everest?	Punctuation	Question Refiner
E7	how high is mount everest	Natural language	Question Refiner
E8	how high is mount everest?	Punctuation	Question Refiner
E9	how tall is mount everest	Natural language	Question Refiner
E10	how tall is mount everest?	Punctuation	Question Refiner

Our list of queries did not attempt to cover every possible variation of search terms, but simply sought to give a fair cross section of query permutations for each construction consideration listed in the third column of Table 7.3. The first column lists the unique identifiers that we will use throughout the remainder of this thesis. The second column displays the search queries that were entered into each internet search engine. The third column describes the query construction variables being tested for each search query. The fourth column identifies the Query Qualifiers or Query Refiners that are being tested by the search query and refer to the types of Qualifiers or Refiners detailed in Table 7.1.

#### 7.1.4. Web Browser Setup

We used a Google Chrome web browser on a 27inch iMac Macintosh computer running OSX 10.8.5 set at a native resolution of 2560x1440 pixels. The viewable area of the browser was 1208 pixels by 1048 pixels (height x width). The horizontal position of 1208pixels from the top of the browser window will be referred to as the *fold* (described in Section 7.2.2). Unless stated otherwise in the result discussion, we did not scroll the SERPs viewed and did not record screenshots of the information from below-the-fold.

To help describe the visual presentation of text and other spacing or measurable units, a screen ruler application<sup>12</sup> was used. Measurements were made within the web browser (Google Chrome), not using the screenshot. This ensures that no measurable size differences are reported by use of screenshot images for measurements. To gain a standard measure of the scale of the type for titles we measured the capital E of Everest.

We ran the searches in Incognito mode of the Google Chrome web browser to reduce the influence of history or cached information on the search results. We ensured that no user stylesheets were activated that could affect the presentation of visual information during our study.

#### 7.1.5. Evaluation Criteria

We discuss the potential impact of the presentation of information and the visual features of the search engines. We do not evaluate the possible implications of the ordering of the returned websites nor the inherent quality of the information of the returned websites. Our intention is not to reverse engineer the algorithms used by these search engines but

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<sup>12</sup> Free Ruler 1.7b5 for Mac OS X <http://www.pascal.com/software/freeruler/>

to provide insights into the presentation of information when current best practices and self-reported practices for query construction advice for children are used.

We assess the *visual presentation differences*, i.e., the variables in the visual display of information that result from the various query construction strategies. Our observations are detailed in Sections 7.2.2 through 7.2.3 and include identification and discussion of the design of typographic and graphic features of the search engines and the search result lists and how these impact children's ability to read and find information when triaging and searching.

We also assess the *search result list differences*, i.e., the differences in search engine entries on a results page. These are discussed in Section 7.2.4 and include identification of the numerous differences in result list ordering when query constructions strategies are implemented.

## 7.2. Results

Here we report the findings of our visual analysis of the presentation differences and the search result list differences that result from our tested query constructions. The recorded screenshots were used to analyse the visual presentation of information. We manually entered tabular data into a spreadsheet for the analysis that we report throughout this chapter. Due to the complexity of the results discussed in this section, we will report and examine the implications of the features reported within this section and save only high-level summary for Section 7.3 (Discussion).

### 7.2.1. Visual Presentation of Search Page Layout

All four search engines used a similar overall page layout for their SERP pages, and we observed a strong visual similarity amongst them. We will briefly list the similarities and differences of these four SERPs with detail available in Table 7.4. For the purposes of illustrating the observed design of these four ISEs, we show screenshots of the search query A1 in each SERP as they appeared at the time of this study (Figure 7.1)<sup>13</sup>.

All four ISEs used a left-aligned page layout. Branding was presented top left alongside the search box. Scrolling was required in all ISEs so that the user could review the entire SERP list.

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<sup>13</sup> A larger visual of each of these screenshots is available in Appendix C.

Table 7.4 SERP page layout

	Google	Google-BRLF	Bing	Yahoo!
Page Alignment	Left	Left	Left	Left
Columns	2-Column	2-Column	2-Column	3-Column
Page Colour	None	None	None	Light Grey
Sidebar Boarder	✓	✓	✓	✓
Sidebar Colour	X	X	X	Light Grey
Gutter	Visually Generous	Visually Generous	Visually Generous	Visually Thin
Scrolling Required	✓	✓	✓	✓

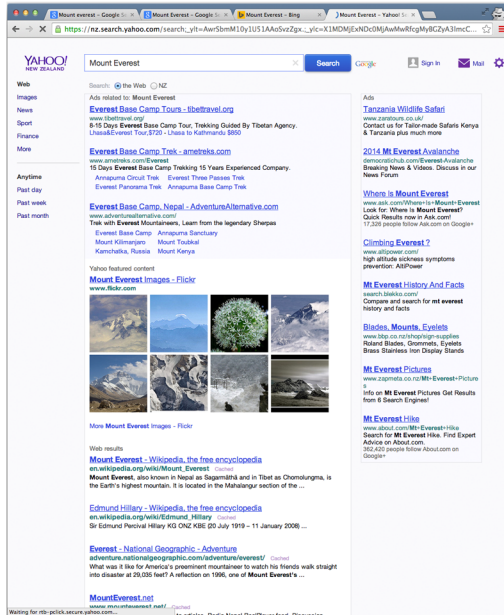
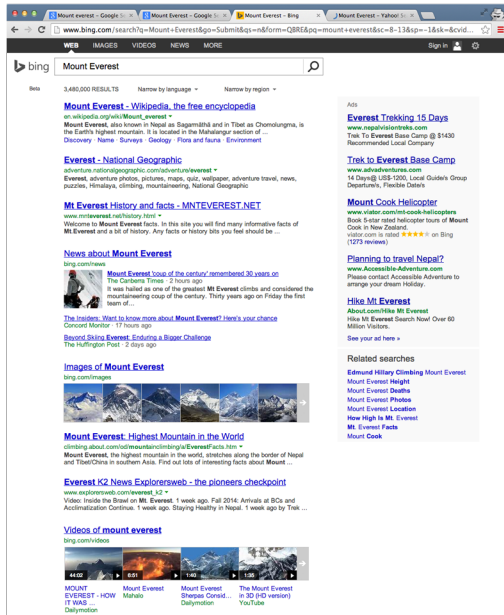
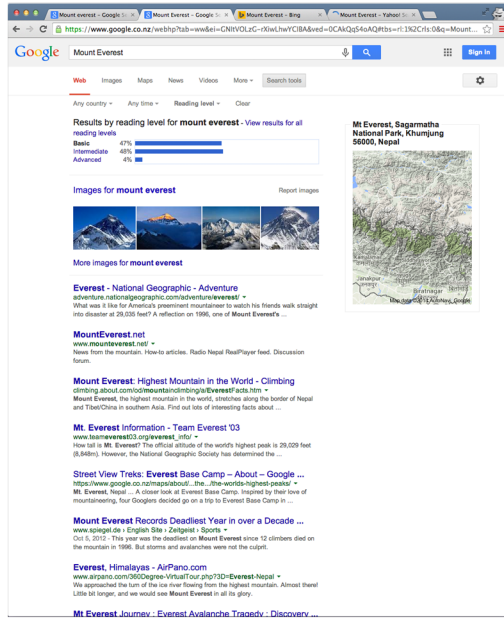
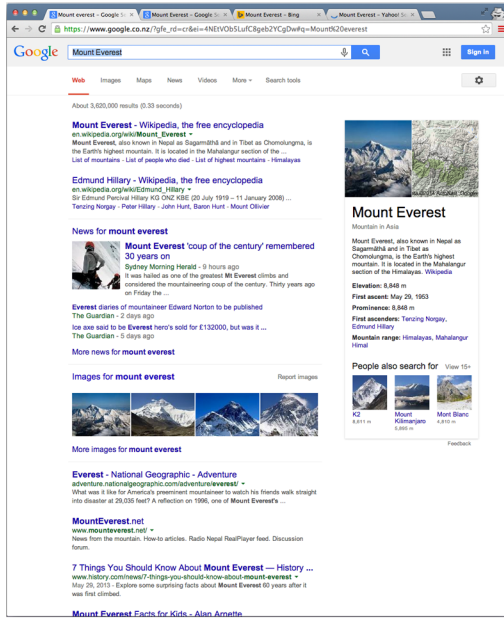


Figure 7.1 Google (top L), Google-BRLF (top R), Bing (bottom L), Yahoo! (bottom R). Google and the Google logo are registered trademarks of Google Inc., used with permission. Bing, used with permission from Microsoft. Yahoo! used with permission from Yahoo!

Google and Bing both presented a two-column layout, while Yahoo! used a three-column layout. The two-column layout had the visual effect of appearing more visually open and

suffered less from any adverse consequences caused by crowding compared to the three-column layout. This crowding was accentuated by Yahoo!'s use of a light-grey background colour for the entire page and the need to place the search results list within a bordered-white-background box. A page that is less visually crowded and clearly guides the user through effective eye paths is required for children who become easily distracted by complex information presentation.

All four ISEs bordered their sidebars (see Section 7.2.3.2) using a solid black or grey line. The margin between the content of the sidebar and the border was generous for both Google and Bing and smaller on the Yahoo! search engine. Clear demarcation of information areas and generous space between text and visual content will aid children's reading through minimising features that impact the types of eye movements required for efficient and effective reading.

Google and Bing both used a white background colour for both the page and sidebars, while Yahoo! offered a light grey background colour for both. Colour is often cited as important for children's motivation and pleasure, however, foremost in a text-based information seeking environment must be consideration of readability and legibility. In this instance, the difference is foreground and background colour when we consider the contrast of text colour and background colour should not negatively impact readability or legibility for children or adults using these search engines.

### **7.2.2. Conventions and Definitions of SERPs**

During our analysis of these four internet search engines, we identified that there is a need for terms to refer to the various typical elements of a search engine results page. To our knowledge, no other researcher or design authority has named these page elements previously. We identify two categories of visual presentation elements found on search results pages across the four ISEs; we term these *block-level* and *entry-level* units. Block-level units are elements that are visually separated from other information using techniques including borders and background colours. Entry-level units are the typical search engine results, which if clicked on, will lead a user to a specified website.

When describing our results, we will use the layout references as labelled in Figure 7.2.

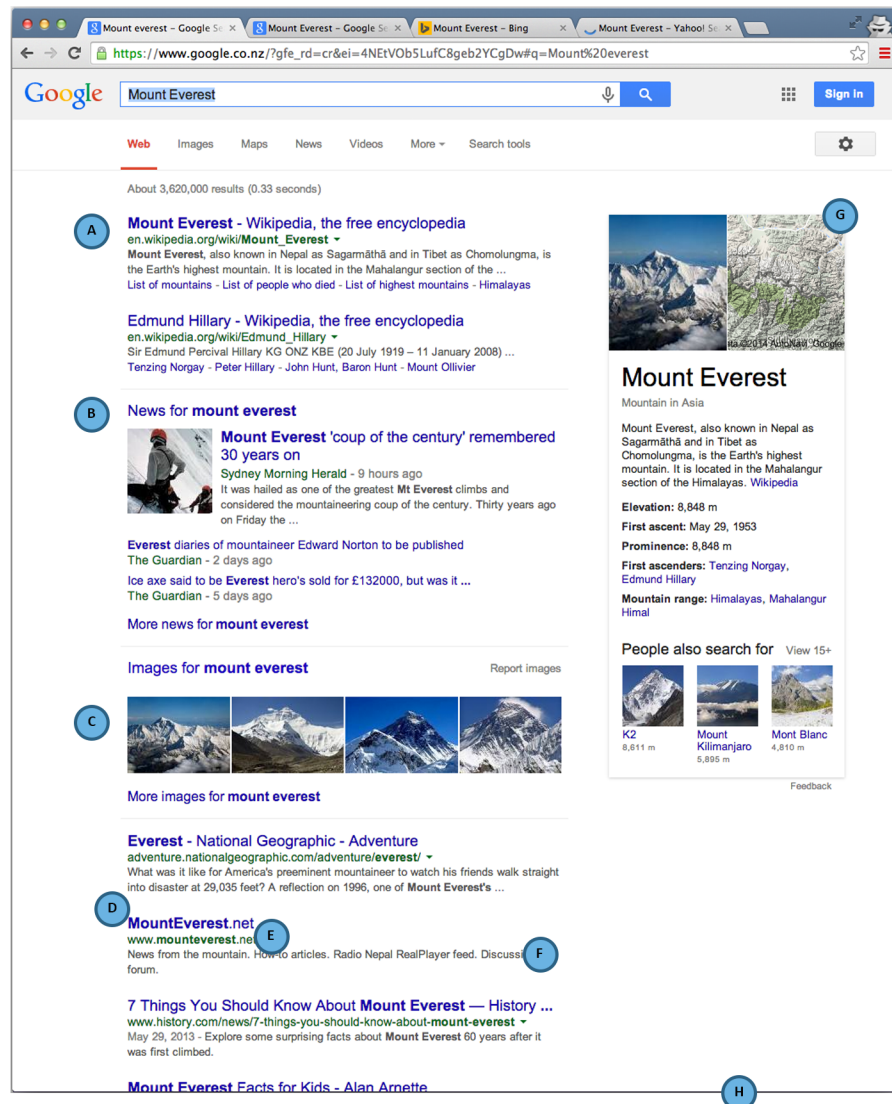


Figure 7.2 SERP Conventions. Google and the Google logo are registered trademarks of Google Inc., used with permission.

### 7.2.2.1. Block-level Units

The two block-level units identified in our study were pull-boxes and sidebars. These two block-level units also included a number of sub-block-level units such as image-blocks, video-blocks, news-blocks, and ad-blocks. Each of these block-level units and their respective sub-block-level units are described in Section 7.2.3, and a selection of these units are labelled in Figure 7.2.

SERPs typically consist of multiple entry-level units (see Section 7.2.2.2) *Entry(ies)* and block-level units (Section 7.2.2.1). We will label both of these units of information with a Position number starting at Position 1 as indicated in Figure 7.2. Positions will be numbered from the top-most Position in the SERP as shown in Figure 7.2 and will include both entry-level and block-level items. The numbering of Entries will only include non-block items and therefore, Entry1 will not always fall in Position1.

### 7.2.2.2. Entry-level Units

Entry-level units were identified to be very similar across all four ISEs. All entry-level units comprise a *Title*, *URL*, and *Descriptor* as labelled in Figure 7.2 and described in Section 7.2.3.1.

### 7.2.3. Visual Presentation of Information

We assessed the page layout used within the SERPs of the four search engines and identified three visual features that may affect children’s ability to find information:

- 1) presentation of results list text (see Section 7.2.3.1)
- 2) location and presentation of block-level units (Section 7.2.3.2)
- 3) location and presentation of related searches (Section 7.2.3.3)

#### 7.2.3.1. Presentation of Results List Text

We previously observed that text presentation features that affect readability and scannability include the size of text, the length of a line of text (line-length), the horizontal space between lines of text (interlinear space) and between blocks of text (paragraph space) as well as the vertical space around blocks of text (margins and gutters) (Vanderschantz, 2007). Text must be large enough for the child to distinguish and identify the shape and meaning of the letterforms and wordforms so that the complex act of reading and decoding can be conducted with automaticity (Vanderschantz, 2008). The greater the size of the interlinear space, the easier to distinguish the separate lines of text. Greater space between lines of text, blocks or paragraphs of text and surrounding text is known to improve children’s ability to find the next line of text when reading running text (Burt, 1959). Text presentation, including spacing, is important for encouraging eyeflow and leading the eye around a document in an effective and efficient manner.

The display of text, particularly the display of results lists, will impact on children’s effective and efficient location of information within a search engine page. Teachers described “skimming and scanning” to be the reading strategy children are taught as a part of the literacy curriculum in NZ schools.

Table 7.5 details the features of text presentation considered in our analysis. We assume that the Title is the most likely SERP text to be skimmed first by a child. All four search engines use the common convention of blue link text for titles. Google set type with a 15 pixels height, while Bing and Yahoo! both set type with a 13 pixels height. We make no judgement of the size of this text in this instance. All search engines display URL and

Descriptor text at the same type size and therefore the difference in size between URL and Title size is most prominent for Google. These text size differences on Google will likely aid skimming and scanning by children because the size difference makes the more important (larger text) more visible.

**Table 7.5 Presentation of text to assist skimming and scanning**

	Google	Google-BRLF	Bing	Yahoo!
<b>Title Colour</b>	Blue	Blue	Blue	Blue
<b>Text Size</b>	15px	15px	13px	13px
<b>Inter-linear Spacing</b>	9px	9px	9px	6px
<b>Inter-Entry Spacing</b>	32px	32px	30px	37px
<b>Underline</b>	x	x	✓	✓
<b>Margin</b>	137px	137px	100px	21px

Google and Bing both used 9 pixels of interlinear space between the title and the URL while Yahoo! only a 6 pixels interlinear space. The spacing<sup>14</sup> between lines of text will help with the readability of individual lines of text while negative space between entries will improve the skim-ability and scan-ability of SERP Entries. Underlined text decreases the interlinear spacing resulting in the complicated presentation of text. Lines of text become harder to distinguish, and reading on from one line to the next is made harder. This difficulty to easily distinguish lines of text will result in slower reading for children. Scanning for the Titles of Entries will also be less efficient for younger users. Both Bing and Yahoo! use underlined text for the titles of each entry. Due to the use of underline the interlinear space for Bing and Yahoo! were measured from below the underline, while for Google the interlinear space was measured from the *baseline* of the Title to the *capline* of the URL.

Similar to interlinear space, paragraph or Entry spacing was measured from the baseline of a Descriptor to the capline of the following Title. Yahoo! provided the most generous space between Entries with 37 pixels of space, Google with 32 pixels of space and Bing with 30 pixels of space.

Document spacing, such as margin and gutter spacing is also important for encouraging eye flow and navigation of a document. Margins are the spaces to the top, bottom, and sides of a page while gutters are the vertical spaces between blocks of text or image information. When a margin or gutter is too small, the border between text and its bordering object becomes complex and hard to distinguish easily and therefore, harder to read. Google has a 137 pixels left margin to its first entry while Bing has a 100 pixels left

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<sup>14</sup> Designers and printers refer to spacing between lines of text as *interlinear spacing* and spacing between blocks of text (i.e. paragraphs) is referred to as *paragraph spacing*.

margin to the bar in which its first advertisements appear and Yahoo! has a 21 pixels left margin to the left-hand navigation items. Following the rightmost point of Yahoo!'s navigation items, there are 75 pixels of gutter space before the vertical bar appears that encloses the search results list for Yahoo!.

All four ISEs use a similar line length (number of characters per line) to represent their results. All ISEs used a single line of text for Titles, and two lines for Descriptors. All ISEs highlighted keywords in search result Titles, URLs, and Descriptions using of Bold type. Entry Titles appear in blue, URLs appear in green and Descriptors in grey in all four internet search engines. Taken together, the generous text size of the title and interlinear space along with the comfortable space between search entries, and the lack of title underline, Google is likely more scannable for children.

### 7.2.3.2. Location and Presentation of Block-level Units

In this section, we describe the location and presentation of the two types of block-level units, which included pull-boxes and sidebars that we identified. Table 7.6 identifies the inclusion of block-level units identified to be used by each of the ISEs during our study. This section includes a detailed discussion of the visual design and use of these units.

**Table 7.6 Block-level units used by ISEs**

	Google	Google-BRLF	Bing	Yahoo!
Ad-blocks	x	x	✓	✓
News-blocks	✓	x	x	x
Image-blocks	✓	✓	✓	✓
Video-blocks	✓	✓	✓	x
Info-blocks	✓	✓	x	x
Sidebars	✓	✓	✓	✓

#### Pull-boxes

Pull-boxes were identified as page elements that were placed as interruptions to the search result entries. Pull-boxes are page elements that are encapsulated by a filled or bordered box or used a horizontal rule to separate this content visually from the run of the page. All search engines investigated used pull-boxes in some form. We identified pull-boxes used for four types of content; advertisements, news, images, and videos and these are discussed in the following sections.

#### Pull-boxes for Advertisements (ad-blocks)

Advertisements are prominent and often displayed in both Yahoo! and Bing. Google and Google-BRLF did not show advertisements for any of the queries that were tested for this study. Table 7.7 details the features of ad-blocks that we discuss in this section.

Table 7.7 Visual design of ad-blocks<sup>15</sup>

	Google	Google-BRLF	Bing	Yahoo!
List Position	–	–	1	1
Boarder	–	–	Right Hand	x
Background	–	–	Green	Grey

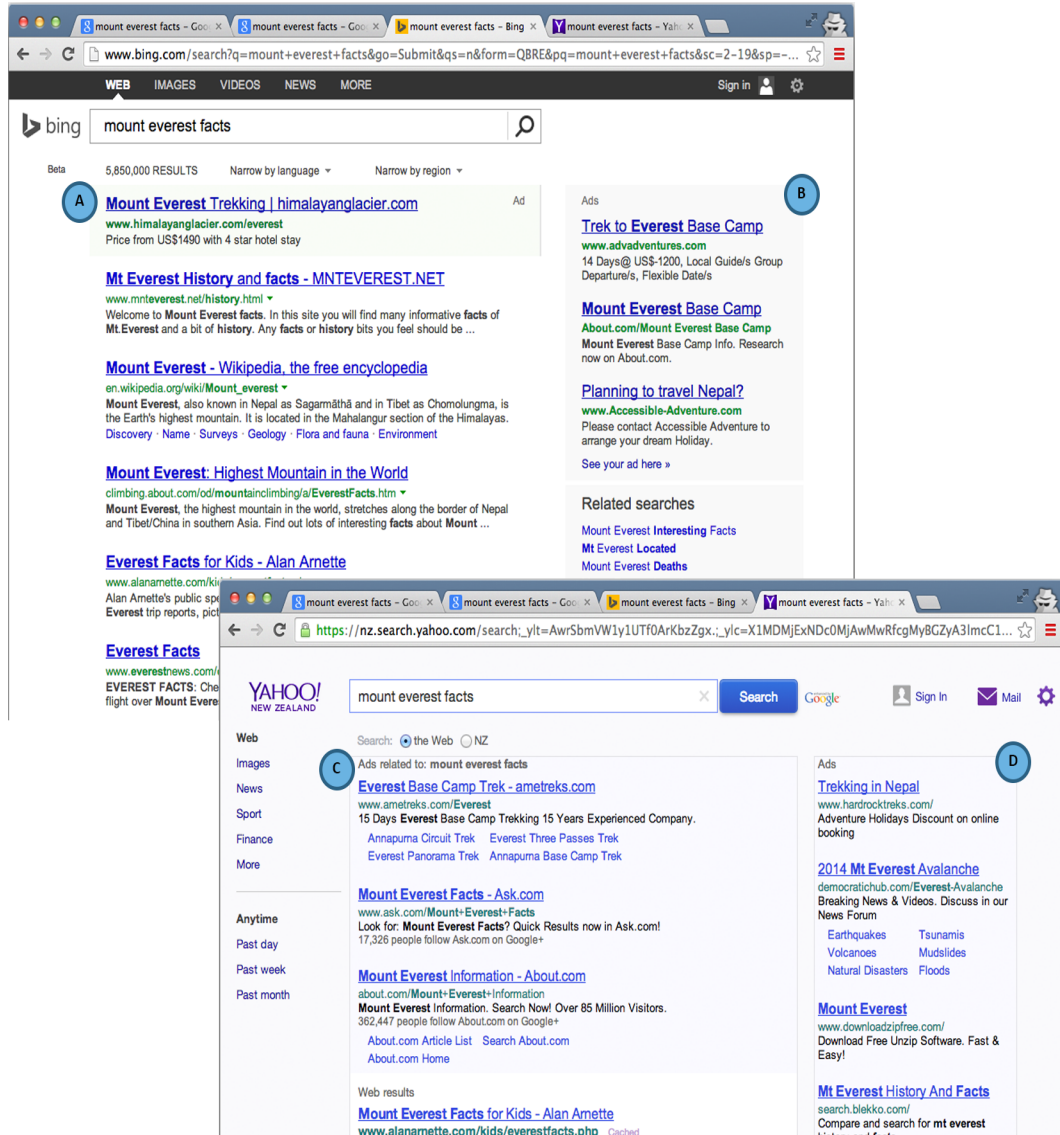


Figure 7.3 Bing (top) and Yahoo! (bottom) advertisements (advertisements labelled). Bing, used with permission from Microsoft. Yahoo! used with permission from Yahoo!

Bing and Yahoo! were both recorded with pull-boxes that contained ad-blocks in Position 1 of the search result list. Yahoo! returned three ad-blocks in Position 1 for every search conducted for our study, while Bing only sometimes displayed advertisements. Figure 7.3 illustrates Bing and Yahoo!’s use of ad-blocks. Advertising portions in Bing are labelled with A and B, while advertising in Yahoo! is labelled with C and D. Bing used a

<sup>15</sup> Tables that describe the features of pull-boxes will follow these conventions: The List Position row details the most common entry list position(s) at which these pull boxes were noted. The Boarder row details the use of borders, while the Background row details the use of a background colour to demarcate an area.

light-green background-colour with a grey right-hand border with the title 'ads' in the top right corner. Yahoo! used a light -grey background-colour and the title 'advertisements related to:'. Both Bing and Yahoo! also used the sidebar to show advertisements. Yahoo! used the entire sidebar for advertisements, while Bing would include only a small number of advertisements in the top of the sidebar and sometimes no advertisements in the sidebar at all.

Figure 7.4 illustrates the display of advertisements in Google and Google-BRLF.

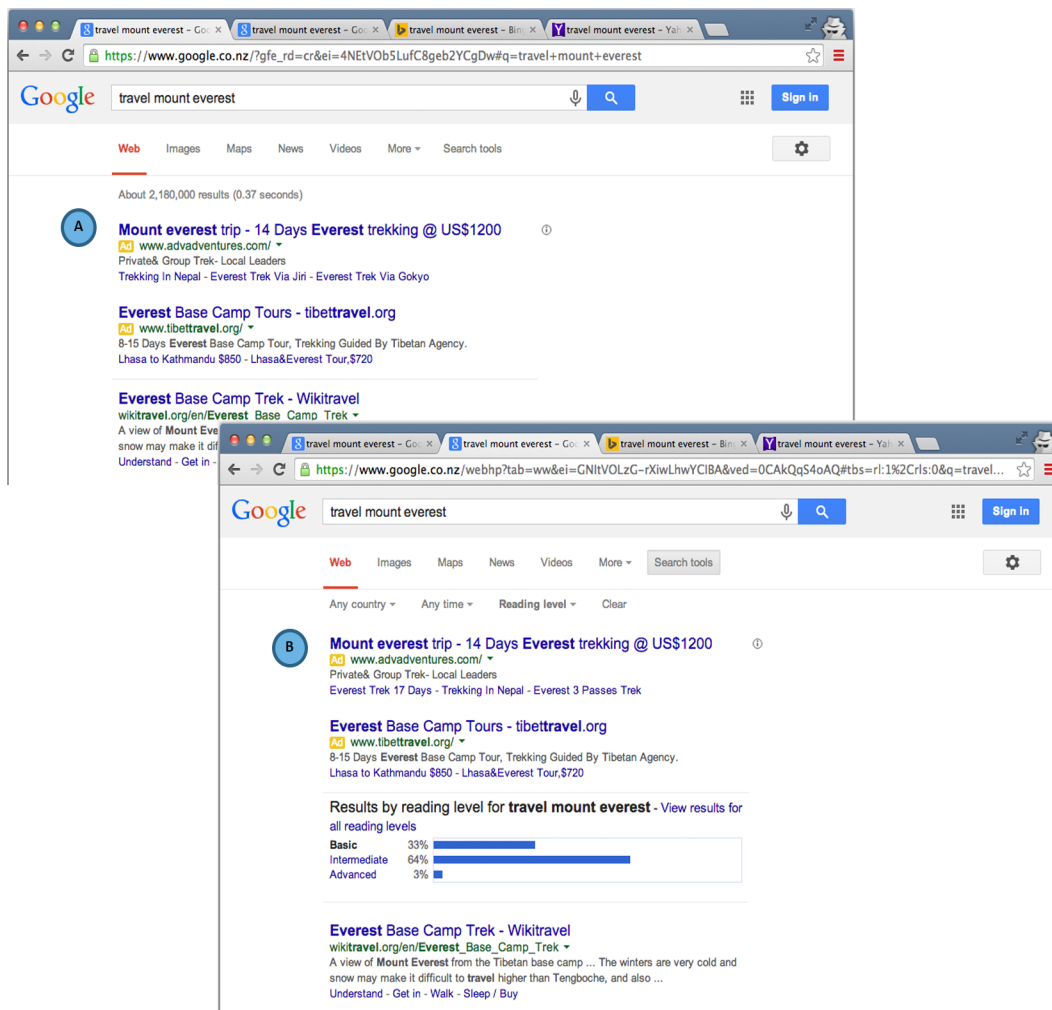


Figure 7.4 Google (top) and Google-BRLF (bottom) advertisements (advertisements labelled). Google and the Google logo are registered trademarks of Google Inc., used with permission.

To force advertisements to appear in Google we ran a search query which was not included as a part of the search set detailed in Table 7.3 for this experiment. We searched for *travel mount everest* and were able to return two advertisements in both Google and Google-BRLF. Advertisements in Google appeared in pull-boxes in Position1. Each sponsored link was marked with a small yellow graphic next to the URL. Pull-boxes for advertisements in Google are separated from the SERP list by a thin grey horizontal rule.

When advertisements are present in Google-BRLF, they appear above the reading level filter. This may prove beneficial to children who may, with experience, be blind to content above this visual element as being irrelevant to their study.

When discussing advertising on web pages, one teacher in our interviews in Chapter 6 explicitly reported: “websites cluttered with advertisements hinder them [children] finding information.” This obscuring of useful information, through the inclusion of advertising links, is likely detrimental to the successful information search by children who are learning to skim and scan results pages to identify information of relevance to their search.

Pull-boxes for News Items (news-blocks)

Google is the only internet search engine to include news-blocks as clearly marked boxes, while Bing was the only other search engine to include news-blocks, they were not visually separated from other results list links. Pull-boxes for news items did not appear in Google-BRLF or Yahoo! for any of the searches that we ran. Table 7.8 details the features of news-blocks that we will discuss in this section.

**Table 7.8 Visual design of news-blocks**

	Google	Google-BRLF	Bing	Yahoo!
<b>List Position</b>	4	-	4	-
<b>Boarder</b>	✓	-	x	-
<b>Background</b>	x	-	x	-

News-blocks were visually identical to Google’s pull-boxes used for images (see A in Figure 7.5). Google news-blocks were encased in a grey top and bottom border without a coloured background. Google news-blocks often displayed news results at Position3 or Position4. Typically news-blocks contained either a single news item with an accompanying image or 3 news items with only the first news item containing an accompanying image. News-blocks contained a title ‘News for ...’ and each news item entry also included its own title. Google also included a Title at the bottom of the news-blocks that read ‘More news for ...’.

Bing does not visually separate news-blocks from content using boxes in the same way that they do ad-blocks (see B in Figure 7.5). Bing does increase the space between news-blocks and typical SERP Entries by approximately 2 pixels. News-blocks used by Bing, therefore, have 34 pixels of white space before a news-block.

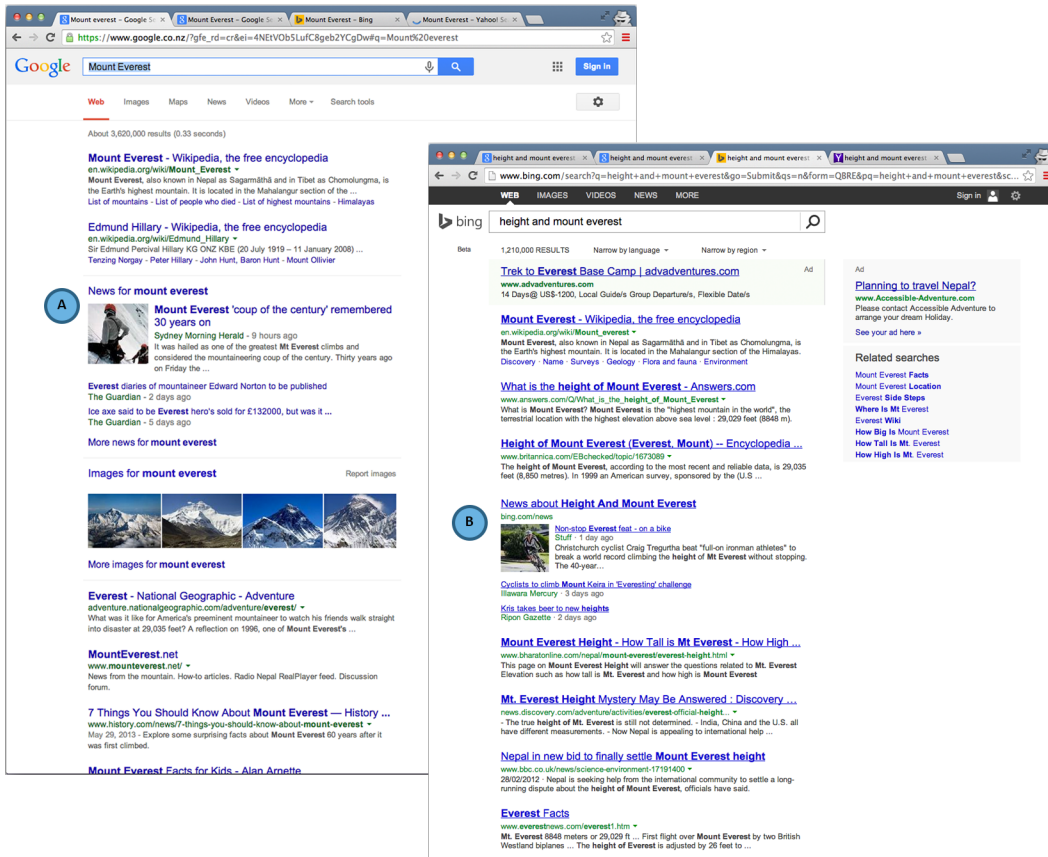


Figure 7.5 Pull-boxes used for news items used by Google (left) and Bing (right). Google and the Google logo are registered trademarks of Google Inc., used with permission. Bing, used with permission from Microsoft.

It is arguable that news-blocks serve a greater informational purpose than ad-blocks. We do not argue that these news-blocks are unnecessary for the searches that produced them. Similar to ad-blocks, news-blocks may obscure informational SERP links and may be detrimental to the successful information search by children.

Pull-boxes for Images and Videos (image-blocks and video-blocks)

Pull-boxes for images (image-blocks) were included in SERPs by all four ISEs. Google (including Google-BRLF) and Bing presented 4 and 6 images respectively in a *carousel* strip, while Yahoo! presented 8 images in a grid. Table 7.9 details the features of image-blocks that we will discuss in this section.

Table 7.9 Visual design of image-blocks

	Google	Google-BRLF	Bing	Yahoo!
List Position	3 or 4	2 to 4	4	2
Boarder	✓	✓	x	x
Background	x	x	x	x

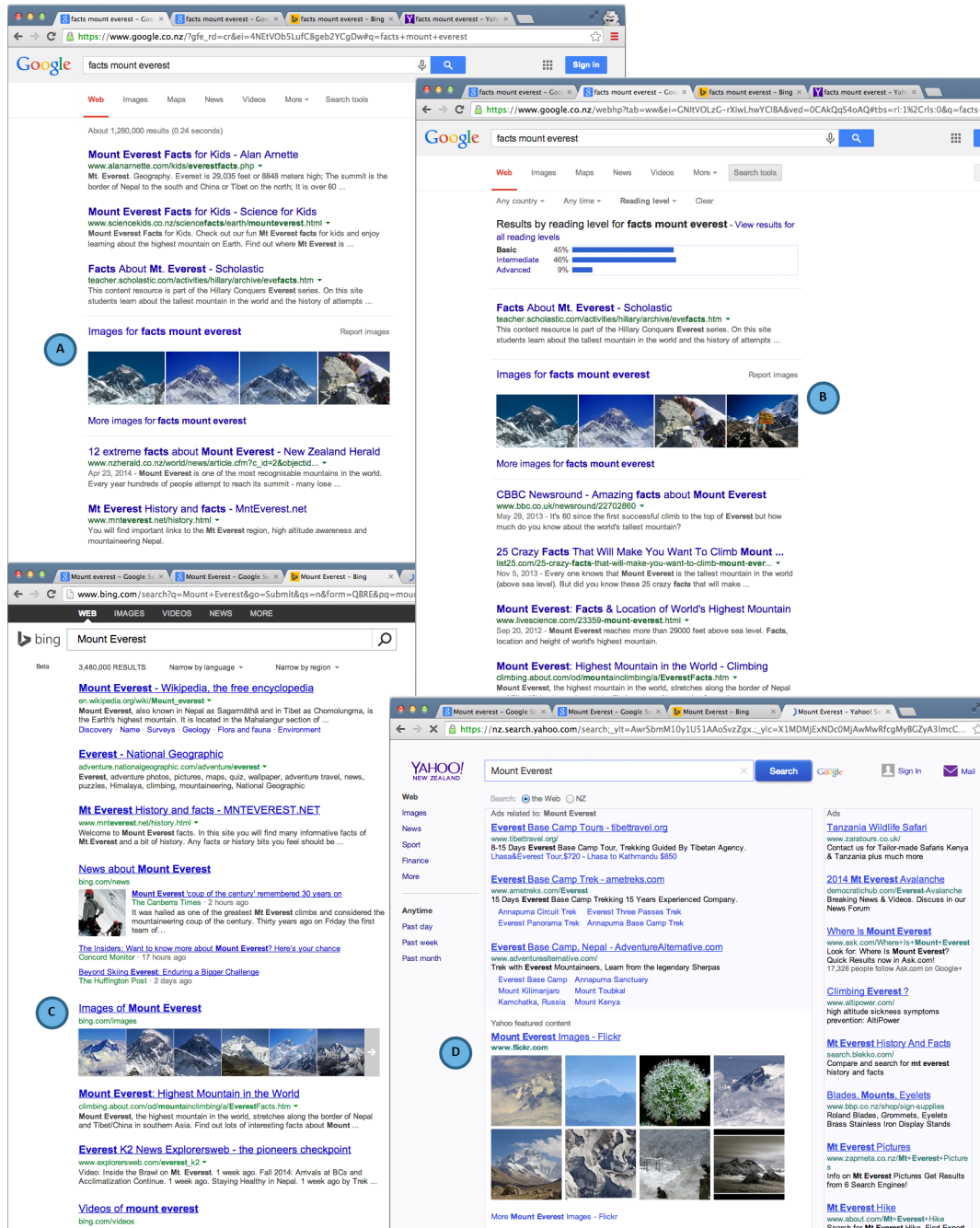


Figure 7.6 Pull-boxes used for images as used by SERPs. Google and the Google logo are registered trademarks of Google Inc., used with permission. Bing, used with permission from Microsoft. Yahoo! used with permission from Yahoo!

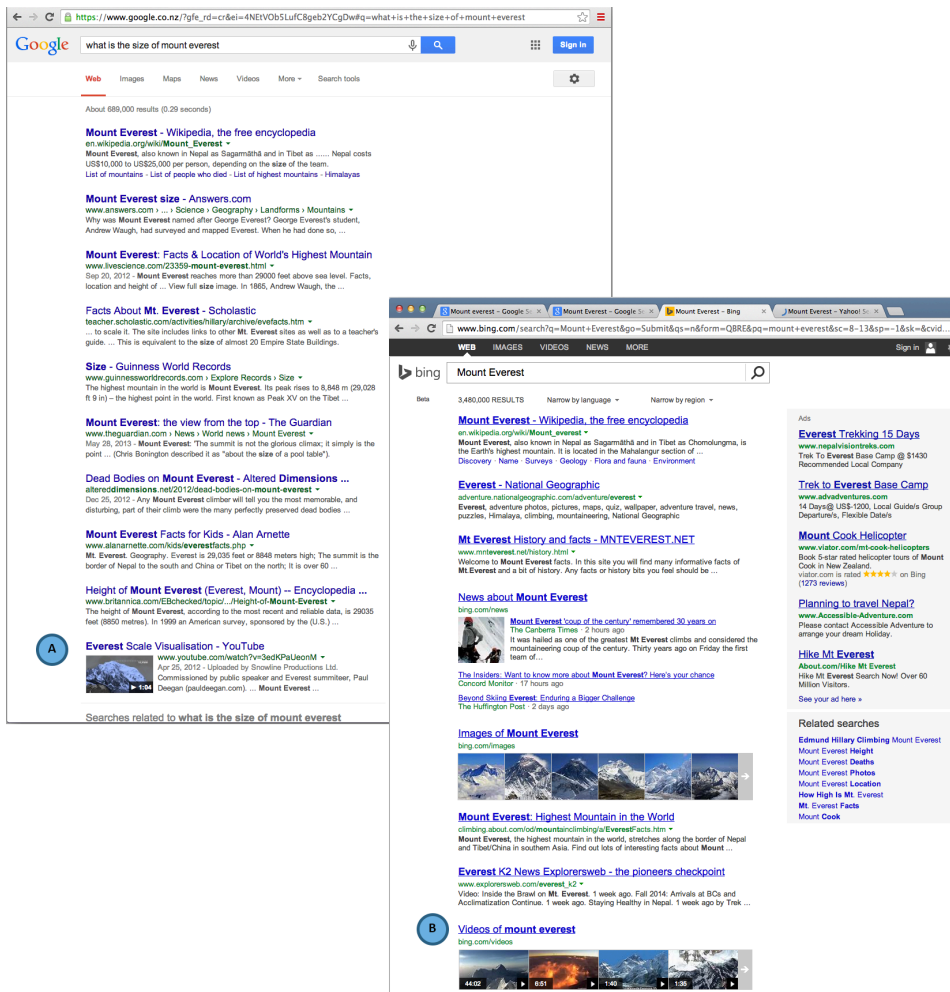
Figure 7.6 shows image-blocks for Google (see A in Figure 7.6), Google-BRLF (see B in Figure 7.6), Bing (see C in Figure 7.6) and Yahoo! (see D in Figure 7.6). As per news-blocks, Google encapsulated image-blocks with a top and bottom border to visually demarcate these from the run of typical Entries. Equally, Bing treated image-blocks the same way that they treated news-blocks by adding additional space before and after an image-block to visually separate this from the run of typical Entries. Yahoo! displayed image-blocks in a 4x2 grid. No visual separation or differentiation for this display block

was used. Image-boxes that are clearly separated from Entries (e.g. by way of space or a visual indicator such as a border or background colour) are likely to assist with skimming due to their visual differentiation, which creates separation from the skimmable text.

Table 7.10 details the features of video-blocks that we will discuss in this section.

**Table 7.10 Visual design of video-blocks**

	Google	Google-BRLF	Bing	Yahoo!
List Position	6	2	4	-
Boarder	x	x	x	-
Background	x	x	x	-



**Figure 7.7 Pull-boxes used for videos by Google (L) and Bing (R). Google and the Google logo are registered trademarks of Google Inc., used with permission. Bing, used with permission from Microsoft.**

Pull-boxes used for videos were only noted in Bing and Google (and Google-BRLF). Bing clearly marked a video with a pull-box containing multiple videos in a strip similar to how Bing displays image-blocks. Google, however, simply included single videos, with a

video still as a clickable icon to the left of an Entry. No additional space, background colour or horizontal rule was discernable for pull-boxes used for video-blocks by Google.

Pull-boxes for Information

The most valuable pull-boxes that we identified in our examination were the info-blocks used only by Google and Google-BRLF. These info-blocks were noted only when a specific question or recognizable fact was searched for. These information-blocks returned the answer to the question being searched with reference images where relevant. For example (but not limited to), we noted info-blocks for queries D3, D6, and E5. Info-blocks are illustrated in Figure 7.8.

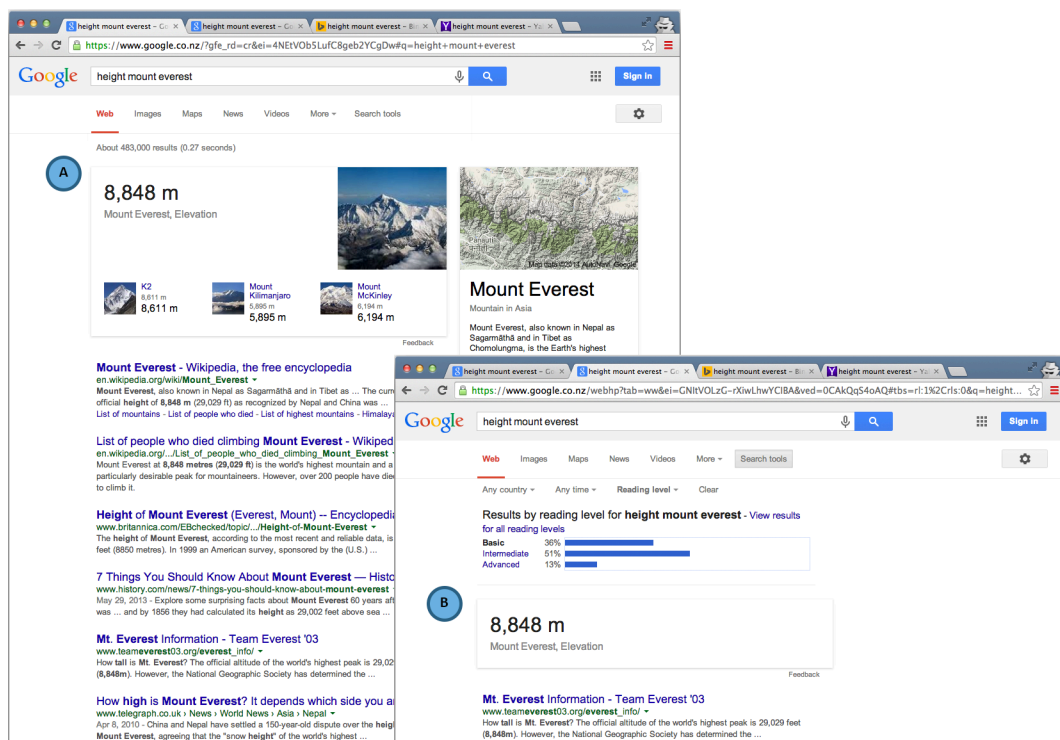


Figure 7.8 Information-boxes used by Google (left) and Google-BRLF (right). Google and the Google logo are registered trademarks of Google Inc., used with permission.

The use of pull-boxes resulted in a decreased number of search result entries visible above-the-fold. Investigation of the positive or negative impact of pull-boxes on information triage or skimming and scanning by children would be warranted.

Sidebar

We observed that the rightmost column in each search engine was used for either additional information or additional navigation. We refer to these block-level units as sidebars, and we note these were used differently by each internet search engine.

Figure 7.9 illustrates sidebars for each search engine, showing these in the context of the entire viewable area for each SERP.

Sidebars are potentially very relevant for a child when they contain useful information, for a similar purpose to that seen in the use of info-blocks by Google and Google-BLRF or as a tool to raise related searches or other such useful navigational tools above the fold. This style of sidebar would serve to provide an answer to a searched question or provide alternative keywords for query reconstruction, or indeed related searches themselves. Table 7.11 details the features of sidebars that we will discuss in this section.

**Table 7.11 Visual design of sidebars**

	Google	Google-BLRF	Bing	Yahoo!
<b>For</b>	Image & Text	Image & Text	Ads & Related Search	Ads
<b>Boarder</b>	✓	✓	x	✓
<b>Background</b>	x	x	✓	✓

Google and Google-BLRF used sidebars to list information related to a search. This search-related-information always included an image. Google most often displayed a heading above which was often one or two images. Below the heading was a short list of factual information. The provenance of some of the information is clear and can be tracked by way of the link text provided, while some of the information requires interpretation to track its provenance. When Google-BLRF is used the sidebar, it was only found to include an image, often a map with an informative heading below this as noted with Google sidebars.

Yahoo! and Bing both included advertisements in the top most portion of the sidebar. Yahoo! typically displayed 6 to 8 advertisements while Bing most often displayed 3 advertisements. Google did not display advertisements in a sidebar for any of the searches that we conducted.

Bing included a lower section to its sidebar that was visually separated from the advertisements by a thin white horizontal rule. This lower sidebar contained related-searches. Bing's inclusion of related-searches in an above-the-fold and visible location in the sidebar will also assist users with query reformulation.

Images are known to draw the eye as shown by heat-map and eye tracking studies (Beymer, Orton, & Russell, 2007; Buscher, Cutrell, & Morris, 2009). Use of images in the sidebar will likely attract the eye of a young user and therefore, increase the likelihood of

attention to this area. Google often incorporated images and factual information in the sidebar, which may provide a helpful tool to children.

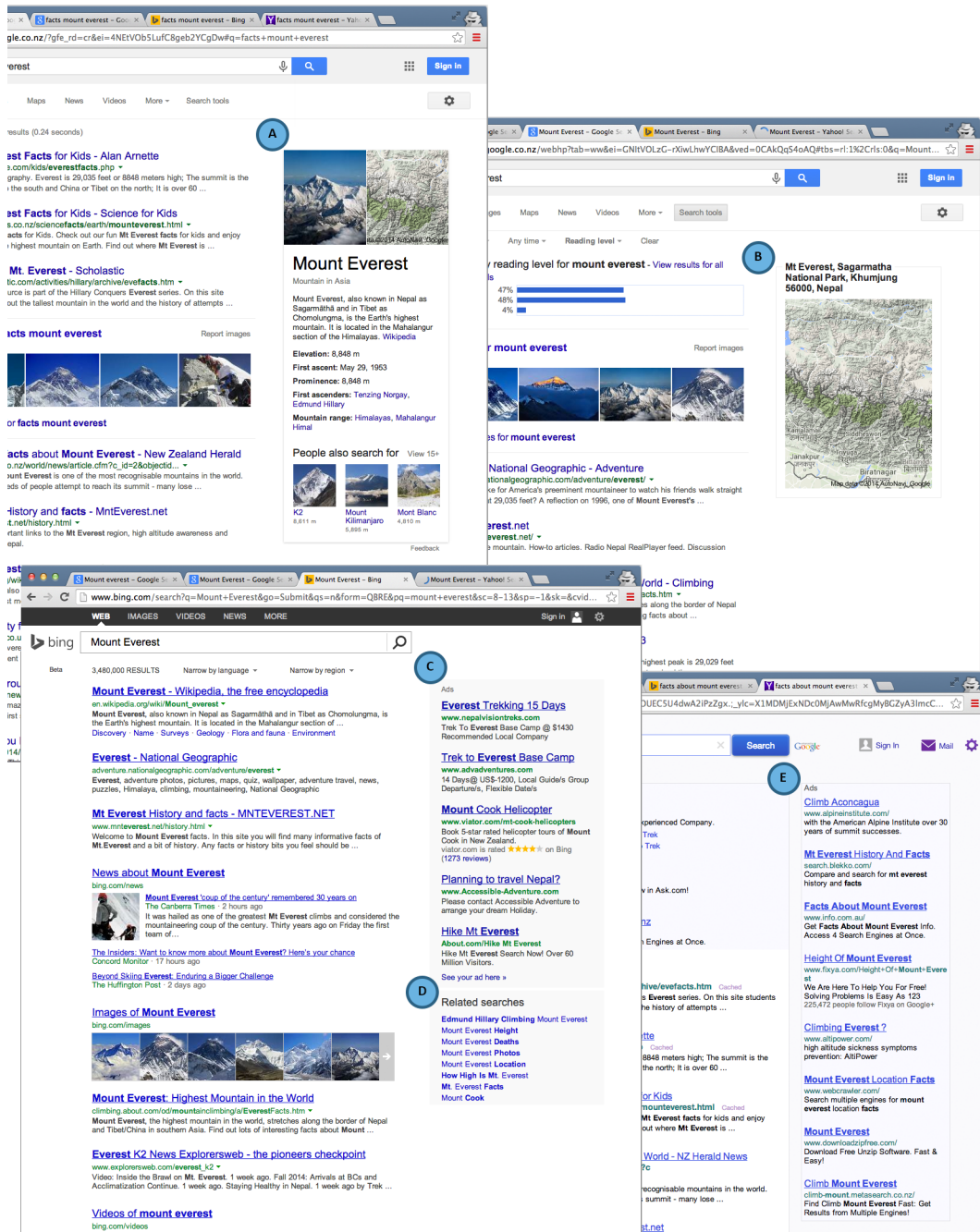


Figure 7.9 Sidebars in ISEs. Google and the Google logo are registered trademarks of Google Inc., used with permission. Bing, used with permission from Microsoft. Yahoo! used with permission from Yahoo!

While we did not observe images associated with advertisements in our study, should images be subconsciously associated with advertisements in a sidebar this would have an adverse impact on children’s ability to find information. Eye tracking studies have also shown the existence of the *banner-blindness* and *ad-blindness* phenomena, or according to Hervet et al. (2011) more correctly *ad-avoidance*. Sidebars that do not include images may

prove to have a very low magnetism for children and may, therefore, result in scarce eyeflow to this area.

#### 7.2.3.3. Location and Presentation of Related Searches

Related searches features of ISEs were investigated because children and teachers in our studies (see Chapters 5 and 6) discussed difficulties reformulating searches when a search query is failing to return the results that they desire. To review the use of Related Searches we did need to scroll the browser to allow assessment of information that was below-the-fold. This mere fact that related searches are demoted to presentation below-the-fold and some distance from the search box may prove detrimental to children's ability to associate this as a tool for reformulating search queries.

Bing clearly displayed related-searches in the sidebar (above-the-fold), while both Yahoo! and Google placed related-searches at the bottom of the search result list (below-the-fold). Bing also gave secondary related-searches in the lower part of the search result list in a similar manner to Yahoo! and Google. Google-BRLF did not display related-searches for any of our search queries.

Related searches were present for all searches in Bing and Google, but not for Yahoo!. For example, we noted that for the query *mt everest*; related-searches were present, however for *mt everest for kids*; no related-searches were given by Yahoo!. When related-searches are not present in a Yahoo! SERP, advertisements are placed in the same space.

Related-searches that are above-the-fold will be more readily available to a user, and thus, when these are used in the sidebar they are likely more accessible to children. However, when advertisements are placed in the position that a related-searches have appeared previously (such as noted by Yahoo!) confusion for a child may occur.

All four ISEs present the related searches as blue link text and use the words "related searches" in a title for this page unit.

#### 7.2.4. Query Construction Effects on Search Engine Results

Here we consider the influence of query construction on the display of the SERP. We analysed the *visual differences* in the SERP display. This section shows how minor changes in query construction can have significant effects on both the result list itself as well as the presentation of the search result page. We do not interpret the quality of the search

results returned, nor do we interpret the relevance of the results returned to the query submitted.

For each of the compared queries construction types in this section, we will report a typical comparison of that construction type with an accompanying table to visualise the comparison. For example, Section 7.2.4.1 presents a comparison of keyword and natural language queries. To illustrate this comparison we reported in Table 7.12<sup>16</sup> the keyword vs. natural language queries of D3 and D13 as indicative of the typical types of differences noted throughout this section. It should not be misunderstood that this was the only keyword vs. natural language query for which these differences were found.

#### 7.2.4.1. Keyword vs. Natural Language Queries

The effect of keyword queries compared to natural language queries is illustrated by the comparison of the keyword query *height mount everest* (D3) and the natural language query of *height of mount everest* (D13) in Table 7.12.

**Table 7.12 Comparison of keyword vs. natural language sentences (search query D3 vs. D13)**

	Google (D3)	Google (D13)	Google-BRLF (D3)	Google-BRLF (D13)	Bing (D3)	Bing (D13)	Yahoo! (D3)	Yahoo! (D13)
Entries	x	x	x	x	x	x	x	x
Ad-blocks	-	-	-	-	x	x	x	x
News-blocks	-	-	-	-	x	-	-	-
Image-blocks	-	-	-	-	-	-	-	-
Video-blocks	-	-	x	-	-	-	-	-
Info-blocks	✓	✓	✓	✓	-	-	-	-
Sidebar	✓	✓	-	-	✓	✓	x	x

<sup>16</sup> We have not attempted to record the total number of differences in compared result lists, however, it can be assumed that when two comparable entries do not match, both the order and some of the returned Entries in a result list were different. We provide the following key to assist with reading the tables in this section.

**Key for tables in Section 7.2.4**

✓	This feature was present and the same for both of the compared queries
x	This feature was present but different to the compared query
-	This feature was not present in this query

We also explored the effect of keyword queries compared to natural language queries that used a question. Table 7.13 lists the differences for keyword query *height mount everest* (D3) vs. natural language question *what is the height of mount everest* (E2).

**Table 7.13 Comparison of keyword vs. natural language (questions) (search query D3 vs. E2)**

	Google (D3)	Google (E2)	Google-BRLF (D3)	Google-BRLF (E2)	Bing (D3)	Bing (E2)	Yahoo! (D3)	Yahoo! (E2)
Entries	x	x	x	x	x	x	x	x
Ad-blocks	-	-	-	-	x	x	x	x
News-blocks	-	-	-	-	x	-	-	-
Image-blocks	-	-	-	-	-	-	-	-
Video-blocks	-	-	x	-	-	-	-	-
Info-blocks	✓	✓	✓	✓	-	-	-	-
Sidebar	✓	✓	-	-	x	x	x	x

All four internet search engines had differences for very early entries (often Position1 or Position2) in the SERP list when a keyword search is compared to a natural language search. In Bing, news-blocks were only displayed for keyword searches, not NL searches. In Yahoo! video-blocks were only used for keyword searches, not NL searches. Table 7.12 and Table 7.13 indicate that Bing and Yahoo! presented a different number of advertisements when a natural language search was used compared to a keyword search. Deeper investigation reveals that when NLS and NLQ were used Bing and Yahoo! both presented the user more advertisements. Should NL queries be something that a less confident searcher is likely to exhibit, it is of concern that these result in increases in advertising numbers.

Google and Google-BRLF resulted in the fewest differences when NLQ are compared to keyword queries and no advertisements.

#### 7.2.4.2. Natural language sentence vs. Natural language question

Here we report our findings of the effect of natural language queries that used a sentence compared to natural language queries that used a question. Table 7.13 lists the differences that we identified for the natural language sentence query *height of mount everest* (D13), which we compared to the natural language question query *what is the height of mount everest* (E2).

**Table 7.14 Comparison of NL (sentences vs. questions)  
with search query D13 vs. E2**

	Google (D13)	Google (E2)	Google-BRLF (D13)	Google-BRLF (E2)	Bing (D13)	Bing (E2)	Yahoo! (D13)	Yahoo! (E2)
Entries	x	x	x	x	x	x	x	x
Ad-blocks	-	-	-	-	x	x	✓	✓
News-blocks	-	-	-	-	x	-	-	-
Image-blocks	-	-	-	-	-	-	-	-
Video-blocks	-	-	✓	✓	x	-	-	-
Info-blocks	✓	✓	✓	✓	-	-	-	-
Sidebar	✓	✓	-	-	x	x	x	x

Differences between NLS and NLQ queries had some impact on the results lists for all search engines. This first difference happened very low on the list at Position6 or Position7 in all ISEs. NLQ queries resulted in fewer advertisements for both Bing and Yahoo!. For Bing, only NLS queries returned news-blocks or video-blocks.

We further investigated the effect of punctuation with the use of a question mark (?) to understand what effect this might have. Table 7.15 lists the differences that we identified for the compared use of a natural language question without a question mark E1 (*what is the height of mount everest*) compared to a natural language question with a question mark E2 (*what is the height of mount everest?*).

**Table 7.15 Comparison of punctuation in search query E1 vs. E2**

	Google (E1)	Google (E2)	Google-BRLF (E1)	Google-BRLF (E2)	Bing (E1)	Bing (E2)	Yahoo! (E1)	Yahoo! (E2)
Entries	✓	✓	x	x	✓	✓	✓	✓
Ad-blocks	-	-	-	-	✓	✓	✓	✓
News-blocks	-	-	-	-	-	-	-	-
Image-blocks	-	-	-	-	-	-	-	-
Video-blocks	✓	✓	✓	✓	-	-	-	-
Info-blocks	-	-	-	-	-	-	-	-
Sidebar	✓	✓	-	-	✓	✓	✓	✓

Punctuation returned no visual differences, nor did it impact the number of search results returned by either Google, Bing or Yahoo!. Google-BRLF did result in different entries in Position7. Therefore, these results would suggest that the using, or not using punctuation for queries, will neither hinder, will have little bearing on the results returned and should not hinder children’s ability to find information.

To confirm the results we noted here we also compared the effect of punctuation using queries E9 and E10, along with the queries E1 and E2. We saw similarly few differences in presentation and entry results as we present in Table 7.15.

#### 7.2.4.3. Phrase Ordering

The effect of phrase ordering on searches is shown in Table 7.16. Table 7.16 lists the differences that we identified for phrase ordering of queries *mount everest facts* (B2), which we compared to *facts mount everest* (B3). Further, Table 7.17 lists the differences that we identified for the query *mount everest and height* (D5) vs. *height and mount everest* (D6).

**Table 7.16 Comparison of phrase ordering in search query B2 vs. B3**

	Google (B2)	Google (B3)	Google-BRLF (B2)	Google-BRLF (B3)	Bing (B2)	Bing (B3)	Yahoo! (B2)	Yahoo! (B3)
Entries	x	x	x	x	x	x	x	x
Ad-blocks	-	-	-	-	✓	✓	x	x
News-blocks	-	-	✓	✓	✓	✓	-	-
Image-blocks	✓	✓	✓	✓	-	-	-	-
Video-blocks	-	-	-	x	-	-	-	-
Info-blocks	x	x	x	x	-	-	-	-
Sidebar	✓	✓	-	-	✓	✓	x	x

Table 7.17 Comparison of phrase ordering in search query D5 vs. D6

	Google (D5)	Google (D6)	Google-BRLF (D5)	Google-BRLF (D6)	Bing (D5)	Bing (D6)	Yahoo! (D5)	Yahoo! (D6)
Entries	x	x	x	x	x	x	x	x
Ad-blocks	-	-	-	-	✓	✓	x	x
News-blocks	-	-	-	-	-	-	-	-
Image-blocks	✓	✓	✓	✓	-	-	-	-
Video-blocks	-	-	✓	✓	-	-	-	-
Info-blocks	x	x	x	-	-	-	-	-
Sidebar	✓	✓	-	-	✓	✓	x	x

Phrase ordering effects the SERP list returned for all four ISEs. This was typical at Entry2 or Entry3. Advertisements in Yahoo! were also affected for Yahoo! but not Bing.

#### 7.2.4.4. Abbreviation

We investigated if spelling differences, such as abbreviation, is likely to make a difference to the results that a search will return. Table 7.18 lists the differences that we identified for the compared use of abbreviations on broad searches such as *mount everest* (A2) vs. *mt everest* (A4).

Table 7.18 Comparison of abbreviation in search query A2 vs. A4

	Google (A2)	Google (A4)	Google-BRLF (A2)	Google-BRLF (A4)	Bing (A2)	Bing (A4)	Yahoo! (A2)	Yahoo! (A4)
Entries	x	x	x	x	x	x	x	x
Ad-blocks	-	-	-	-	-	-	x	x
News-blocks	x	-	-	-	-	-	-	-
Image-blocks	✓	✓	✓	✓	x	-	x	-
Video-blocks	-	-	-	-	-	-	-	-
Info-blocks	✓	✓	-	-	-	-	-	-
Sidebar	✓	✓	✓	✓	✓	✓	x	x

Google returned no news items for the queries that were constructed using abbreviations, and this resulted in an increased number of full entries visible above-the-fold. While Bing returned news-blocks, image-blocks, and video-blocks for non-abbreviations resulting in

fewer full entries above-the-fold. Yahoo! also returns a greater number of full entries above-the-fold for the abbreviation than for the full spelling.

When we compared these searches with queries A1 vs. A3 (the capitalisations of queries A2 and A4), we confirmed these results to be typical. We also confirmed similar effects are present when abbreviation is used with query refiners such as B2 (*mount everest facts*) compared to B5 (*mt everest facts*).

#### 7.2.4.5. Capitalisation

We explored the effect of capitalisation on search results. Table 7.19 lists the differences that we identified for the compared use of capitalisation on broad searches such as *Mount Everest* (A1) compared to *mount everest* (A2).

**Table 7.19 Comparison of capitalisation in search query A1 vs. A2**

	Google (A2)	Google (B2)	Google-BRLF (A2)	Google-BRLF (B2)	Bing (A2)	Bing (B2)	Yahoo! (A2)	Yahoo! (B2)
Entries	✓	✓	x	x	✓	✓	✓	✓
Ad-blocks	-	-	-	-	-	-	✓	✓
News-blocks	✓	✓	-	-	✓	✓	-	-
Image-blocks	✓	✓	✓	✓	✓	✓	✓	✓
Video-blocks	-	-	-	-	✓	✓	-	-
Info-blocks	✓	✓	-	-	-	-	-	-
Sidebar	✓	✓	✓	✓	✓	✓	✓	✓

We also compared capitalisation effects on queries that utilised abbreviations (A3 vs. A4) and queries with the query refiner *facts* (B1 vs. B2). We found no effects from capitalisation. Entries for capitalised and non-capitalised queries returned identical lists and use of block level units matched. Our results suggest that the effect of capitalisation of queries will neither hinder nor ease skimming and scanning.

#### 7.2.4.6. Query Qualifiers

The children in the schools that we studied are taught to use search qualifiers such as *facts* and *for kids*. Adding this phrase to a query is intended to result in websites whose language or structure are appropriate for, or designed for, children. We explored the effect of query qualifiers on searches to understand what effect this might have.

Table 7.20 lists the differences that we identified for the compared use of the qualifier *facts* (B2) on the broad searches such as *mount everest* A2.

**Table 7.20 Comparison of query qualifiers (facts) in search query A2 vs. B2**

	Google (A2)	Google (B2)	Google-BRLF (A2)	Google-BRLF (B2)	Bing (A2)	Bing (B2)	Yahoo! (A2)	Yahoo! (B2)
Entries	x	x	x	x	x	x	x	x
Ad-blocks	-	-	-	-	-	x	x	x
News-blocks	x	-	-	-	x	-	-	-
Image-blocks	✓	✓	✓	✓	x	-	x	-
Video-blocks	✓	✓	-	-	x	-	-	-
Info-blocks	✓	✓	-	-	-	-	-	-
Sidebar	✓	✓	x	-	x	x	x	x

We further explored the effect of query qualifiers on searches, as illustrated in Table 7.21, which lists the differences that we identified for the compared use of the qualifier *for kids* (C1) on the broad searches such as *mount everest* A2.

**Table 7.21 Comparison of query qualifiers (for kids) in search query A2 vs. C1**

	Google (A2)	Google (C1)	Google-BRLF (A2)	Google-BRLF (C1)	Bing (A2)	Bing (C1)	Yahoo! (A2)	Yahoo! (C1)
Entries	x	x	x	x	x	x	x	x
Ad-blocks	-	-	-	-	-	-	x	x
News-blocks	x	-	-	-	x	-	-	-
Image-blocks	✓	✓	✓	✓	x	-	x	-
Video-blocks	-	-	-	-	x	-	-	-
Info-blocks	✓	✓	-	-	-	-	-	-
Sidebar	x	x	x	x	x	x	x	x

The introduction of these query qualifiers produced noticeable effects early on the entry list with changes to the first entry for Google, Google-BRLF and Bing. The addition of qualifiers resulted in both Google and Bing removing news-blocks from their SERP lists. Bing and Yahoo! both removed image-blocks.

Google dropped sidebars from the SERP, and Bing dropped video-blocks for the qualifier; “facts”. Google dropped sidebars from the SERP, and Bing dropped video-blocks for the qualifier; “facts”. Bing dropped image-blocks and video-blocks, and Yahoo! dropped image-blocks for both qualifiers.

The addition of a query refiner resulted in more searches in Google-BRLF being returned that were classified as ‘Basic’.

#### 7.2.4.7. Operators

Search operators including *and* and + are common tools for Internet search. While these have not been identified as specifically taught to children, teachers in our study reported in Chapter 6 did discuss *modelling* of searches. During a modelling session, it would not be unexpected for a teacher to enter searches that included operators, though the teacher may not discuss the use of these operators with the children in detail.

We explored the effect of query operators on searches to understand what effect this might have. Table 7.22 lists the differences that we identified for the compared use of the ‘+’ operator on the refined searches such as *mount everest size* (D7), which we compared to *mount everest + size* (D11).

**Table 7.22 Comparison of query operators (+) in search query D7 vs. D11**

	Google (D7)	Google (D11)	Google-BRLF (D7)	Google-BRLF (D11)	Bing (D7)	Bing (D11)	Yahoo! (D7)	Yahoo! (D11)
Entries	✓	✓	✓	✓	x	x	x	x
Ad-blocks	-	-	-	-	-	-	x	x
News-blocks	-	-	-	-	x	-	-	-
Image-blocks	✓	✓	✓	✓	-	-	-	-
Video-blocks	✓	✓	-	-	-	-	-	-
Info-blocks	-	-	-	-	-	-	-	-
Sidebar	-	-	-	-	x	x	-	-

Google and Google-BRLF were not affected by the use of query operators. Bing and Yahoo! displayed different amounts of advertising when an operator was used. Sidebars utilized by Bing did not match, and no news-block was presented when a query operator was used.

#### 7.2.4.8. Google Basic Reading Level Filter (Google-BRLF)

Children in NZ classrooms are encouraged to use the Google-BRLF to simplify the reading level of the results returned by Google. At present only Google offers a reading level filter. We did investigate whether *Safe Search* provided by Bing and Yahoo! is a corresponding service. However, these filters did not appear to alter the returned search list in the way that Google's filter did.

Entries are often different at the first entry of the SERP list. We offer the query A1: *Mount Everest*, as a comparison of the results in Google, compared to Google-BRLF in Figure 7.10. The Google-BRLF produces quite a different list of results compared to Google for all query formulations tested (see A in Figure 7.10). Wikipedia was often removed from the search result list of a Google-BRLF query (see B in Figure 7.10), as were the news-blocks (see C in Figure 7.10). Interestingly, even a website result with titles "Mount Everest Facts for Kids – Alan Arnette" was removed from the search results list, presumably because the algorithm deems the language of the website too difficult, even if the author considers otherwise.

The contextual information contained in the sidebar is removed, along with additional imagery (see E in Figure 7.10). This is seemingly detrimental in this instance as the contextual information held in the sidebar does provide useful information, though potentially at a reading level that differs from that tested by the algorithm. Often we also noted differences in the content of the pull-boxes. Image-blocks often contained different image sets (see D in Figure 7.10).

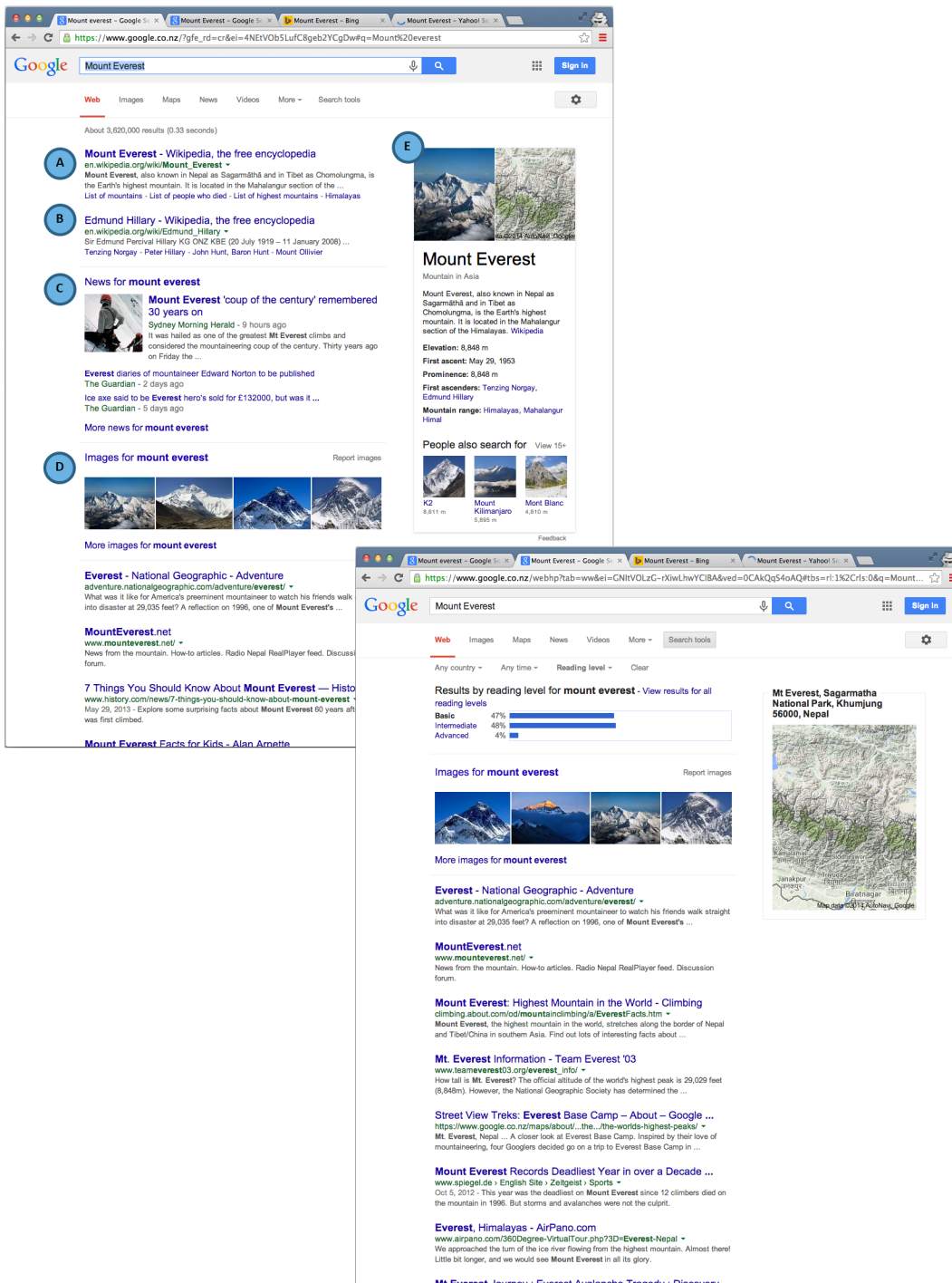


Figure 7.10 Google Reading Level Filter (differences circled in red). Google and the Google logo are registered trademarks of Google Inc., used with permission.

## 7.3. Discussion

Query construction influenced SERP list order and the presence or absence of block-level-items (such as news-blocks, ad-blocks, and image-blocks) in all search engines tested as well as the inclusion of pull-boxes and sidebars in Google and Google-BLRF.

The query construction also produced a number of visual and content ordering differences that bear further discussion yet are outside the scope of this thesis. There are few relevant studies with which to compare to our results. However, the myriad of open questions presented in this chapter deserves examination in future work. In order to provide a starting point for future researchers, we present a list of the open questions we believe we identified by this study.

In Section 7.2.2 we identify a number of visual conventions used by these search engines. Little empirical evidence is presently available regarding the effects of these visual features for web searchers or digital information users, and no evidence is reported in the literature regarding children's use of these visual features of search engines. Ergonomics, HCI, and IR studies, which assess the effectiveness of these visual features of search engines for children and adults would be of interest to a number of researchers and practitioners in the web design, and development fields, as well as the information science, information retrieval, digital library and library science fields.

The research reported in this thesis and in particular the findings of the present study relate to the area of *Visual Aesthetics*, which was proposed by Tractinsky (2013). Tractinsky points to the work of Norman (2005) and Leder et al. (2004) who discuss how aesthetically pleasing design positively influences both emotional and cognitive processes. He further extends the work of Thuring and Mahlke (2007) and De Angeli et al. (2006), who provide empirical evidence that aesthetically considered design of interactive technology can increase users' pleasure and engagement. Importantly, Tractinsky also draws us to the work of Moshagen et al. (Moshagen, Musch, & Göritz, 2009; Moshagen & Thielsch, 2010) who showed that "visual aesthetics may improve performance and thereby compensate for usability problems" (Moshagen et al., 2009, p. 1317). We view the development of the research area of visual aesthetics as motivation for further development of our research.

In our own studies (see Chapters 5 and 6), children and teachers reported skimming and scanning being a necessary feature of information processing in the search engine. The grey media often reports eye movement studies of participants presented with websites. We found no empirical studies based on search engine results pages (SERPs) to report in depth here. These eye movement studies (Beymer et al., 2007; Buscher et al., 2009; Hervet et al., 2011; Kim, Thomas, Sankaranarayana, Gedeon, & Yoon, 2015; Pan et al., 2004) of web pages (differing from web search engines) often show the eye is drawn to visual

stimuli such as images and logos. Thus, a future investigation with children is required to gauge the potential for benefit or distraction of such block-level items as image-blocks, news-blocks, and video-blocks presented in the run of SERP lists.

In Section 7.2.3.2 we noted that the number of entries above-the-fold was affected by the presence of block-level items in SERP lists. Should the number of entries above-the-fold be a contributor to ease of skimming and scanning for children's search then the use of these block-level items requires further investigation with children.

In our own studies (see Chapters 5 and 6), children and teachers reported the use of Google-BRLF. Additionally, studies by Bilal (2013) begin to report the effectiveness of the Google-BRLF. At the time of writing this feature has been removed from Google and no replacement has been incorporated. Should a similar feature be integrated into Google or another search engine the use of these features by children warrants investigation.

In our studies here we have not attempted to evaluate the quality of the returned SERP lists nor the effect on quality of results returned by any of the query construction techniques we tested. Investigation of the impact on quality of results returned based on query construction would prove useful to teachers and information searchers.

### **7.3.1. Limitations**

There was a wealth of data collected by this simple experiment that is outside the scope of this thesis. Analysis of the quality of the differences in results returned by different queries may provide insights into the types of query formulations that return *good* quality results for children. Equally, analysis of the differences in results returned by different search engines might provide insight into which search engine provides results that are preferable for children's information seeking on the Internet.

This study was performed in 2014 and there are likely to be technology advances and visual design improvements that have been made by each of the three search engine manufacturers by the time of publication of this thesis. A cursory analysis in light of this fact reveals that visual design changes have occurred in both Bing and Yahoo! resulting in all four SERP's having visually open and minimalist page designs with a focus on clarity of information presentation. Neither a precise calculation nor accurate measurement has been conducted, however, it appears that when the searches "Mt Everest", "Mt Everest height", "mt everest for kids", and "what is the height of Mt Everest" are performed there are less advertisements shown and less space used for

advertisement blocks by Bing and Yahoo!. Google has removed the Basic Reading Level Filter mechanism from the Google search engine and we have not identified a similar tool in Bing, Yahoo! or Google to date. All three search engines still display images and videos in pull-boxes, yet in slightly different visual styles. Using the four search terms we report in this section, only Google could be shown to produce pull-boxes for information. These modifications by the respective manufacturers is further evidence of the rapid state of advancement and change that is evident in technology and supports the continual and progressive research into what is required to assist children and adults in searching for information. While these changes do not alter our findings regarding what is necessary in an internet search engine for children, it is necessary for the record to acknowledge these advancements by all manufacturers.

## 7.4. Study Conclusions

We identified typical query construction strategies in Chapters 5 and 6 that are promoted by teachers and used by children in NZ classrooms. In this chapter, we tested the strategies using Google, Google-BRLF, Bing and Yahoo!.

We found that the visual design and presentation of SERP result link Entries is fairly consistent across search engines, and therefore, further studies reported in this thesis could be based on any one of these search engines.

Pull-boxes and sidebars that contain information related to the search query (as used by Google) will serve the needs of young searchers by providing useful resources to compliment the websites presented in the search lists. These pull-boxes and sidebars need to differentiate themselves visually from typical results list links to assist with skimming and scanning by web searchers. Designers could visually differentiate these page elements by using borders, background colour differences, typographic differences and increased white space around these features.

The increased use of advertising noted by Yahoo! and Bing would suggest that Google is better suited for our studies that follow. However, Google does not clearly visually differentiate advertising entries compared to Yahoo! and Bing. Advertising was used less with natural language queries suggesting these might prove a successful search technique when looking to avoid entries that detract from the search at hand. Additionally, natural language questions resulted in fewer advertisements than natural language sentences.

Abbreviation resulted in more entries above the fold due to fewer news-blocks and less advertising present in searches. Abbreviation also appeared to have the effect of producing a greater number of 'basic' results in Google-BRLF compared to the full spelling of 'mount'. The addition of Query Qualifiers such as 'facts' and 'for kids' appeared to have positive effects on keyword searches by reducing advertising, news-blocks and resulting in more results above-the-fold.

## **7.5. Chapter Summary**

We discussed in this chapter the design of four internet search engines. We used a lab-based experiment to explore the range of presentation devices employed by ISEs when returning a search engine results page. We also briefly described the types of differences that are present when alternative query structures are used. We developed a labelling convention for common visual and interface elements of current internet search engines.

The work in this chapter showed there is a need for investigations into how the interface elements described in this chapter affect children's information search and how the presentation differences created by alternative query formulations impacts a child's ability to find information.

The results presented in this chapter serve to assist with the choice of ISE for studies in this thesis that follow as well as for the design of prototype interfaces that follow. This chapter has contributed to Research Question 2 by providing insight into the potential issues that children are likely to encounter when subtle differences in query construction can result in dramatic differences in visual presentation of information and the structure of results lists.

## Chapter 8.

### Observing Children's Information Search

Recent research into the issues encountered by children during digital information search and retrieval in educational settings is limited. Our interviews in Chapters 5 and 6 show that children have issues constructing information searches and have a range of difficulties using internet search engines. This chapter seeks to reveal further insight into the issues children encounter during Internet search. We conducted an observational study with school children at primary and intermediate schools in the Waikato region of New Zealand to gain insights into their practice of information searches during their educational pursuits. This study took the form of a task-based usability observation with children in their school environments.

This chapter is structured as follows: Section 8.1 reports on the study setup. Our analysis of these observations provides evidence of the specific issues encountered by children (Section 8.2). We discuss our findings and draw conclusions for the design of search interfaces that are supportive of child-appropriate information seeking behaviour (Section 8.3).

This chapter further addresses Research Question 2; *what are the issues children encounter when using digital information seeking technology?*

#### 8.1. Study Method

A series of structured naturalistic observations were conducted in the third and fourth school terms of 2014. These observations explored how children perform a search task for digital information using an internet search engine (ISE). The observations were conducted at three schools using the school computers and the Google web browser that

the children were all familiar with. Observations were carried out in library or classroom environments while teachers, librarians, and classes shared the spaces. They involved three distinct phases, pre-observation survey (see Section 8.1.1), task-based user observations (Section 8.1.2), and post-observation interviews (Section 8.1.3).

Observation and interview sessions typically took between 30 and 45 minutes. On average, the younger children spent longer with the researcher than the older children as they generally took longer answering interview questions and conducting searches. The observations and interviews were video recorded, and additional handwritten notes were taken in situ. Video footage was captured over the shoulder of the participant so that the screen was visible to the camera, yet the participant was not recognisable. Head movements, mouse movements, text, entered onto the screen, and mouse click and location information were recorded. The researcher conducted post-observation coding as well as quantitative and qualitative analysis. A combination of video, audio, and field notes was used for the analysis reported in this chapter. Audio from the video recording was not always reliable or able to be accurately transcribed due background noise. Interview answers were analysed as a combination of audio that is transcribable as well as written field notes.

The method that we use here follows similar processes to observation studies of children's information seeking and builds on the methods described in Section 3.2. Specifically, we build on those studies of Bilal (2000) and Foss et al. (2013) for example, whom both used a similar combination of interviews and researcher set tasks.

### **8.1.1. Phase 1 Pre-observation Survey**

Basic demographic information was gathered with a short pre-study survey at the beginning of each observation. We asked each child how old they are; and what year level at school they are. We noted their gender; and what school they attended.

During this pre-observation survey and before the tasks were introduced, the children were encouraged by the researcher to conduct themselves as they would have had a teacher set the topics of investigation for them during an ordinary school task.

An example of the researcher's field notes for the observations can be found in Appendix D. These field notes sheets contained the script for the interviews that were used for demographic information collection and post-observation interviews as well as for the administration of the tasks.

### 8.1.2. Phase 2 Task-based User Observation

The observation study consisted of a set of five search tasks (see Figure 8.1) administered by the researcher. Each child was asked to conduct the search tasks in order.

1	Do you have a favourite book or sport or musician? ... Right, can you please search for information about ...	<i>Open Task</i>
2	Where do possums live and are they a pest in New Zealand?	<i>Verbal Question</i>
3	Mount Cook is a mountain in the South Island of New Zealand, let's find facts about Mount Cook.	<i>Verbal Instruction</i>
4	How many rings does Uranus have, and what are they made of?	<i>Written Question</i>
5	The Cricket World Cup will be held in New Zealand in 2015, find facts about the Cricket World Cup.	<i>Written Instruction</i>

**Figure 8.1 Search tasks**

These tasks were developed to be educationally appropriate for children in these school year levels. We designed these tasks based the results of our interviews with teachers (see Section 6.2.1.1<sup>17</sup>), our investigation of the NZ Curriculum (Ministry of Education, 2007), and informal expert review by a teacher who has experience working with senior primary school children as well as teacher education.

Tasks 1, 2 and 3 were read aloud to the child with all instructions given verbally by the researcher. Tasks 4 and 5 were both given to the children as a printed hand-out. The combination of verbal instruction as well as written instruction is realistic when compared to the various manner in which children receive instruction in the modern classroom.

The tasks were completed using workstations provided by the school that the children were familiar with. Each school provided different workstations. However, all were desktop Apple OSX or Windows 7 computers running the Google Chrome web browser and the Google search engine.

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<sup>17</sup> We used Questions 1 and 15 of the teachers interviews (Chapter 6) to guide the selection of topics that mirrored topics used previously or in the future at these schools. We avoided replicating a topic noted in these interviews so as to ensure some new knowledge investigation by the participants of our studies. Additionally, we chose topics that would be within a participants' general knowledge so that some prior knowledge and general understanding of the topic area was present for participants where possible.

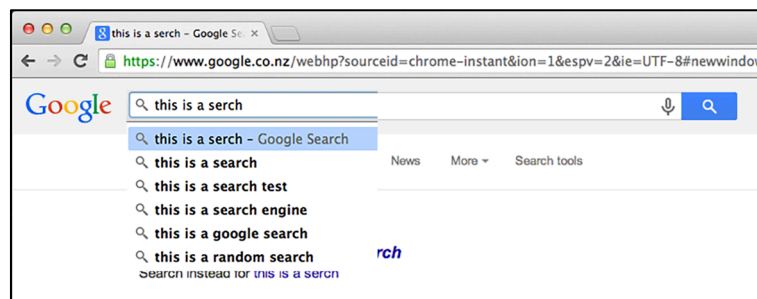
### 8.1.3. Phase 3 Post-observation Interviews

At the completion of the user observation phase, the researcher administered a short interview with 14 questions. Each child was asked each question in order.

- 1) What was hard when searching today?
- 2) What was easy when searching today?
- 3) What can be hard when searching on a computer?
- 4) What can be easy when searching on a computer?
- 5) How did you decide what to type into the search box today?
- 6) When a teacher sets an inquiry, what is your process?
- 7) Is there anything else about searching for and using information you would like to tell me?
- 8) Here is an example of what an example search might look like.  
Did you see an example search while you were typing today?
- 9) Do you use these example queries? When?
- 10) Have you ever seen a list like this one in the red box before?
- 11) Do you use these related queries? When?
- 12) The image above is what a search result list might look like, what coloured text did you use/read today when you were making decisions about which website to visit?

**Figure 8.2 Post-observation interview**

We showed each child a printed visual example of a query suggestion (Figure 8.3) and asked if they had seen one of these during their tasks. We then asked if they use these query suggestions during Internet searching (Questions 8 and 9 of Figure 8.2).



**Figure 8.3 Query suggestion visual shown to participants.**

Google and the Google logo are registered trademarks of Google Inc., used with permission.

During the interview, we showed children a printed visual example of a search results page (see Figure 8.4). We used this visual when we asked Questions 10, 11 and 12 of Figure 8.2. We indicated on the printed example where the relate searches were and asked the children if they use these related searches suggestions during Internet searching (see Questions 10 and 11 of Figure 8.2). We also showed the children the Title, URL, and Descriptor text formatting and asked which text they read when making their decision to visit a website (see Question 12 of Figure 8.2).

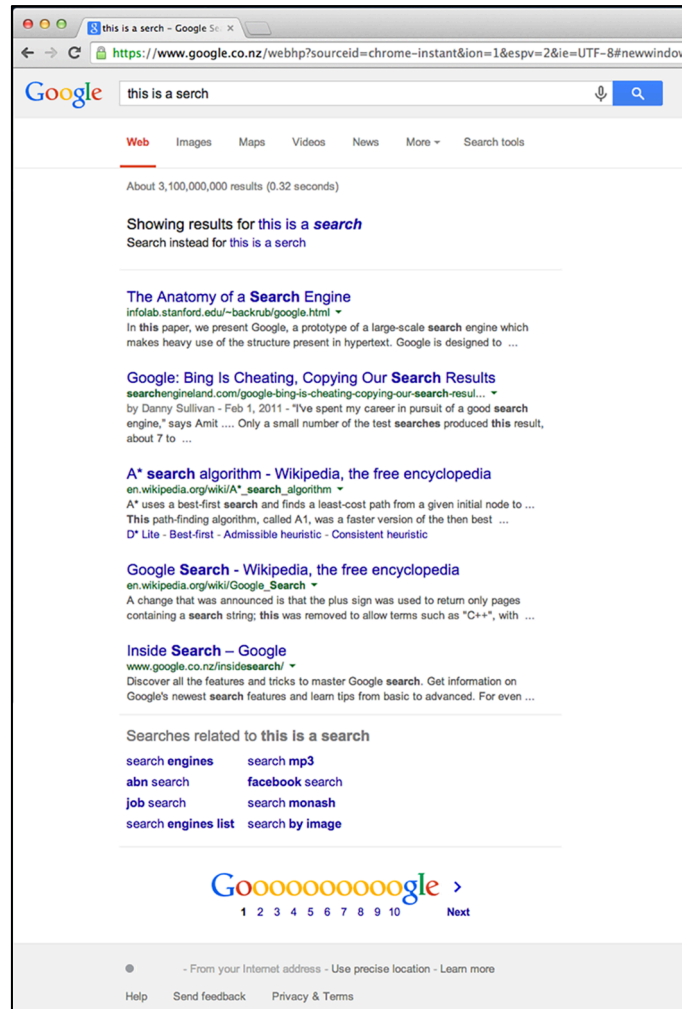


Figure 8.4 Related searches visual shown to participants. Google and the Google logo are registered trademarks of Google Inc., used with permission.

#### 8.1.4. Participant Recruitment

Participants in this study included boys and girls from two primary schools and a single intermediate school, which were the same schools that participated in the studies described in Chapter 5 and 6. As with our previous interview study with children (see Chapter 5), our goal was to identify a sample of male and female children being taught by a range of teachers at more than one school within the given year levels of Year 5 to 8 (see Section 5.1.1 for discussion regarding targeting this age group).

Our study was conducted in the Waikato School District, which is located in the central North Island of NZ. Two primary school principals, and one intermediate school principal, in the Waikato School District, gave their permission to have their school take part. We refer to the schools as Schools A, B, and C, which are rated as Decile 4, 5, and 9, respectively.

The children were invited by the principals of these three schools to gain parental permission to participate in this study. We specifically requested four boys and four girls from each of the year levels Y5, Y6, Y7, and Y8.

Each principal, or their delegate, identified 16 children (8 male, 8 female) from their school to participate in this study. Those children took home the participant information sheet found in Appendix D for their parents to consider their inclusion in this study. No children whose parents did not give consent participated in this study. Where possible, if a child was not given permission to take part in the study an alternative child was selected by the principal, and parental consent was sought for this alternative child participant. In total, 24 boys and 26 girls participated in this study.

The sampling of candidates for this study was conducted in a similar means to that conducted for interview participants in Chapter 5. The same three schools that participated in the studies described in Chapters 5 and 6 were approached and agreed to participate in this study.

### **8.1.5. Participants**

The children at the three participating schools are taught in composite classrooms. Thus, the students came from classrooms of Y5&6 students and Y7&8 students. Children in Year 5&6 attended a Full Primary School while children in Year 7&8 attended an Intermediate School. The children in Y5&6 were aged between 9 and 11 years old. The children in Y7&8 were aged between 11 and 13 years old.

We received a total of 50 participants (24 male and 26 female). All children were aged between 9 years old and 13 years old and all children were in School Years 5, 6, 7 or 8. 16 participants came from School A, 18 from School B and 16 from School C. As with all studies reported in this thesis we have anonymised all participants and given unique participant ID's to each child. Throughout this chapter, we refer to individual students by their ID, which can be read to indicate gender, Year level, and a unique number identifier, i.e., FY5\_1 is a Year 5 female. While we use a consistent naming procedure throughout this thesis, FY5\_1 in this chapter should not be considered to be the same participant as FY5\_1 in another chapter. Table 8.1 shows an overview of all 50 participants.

Table 8.1 Study participant overview

ID	Age	Year level	Gender	ID	Age	Year level	Gender
FY5_1	9	5	F	MY6_1	10	6	M
FY5_2	9	5	F	MY6_2	10	6	M
FY5_3	10	5	F	MY6_3	11	6	M
FY5_4	10	5	F	MY6_4	11	6	M
FY5_5	10	5	F	MY6_5	10	6	M
FY5_6	10	5	F	MY6_6	11	6	M
FY5_7	10	5	F	MY6_7	10	6	M
MY5_1	10	5	M	MY6_8	11	6	M
MY5_2	10	5	M	FY7_1	11	7	F
MY5_3	10	5	M	FY7_2	11	7	F
MY5_4	10	5	M	FY7_3	11	7	F
MY5_5	10	5	M	FY7_4	11	7	F
MY5_6	10	5	M	MY7_1	11	7	M
MY5_7	9	5	M	MY7_2	12	7	M
MY5_8	9	5	M	MY7_3	12	7	M
FY6_1	10	6	F	MY7_4	12	7	M
FY6_2	10	6	F	FY8_1	12	8	F
FY6_3	11	6	F	FY8_2	12	8	F
FY6_4	11	6	F	FY8_3	13	8	F
FY6_5	10	6	F	FY8_4	13	8	F
FY6_6	10	6	F	MY8_1	12	8	M
FY6_7	10	6	F	MY8_2	12	8	M
FY6_8	11	6	F	MY8_3	12	8	M
FY6_9	11	6	F	MY8_4	13	8	M
FY6_10	11	6	F				
FY6_11	11	6	F				

## 8.2. Results

We discuss here the results of our observation study of children's Internet search during the five search tasks using Google. We report the results of our analysis of data from both observations and interviews. Due to the small numbers of participants, we do not attempt to give statistical significance to the representative numbers that we present. A cursory investigation of student gender, student age or Year level and interactions related to verbal or written instruction has revealed no significant observations and we, therefore, leave a detailed analysis of this aspect for future work.

### 8.2.1. Numbers of Queries

We coded the queries that children constructed as follows. We recorded a query once the child hit enter or clicked the search button. When a child started a query and changed

their mind before hitting enter, we coded and counted only the query that was submitted. When Google’s auto-complete feature (query suggestion) was used we recorded both the query as typed by the child before a query suggestion was selected as well as the query suggestion selected. However, we counted query suggestions as a single query only.

The tables in this chapter present the results per school year and, additionally, per school year level composite (grey header), for those results with sufficiently large numbers. Where numbers are smaller, only the two school-year level composites were reported. The conditional colour formatting was created separately for each column (smaller numbers are blue, progressing through grey and yellow to larger numbers that are green); the colours imply no value judgement.

Taken together Y5&6 children made a total of 360 queries while Y7&8 children made only a total of 190 queries. Overall, the 50 children worked through 250 tasks, posting 550 queries. We present a breakdown of queries per task in Table 8.2.

**Table 8.2 Total number of queries per task**

Y5	Y6	Y5&6		Y7	Y8	Y7&8
24	28	52	Open Task	17	23	40
44	35	79	Verbal Question	14	22	36
31	44	75	Verbal Instruction	22	23	45
41	39	80	Written Question	26	16	42
35	39	74	Written Instruction	14	13	27
n=15	n=19	n=34		n=8	n=8	n=16

The average (mean) number of queries for Year 5 children was 11.67, for Year 6 children was 9.74, for Year 7 children 11.63 was the average and for Year 8 children 11.63 was the average number of queries. Taken together the average number of queries constructed by Year 5&6 children was 10.59 and 11.63 by Year 7&8 children. In conclusion, Y7&8 children averaged approximately 1 query more than Year 5&6 children when considering the observation as a whole.

We report our further analysis of the numbers of queries made for each task in Table 8.3. In the Open Task, Verbal Instruction and Written Question Y7&8 children averaged more queries than the Y5&6 children.

Table 8.3 Average number of queries per task

Y5	Y6	Y5&6		Y7	Y8	Y7&8
1.60	1.47	1.53	Open Task	2.13	2.88	2.50
2.93	1.84	2.32	Verbal Question	1.75	2.75	2.25
2.07	2.32	2.21	Verbal Instruction	2.75	2.88	2.81
2.73	2.05	2.35	Written Question	3.25	2.00	2.63
2.33	2.05	2.18	Written Instruction	1.75	1.63	1.69
n=15	n=19	n=34		n=8	n=8	n=16

### 8.2.2. Query Types

We were interested in what search strategies the children use to create queries when given the freedom to construct their own search queries. We, therefore, coded all of the queries that a child made for each search task. The results reported in this section are for both initial query formulations and query reformulations.

We identified that children used the five following query construction strategies:

- Natural language sentences (NLS);
- Natural language questions (NLQ);
- Simplified Searches or Keyword (KW);
- Two Part Searches (2PS); and
- Query Enhancements (qualifiers and refiners).

Children in our study did not construct Boolean search queries. Boolean operators were present only as part of NLS and NLQ. We assume the children in our study had no understanding of Boolean Logic and that they had not been taught to use Boolean operators.

#### 8.2.2.1. Natural Language Queries

We coded two types of queries using natural language (NL), natural language sentences (NLS) and natural language questions (NLQ). We recorded as NL queries those queries that were constructed using language too complex to be considered a keyword query. This included the use of punctuation and non-keyword text within the query string. An example of a NLS is the query by FY5\_1: “facts about mount cook”. This query was coded as a NLS because it contains the non-keyword text “about” and its construction differs from the simplified keyword search (KW) entered by MY5\_1: “mount cook facts”. An example of a NLQ is the query by MY5\_1: “how many rings are there on uranus”, which was created as a reformulation of the initial keyword query “uranus rings”. Table 8.4 summarises the number of children who created a NLS query (col 1–3) or a NLQ query

(col 4–6) for the given search task. We can see that if a task was set as a question the child is likely to enter a question, see rows for Verbal Question (36 children) and Written Question (42 children). For Verbal and Written Instructions this ‘mirroring’ of the task pattern as NLS is not as pronounced with 25 children using NLS for the verbal instruction and 21 using NLS for the written instruction tasks.

**Table 8.4 #Children who created NLS and NLQ**

	NLS			NLQ		
	Y5&6	Y7&8	Total	Y5&6	Y7&8	Total
Open Task	11	6	17	10	3	13
Verbal Question	3	1	4	27	9	36
Verbal Instruction	17	8	25	1	1	2
Written Question	5	0	5	27	15	42
Written Instruction	15	6	21	6	3	9
	n=34	n=16	n=50	n=34	n=16	n=50

### 8.2.2.2. Keyword Queries

We counted the times that children shortened the question or instruction given for the task into a simplified set of keyword search terms (see Table 8.5). For example, MY7\_4 searched for “possum”, FY7\_1 searched for “possum habitat” and FY7\_2 searched for “uranus rings”.

**Table 8.5 #Children using simplified keyword search**

	KW		
	Y5&6	Y7&8	Total
Open Task	14	9	23
Verbal Question	12	9	21
Verbal Instruction	22	10	32
Written Question	9	5	14
Written Instruction	15	9	24
	n=34	n=16	n=50

It seems the children were more likely to use simplified queries when the task is not set as a question but rather as an instruction. Higher numbers of children at all year levels created simplified queries when exploring the Open Task (23), Verbal Instruction (32) and Written Instruction (24) than when exploring the two question-based tasks.

### 8.2.2.3. Two-part Searches

The questions developed for both the verbal question task and the written question task required the child to find information about two inter-related features of a topic. For example, the Verbal Question asked, “Where do possums live, and are they a pest in New Zealand?” This approach is similar to the one used in Bilal’s (2000) studies of

children's use of the now defunct Yahoo!igans!. We were interested to see if students typed exactly what they heard or read, or if they simplified the search into two-part queries (see Table 8.6 with colour coding across both tables).

**Table 8.6 #Children separating question into 2-parts vs. using only 1<sup>st</sup> part to answer question**

	2PQ			1st of 2PQ		
	Y5&6	Y7&8	Total	Y5&6	Y7&8	Total
Verbal Question	12	9	21	6	6	12
Written Question	17	5	22	7	2	9
	n=34	n=16	n=50	n=34	n=16	n=50

Eight (out of 50) children attempted to search for the whole question in a single query for example MY5\_4 who searched: "where do possums live and are a pest". Six of these eight children used the entire two part question for the Verbal Question about possums while three of these eight children attempted to do so for the Written Question about Uranus. Only FY6\_7 tried to use this method for both the Written and Verbal Questions. All of these children were in Year 5&6, not one Year 7 or Year 8 child attempted to search for the entire two part question as a single question.

#### 8.2.2.4. Specific Search

When given freedom to investigate a broad topic such as Mt Cook or the Cricket World Cup, we analysed if children would identify a specific feature of the topic to investigate. We consider this a measure of a child's identification of a personal information need. In Table 8.7 we report the number of children who constructed a specific query for either the Verbal Instruction task or Written Instruction task.

**Table 8.7 #Children who investigated specific topics**

	Specific		
	Y5&6	Y7&8	Total
Verbal Instruction	6	4	10
Written Instruction	10	4	14
	n=34	n=16	n=50

Only 10 of 50 children constructed specific investigations for the Verbal Instruction and 14 of 50 constructed specific investigations for the Written Instruction. Examples of the specific searches conducted included FY6\_1 who searched "who was the first person to climb mount cook" for the Verbal Instruction task and FY5\_4 who searched "how many years apart is each cricket world cup" for the Written Instruction search.

All of the six Y5&6 children who created a specific investigation for the Verbal Instruction task phrased their query as a natural language question or sentence. Of the four Y7&8 children who conducted specific investigations, two constructed KW queries and two conducted NL queries. For example; MY7\_4 constructed a simplified keyword query “mount cook climb” while MY5\_6 constructed a natural language query “top ten facts about mount cook”.

For the Written Instruction task only one of the ten Y5&6 children conducting a specific investigation made keyword queries; FY6\_1: “cricket world cup 2015 schedule” and “cricket world cup 2015 competitors”. The remaining nine Y5&6 children constructed NL queries. All four Y7&8 children who made specific inquiries, constructed natural language queries; FY8\_3 constructed a NLS “the history of cricket” while the remaining three Y7&8 children constructed NLQs.

### **8.2.3. Query Reformulations**

Query reformulations were examined to understand what children do if their first search query does not resolve their investigation. When children broke the Verbal Question and Written Question into two parts, this was not counted as query reformulation. It was, however, counted as reformulation if a child re-phrased the first portion of the search query, e.g., FY6\_2 used the initial query construction of “possums” (KW), yet, reformulated this search after some preliminary analysis of the SERP. She reformulated the query to “are possums pests in new zealand” (NLQ), before creating the second part of her search which used the NLQ “where do possums live”. In this instance, we coded the first NLQ query after the KW query as a reformulation while the second NLQ was considered to be the second part of the original task (and therefore, is not counted as a reformulation).

Table 8.8 shows the total number of children in each composite that reformulated a query for one of the tasks. Considering that there are higher numbers of Year 5&6 participants in our study is equally as likely that a primary school child or an intermediate school child will need to reformulate their query independent of the task set.

Only five students conducted all five of the search tasks without reformulating a query. All other students needed to reformulate at least one of their queries in order to complete the full set of observation tasks established by the researcher.

Table 8.8 #Children who reformulated their search per task

	Y5&6	Y7&8	Total
Open Task	12	6	18
Verbal Question	11	5	16
Verbal Instruction	19	10	29
Written Question	15	10	25
Written Instruction	18	6	24
	n=34	n=16	n=50

If we consider the fact that each child was required to make at least one query per task, there were a possible 170 initial queries made by Year 5&6 children and a possible 80 initial queries made by Year 7&8 children. With this in mind, Year 5&6 students reformulated 75 of their 170 initial queries while Year 7&8 students reformulated a total of 37 of their 80 initial queries. Therefore, a total of 112 queries were reformulated during this study.

We further investigated the number of reformulations that children required in order to satisfy their information needs. We found that 53 of the 112 query reformulations were changed only once, but the remaining 59 were changed two, three or more times. For example, when attempting to answer the first part of the Verbal Question, MY5\_3 made a KW ("mount cook") query and then reformulated this into a NLQ ("where did mount cook get its name from") and again reformulated this as a second NLQ ("how did mount cook get its name") then resolved his query to the NLS ("facts on mount cook") and finally the NLS ("fun facts on mount cook").

Children seemed to continue predominantly with a search formulation pattern they used initially for a task. Table 8.9 (left) shows the number of children who reformulated searches after making an initial keyword query, and the query pattern that was used in the first reformulation. Table 8.9 (middle) shows similar information for initial NLQ and Table 8.9 (right) for initial NLS query patterns.

Table 8.9 First query reformulations

	KW			NLQ			NLS		
	initial: KW	initial: NLQ	initial: NLS	rewrite: KW	rewrite: NLQ	rewrite: NLS	rewrite: KW	rewrite: NLQ	rewrite: NLS
Open Task	12	1	1	0	3	0	0	1	0
Verbal Question	2	3	0	2	7	2	0	0	0
Verbal Instruction	15	1	4	0	0	0	2	3	4
Written Question	6	4	4	1	8	0	1	0	1
Written Instruction	11	0	2	0	1	0	0	3	7
	n=50	n=50	n=50	n=50	n=50	n=50	n=50	n=50	n=50

Reformulations were used most often when the initial query was a KW (see Table 8.9 left). Children reformulated keyword searches by qualifying the search by either adding a query qualifier (e.g., FY8\_4 reformulated “mt cook” to “mt cook facts”) or by converting that search to a natural language query (e.g., FY6\_4 who reformulated “mount cook” to “how was mount cook formed”).

While children who reformulated did not necessarily only reformulate their query once, we report here only the first reformulation that was required. Equally, we report the reformulation for the initial search conducted when children split their Question search tasks into 2-part searches. Typically children who changed from one query type to a new query type for a reformulation did so on their first reformulation. It was not typical for children to attempt all three query types in a single search task.

### 8.2.4. Successful Queries

In Section 8.2.3 we observed that children reformulated queries and made multiple queries when seeking answers to their problems in each of the observation tasks. For this reason, we analysed what the successful queries were per task. Table 8.10 shows the final, or “landing”, query after any possible reformulations occurred. These are the queries for which the children decided that they had completed the search tasks. Tasks 2 and 4 (verbal and written question) overwhelmingly were resolved by the use of natural language questions, while verbal and written instruction tasks were likely to be completed as either a KW or a NLS. Again, the successful query for the first part of a search task is reported where a child chose to break the question tasks into two separate searches. A comparison with starting queries and overall strategies is provided later in this chapter.

**Table 8.10 Type of final query selected by children**

	KW	NLQ	NLS
Open Task	23	14	13
Verbal Question	16	31	3
Verbal Instruction	25	4	21
Written Question	7	38	5
Written Instruction	18	8	24
<b>TOTAL</b>	<b>89</b>	<b>95</b>	<b>66</b>

### 8.2.5. Query Types and Query Changes

Table 8.11 reports all of the “single-part” or “first-part” queries. Table 8.11 shows conditional colour formatting across the table rows (not down the columns as

previously), with smaller numbers blue and larger numbers green; the colours imply no value judgement.

**Table 8.11 Initial queries compared to successful queries**

	KW	NLQ	NLS
Initial Query	106	80	64
Successful Query	89	95	66

The results presented in Table 8.11 indicate the query type of the initial queries and the successful queries. i.e. We counted the number of initial KW queries, and the number of successful KW queries and list these as appropriate. We can see that overall keyword queries are most used initially, and also that keyword queries dominate the reformulations. Natural language queries were used more in changed queries than in initial queries (i.e., children added question words to unsuccessful queries).

For comparison, we coded here only the single-part tasks and the first part of the 2-part tasks. After the 250 initial queries had been posted, these may have been changed, extended or reformulated in any of the other ways we discussed above. Equally, the original query, of course, may not have been reformulated at all.

**Table 8.12 Initial queries compared to successful queries per composite**

		Initial Query		Successful Query	
		5&6	7&8	5&6	7&8
Open Task	KW	16	9	14	9
	NLQ	10	2	12	2
	NLS	8	5	8	5
Verbal Question	KW	11	6	9	7
	NLQ	22	10	23	8
	NLS	1	0	2	1
Verbal Instruction	KW	18	9	15	10
	NLQ	0	0	3	1
	NLS	16	7	16	5
Written Question	KW	11	4	5	2
	NLQ	22	11	26	12
	NLS	1	1	3	2
Written Instruction	KW	14	8	11	7
	NLQ	1	2	6	2
	NLS	19	6	17	7

Table 8.12 shows an overview of all single-part queries according to year level, task and query type. After the initial 50 queries for each task, the queries for Task 3 (verbal instruction) received most changes – 68 – more than twice the amount of all other tasks. The reason may have been that this task also received the most initial keyword queries (27). Both Task 3 and 5 (oral and written instructions) had no or very few (3 for written instruction) initial natural language question (NLQ) queries. Almost all NLQ queries used for these two tasks (overall 15) were created during query reformulation.

When comparing starting queries, changes, and successful queries, we observe that while initially 64 Natural language sentences (NLS) were created, almost the same number (66) NLS were successful. The biggest increase was in the use of Natural language questions (NLQ): initially, 80 NLQ were formulated and finally 95 NLQ were successful. Keyword (KW) queries went from initially 106 KW to finally only 89 KW proving successful.

Here we compare the number of children that reformulated a query per task (see Table 8.13 col 1) to the number of reformulations and average number of reformulations (see col 2 & 3) made per task. We know that the question tasks required the least number of reformulations. This is likely due to the fact that most often children created NLQ as the first query for these question tasks and NLQ queries appeared to be the least reformulated query type.

**Table 8.13 #Query reformulations per task**

	Queries Reformulated	#Reformulations	Average #Reformulations
Open Task	18	44	2.44
Verbal Question	16	21	1.31
Verbal Instruction	29	74	2.55
Written Question	24	42	1.71
Written Instruction	24	50	2.08
<b>Total</b>	<b>111</b>	<b>231</b>	

## 8.2.6. Query Enhancement

In Chapters 5 and 6 we note that when learning to search, primary school children are taught to use two query enhancement techniques, that we term query qualifiers and query refiners.

### 8.2.6.1. Query Qualifiers

Query qualifiers that children are taught include strategies such as the addition of “for kids”, “for children” or “kids” to a search query to assist with the return of results, which

are aimed at children. Additionally, children are often encouraged to “find facts” or “interesting facts” about a broad concept during an investigation. During their educational practices, teachers are known to model search queries that append the addition of the word “facts” as another commonly taught query qualifier. While our instruction explicitly stated that a child should “find facts about” a given concept, we were interested to see how many students used the query qualifiers of either “facts” or “children” (see Table 8.14).

**Table 8.14 #Children used qualifiers: “facts” or “kids”, “for kids”, “children”, “for children”**

	"facts"			"children"		
	Y5&6	Y7&8	Total	Y5&6	Y7&8	Total
Open Task	2	0	2	0	0	0
Verbal Question	1	0	1	2	0	2
Verbal Instruction	25	11	36	4	1	5
Written Question	5	0	5	2	0	2
Written Instruction	15	6	21	2	0	2
	n=34	n=16	n=50	n=34	n=16	n=50

### 8.2.7. Query Refiners

When learning to search, primary school children are taught to use what we term query refiners. Query refiners include methods for shortening queries to keywords, by avoiding “small words”, avoiding punctuation marks, specifying the information need within a broad concept, and the use of Google Advanced Search’s Reading Level Filters.

#### 8.2.7.1. Punctuation

Very little punctuation was used during query formulation. Only three participants used a question mark at the end of a question. MY6\_2: “what’s uranus?” and MY8\_4: “new zealand are possums realy pests?” [sic]. No students used a full stop. One student used a comma “Mount cook, south island new zealand” [FY7\_4].

#### 8.2.7.2. Google Basic Reading Level

In our interview studies (reported in (Vanderschantz et al., 2014b), and Chapters 5 and 6), both students and teachers reported using Google Basic Reading Level filters as a method for simplifying the searches returned by Google. In our observations, only one child (MY8\_3, a 12-year-old boy in Year 8) chose to use the Basic Reading Level Filter.

### 8.2.8. Query Suggestions (Query Expansions)

We both asked children about the query suggestions used by Google during their observation, and we counted how many children used the query suggestions given by the search engine.

We showed each child a printed visual example of a query suggestion (Figure 8.3) and asked if they had seen one of these during their tasks. We then asked if they use these query suggestions during Internet searching. All but one child claimed that they saw a query suggestion during the task session and that they do indeed use query suggestions when conducting Internet searches.

46 of 50 children used query suggestions at some point during the observation studies; only four children did not use a query suggestion during any of their observed searches. These four children were all primary school children, two in Year 5, one aged 9 and one aged 10 years old, and two in Year 6, one aged 10 and one aged 11 years old.

The only child who claimed to have not seen a query suggestion during their searching during these observations was MY6\_5. MY6\_5, however, did use a query expansion during his observation. All but two students claimed to use query expansions during their typical Internet searching. Of the two who claimed to not use query expansions one of these students was FY6\_10, who was one of the four students not to use a query expansion during her observation study, while FY6\_11 was the other student to claim to not typically use query expansions when in fact she had used one during her observation study with our researcher.

Where a query suggestion was used, we coded both the query snippet typed by the student and the query suggestion clicked on. We counted queries where a query suggestion was used as a single query if the chosen query suggestion was perceivably that which the child was typing. For example, MY8\_3 typed, "what are the rings around ura" and chose the query suggestion "what are the rings around uranus made of". We considered this query suggestion to be the query that MY8\_3 had intended to type and therefore, counted this as a single query rather than two separate queries when calculating totals and averages reported in this section and any previous sections where queries are counted. This differs from FY8\_3 who "fun facts about the cricket" and chose the query suggestion "interesting facts about the cricket world cup". In this case, we considered this query suggestion to be an alternative or different query to that which

FY8\_3 had intended to type and therefore, counted this as a separate query when calculating totals and averages.

The 30 Y5&6 children, who used query suggestions, used these overall more often (142 times) than the 16 Y7&8 children (72 times). Year 5 children used query suggestions 65 times (average 4.33), Year 6 children 77 times (average 4.05), Year 7 children 40 times (average 5) and Year 8 children 32 times (average 4). We broke this down further into the separate tasks (see Table 8.15, colour coding down table). For the Written Question, all age groups used query suggestions most often. This may have been due to the utilization of the proper noun Uranus, and the children's unfamiliarity with its spelling.

**Table 8.15 #Children using query suggestions**

Y5	Y6	Y5&6		Y7	Y8	Y7&8
8	6	14	Open Task	3	4	7
8	11	19	Verbal Question	3	5	8
8	9	17	Verbal Instruction	4	5	9
12	14	26	Written Question	7	7	14
7	11	18	Written Instruction	5	4	9
n=15	n=19	n=34		n=8	n=8	n=16

We analysed the query suggestions used to ascertain if these functioned as extensions of an existing query, or if a prompt led to an alternative query to what a child was already typing. For example, MY8\_4 entered "how long till thecricket [sic] world cup 2015" and chose "where will the cricket world cup 2015 be held" from the list of query suggestions. This is clearly a different question to that being typed by the child. This case was coded as an alternative query while the option "how long till the cricket world cup 2015" would have been coded as query extension.

The majority of query expansions were extensions as opposed to query alternative. Of the 142 query suggestions used by Y5&6 students, 121 were simply query extensions instead of query alternatives. Of the 72 query suggestions used by Y7&8 students, 5 were simply query extensions instead of query alternatives. 18 of 34 Y5&6 children used alternative queries and only 4 of the 16 Y7&8 children. To break this down further, the Year 5 students selected 11 alternative queries, the Year 6 students selected 10 alternatives, the Year 7 students selected 2 alternatives, and the Year 8 students selected only 3 alternatives.

More use of query suggestions by younger children may be due to less confidence with spelling, keyboard use, and query construction. We observed that the Y5&6 children

were more likely to review their query before hitting enter in comparison to the Y7&8 children.

### **8.2.9. Related Searches**

We counted how many children used the Related Searches feature presented in the Google SERP, and also asked follow-up questions in the post-observation interview. No students at Y5&6 level and only three students at Y7&8 level used a related search during our study. During the interview, we showed children a printed visual example (Figure 8.4) of a related searches suggestion and asked children if they had seen one of these during their tasks. We asked if they use these related searches suggestions during Internet searching. We found that children were not as familiar with related searches as they were with query suggestions. Fifteen (15/16) of the Y7&8 students claimed to have seen a query suggestion during this session while only fourteen (14/34) of the Y5&6 students claimed to have seen a query suggestion. No Y5&6 student claimed to use Related Searchers during their normal search habits. Of the three students who were observed to use related search during the study, only one of these students claimed to use this feature during their typical search activities; the remaining two students claimed only sometimes to use this feature. Four more Y7&8 students claimed sometimes to use their related searches, and only two Y5&6 students claimed sometimes to use related searches.

### **8.2.10. Spelling Suggestions**

We counted how many children clicked a spelling correction as presented in the Google SERP (see Figure 8.5). Only eight children used the provided spelling correction. One Year 5, two Year 6, one Year 7, and four Year 8 children used the spelling correction. One Year 8 female was noted to use the spelling correction twice and one Year 8 male was noted to use the spelling correction three times. All of the remaining six children used the spelling correction only once. We did not attempt to differentiate if a child was using a query extension to correct their spelling or complete the entering of the query, so we do not report information about spelling corrections during query extension here (see Section 8.2.8 for discussion of Query Suggestions).

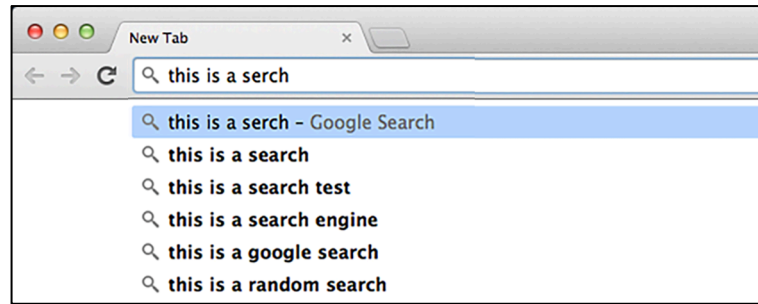


Figure 8.5 Spelling correction as presented by Google. Google and the Google logo are registered trademarks of Google Inc., used with permission.

### 8.2.11. Link Selection

In Chapter 6, we reported the joint belief by teachers that children would likely have poor SERP triaging habits. To investigate this, we identified the number of links visited and where in the SERP list a clicked link fell.

We found that the older children visited more websites to complete the tasks for all five of the tasks (see Table 8.16). This is interesting when we contrast Table 8.17, which shows that the average number of minutes to complete a task was comparable for the younger and older children. Table 8.17 showed older children typically taking longer to complete the Open Task and the same average length of time to complete the Written Question with all other tasks requiring more time spent by the younger children. Taking this into consideration Table 8.16 indicates that the older children were able to visit more websites in a shorter amount of time to the younger children.

Table 8.16 Average (mean) number of visited links per task

Y5	Y6	Y5&6		Y7	Y8	Y7&8
1.40	1.84	1.65	Open Task	3.75	3.50	3.63
2.47	2.26	2.35	Verbal Question	3.75	4.25	4.00
1.87	1.89	1.88	Verbal Instruction	2.75	3.38	3.06
2.07	2.05	2.06	Written Question	4.25	5.00	4.63
1.67	1.79	1.74	Written Instruction	2.75	3.00	2.88
n=15	n=19	n=34		n=8	n=8	n=16

#### 8.2.11.1. First Link Visited

We examined how many children visited the first link in the results list as the first link they clicked. Of the 50 participants, 20 clicked the first link for the Open Task, 26 for the Verbal Question, 15 for the Verbal Instruction, 32 for the Written Question, and 23 for the Written Instruction. While a number of students appeared to read the content of the Sidebar or Pull Box (see Section 8.2.12), very few students clicked the link associated with

the Sidebar or Pull Box as their first link visit (six in total for all tasks clicked the Sidebar link first, and seven in total clicked the Pull Box link first).

We also examined how many children visited Wikipedia as the first link they clicked. Of the 50 participants, 13 clicked Wikipedia first for the Open Task, 5 for the Verbal Question, 18 for the Verbal Instruction, 6 for the Written Question, and 8 for the Written Instruction. Across all five tasks, nine children in total visited an advertisement or sponsored link as the first link they clicked for one of the set tasks.

#### **8.2.11.2. Wikipedia and Sponsored Links**

In Section 8.2.11.1 we report the first link selected. Children and teachers both discussed the use of Wikipedia in Chapters 5 and 6; here we further analyse link selection of Wikipedia links. Further, we analyse advertising and sponsored link selection here due to the potential for confusion that may arise for these young readers.

Wikipedia was the first link selected by a child in our study a total of 50 times over all tasks (a possible 250 link selections). In total, a Wikipedia link was visited 99 times by children during their search tasks. Only 11 of the 50 students who participated in our study did not visit a Wikipedia link during any of their tasks.

A total of nine children selected an advertisement or sponsored link. All 9 of the children that visited an advertisement or sponsored link were primary school children (four Year 5 and five Year 6 children). In total 20 children visited advertisement or sponsored links during their studies. Six Year 5 children visited advertisements (8 visits total), five Year 6 children visited advertisements (7 visits total) and 3 Year 8 children visited advertisements (5 visits total). The fact that even three of eight Year 8 children who participated in our study visited advertisements shows that the advertisement and sponsored links can be confusing for children at all levels of our study and requires consideration by developers of software for children.

#### **8.2.11.3. Repeat Link Visits**

We complete our analysis of visited links by analysing the number of times students visited the same link within the same query. We counted only the number of times a student visited the same link before adjusting their search query and only for the first query that they created for each task. A total of 14 children visited the same link twice during their first query creation. The children who visited the same link twice were not

just the younger children. We noted that four Year 5, four Year 6, two Year 7, and four Year 8 children visited the same link twice.

Children were also noted to visit a link from a pull-box or sidebar and then revisit the same website via the search results list before realising they had been to this website before. Additionally, children also noted the information found in the pull-box or sidebar and announced to the researcher that this was the answer or a part of the answer, yet still visited the same website via the search results list. In this instance, when a child visited a link that was the same link as was used by the Google pull-box or sidebar, the child appeared to the researcher to be oblivious to the fact that the information has come from the same source.

There was not an opportunity for the researcher to question the student about this second visit of a link. Video analysis has revealed that at times the selection of the link is followed by quick use of the back button, or sometimes a verbal statement by the student acknowledging that they have visited this link previously or that they did not mean to visit this link.

While further evidence is present in the data of children visiting the same link as they had previously visited after a query reformulation we have not reported this data here because it is a tough picture to describe and adds little further evidence of the phenomenon we have already reported.

#### 8.2.11.4. Link Selection Summary

We hypothesize that there may be interactions present with link selection and the content of the link title, link URL or link description. Analysis of these interactions is outside the scope of this thesis and is not reported here. Further studies that investigate these interactions and develop hypotheses regarding the words used within these SERP-text-devices will do well to progress this open question.

### 8.2.12. Search Engine Interactions

Children were noted to conduct a number of physical actions within the search engine interface. While these interactions are both interesting and of note for future investigations they fall outside the scope of this thesis as presented here and thus we offer cursory insight only.

It was recorded in the researcher's field notes and at times in the video footage that children were seen to point to the computer screen with their finger. It appears that these students were pointing at images in the sidebar as if in surprise or an indication to the researcher that this was something of note. At times children appeared to be using their finger as a visual guide when scanning the SERP list, or when reading sidebar or pull box content, much like they would as new readers following their finger when learning to read. We hypothesise that there are a number of reasonable explanations for this action by the children including; difficulties with the scanning of the page due to visual design considerations; reading or comprehension difficulties due to the written language used; ergonomic difficulties created by the position of the chair or monitor. Video footage was not reliable as a mechanism to capture reliable statistics as to the number of students who displayed this mannerism due to the single camera set up and over the shoulder positioning.

It was observed that children highlighted text as they read as a visual marker of information to come back to or as a visual reference of text currently being read (often in sidebars or pull-boxes). Analysis of the typeface choice, typeface size and typographic page layout decisions of the designers of these SERPs is needed to understand how these typographic decisions impact children's use of search engines.

### **8.2.13. In-page Interactions**

We noted a range of interactions that occurred on websites. While these cursory findings are interesting and bear further investigation, we have not attempted to count or make judgments on these interactions within this thesis as they are outside the scope of this thesis. We report here for the readers interest only interactions that were noted by the research to have been performed by at least 3 children.

#### **8.2.13.1. In-Page Triage & Reading**

Children seemed to make value judgments and conduct pre-reading analysis on websites, at times very rapidly. The children would allow the website to load and given very little time to comprehend or read content on the page; the child would hit the back button or delete key to return to the SERP. Alternatively, a cursory and very rapid scroll to the bottom of the page and to the top of the page again, or part therein, was made before a rapid use of the back button. When questioned about these interactions children generally gave full answers or did not know why they had made the decisions to retreat. When a reason was given it was often claimed that the site did not look professional or

“safe”, it was a known website that the child did not trust or something about an image or video was a deterrent to the child.

Pre-reading analysis of web pages was noted when children scrolled the web page. Children described this as “skimming and scanning” the page. A very quick scroll of the page to the bottom or partway was made before the page was returned to the top and slow, conscious reading was begun. It is expected that children are using visual cues such as imagery, tables, and headings to assess or triage the content of the web page. Children appeared to look for keywords or specific text in headings when making these decisions. Children were then noted to return to the top of the page for close reading, or begin close reading at a suitable in page orientation feature, often a heading or image caption.

Children used the mouse to point to body copy text at times in a similar fashion to how a finger would be used by a learning reader. The mouse was also used to point to images and sidebar or navigation features of websites. We have no evidence as to if this was done in correlation with eye movements or if this was done as a memory guide or marker for interesting information or data that may be worth revisiting after page triage was conducted in other eye path locations.

At times, after poor scanning of a web page, children were noted to leave a page declaring information was not present. Should the child have conducted deeper, or longer analysis, of the web page, the information for which they were seeking would have been located. We make this claim as the information that the child was searching for, had been observed by the researcher as being present. This indicates that the children's scanning, reading, and comprehension ability, is understandably still developing and is not at the speed or competence of the researchers'. Perhaps children were also looking for specific words within the text and did not have the vocabulary that the researcher had to understand for example that “habitat” was a term that described, “where a possum lives.”

#### **8.2.13.2. In-page Visual Features**

Images in the run of the text or in right-hand columns of websites were pointed to with the mouse or finger. Maps and illustrations or photographs of Uranus and Mt Cook were used when gathering information about the topics being searched. Some children were even noted to attempt to count the rings in illustrations of Uranus, or use scenic images

of Mt Cook to describe verbally to the researcher the picturesque nature of the part of the country that Mt Cook is located.

As noted in Section 8.2.13.1 children also pointed to text with the mouse as if to guide the eye. Additionally, it was observed that children highlighted text as they read as a visual marker of information to come back to or as a visual reference of text currently being read. Children also highlighted text and copied this directly to a word processor for later use. This copying was not observed to be combined with any referencing during our observations. Analysis of the typeface choice, typeface size and typographic page layout decisions of the designers of these pages is needed to understand how these typographic decisions impact children's use of these web pages.

Navigation and menu items were also moused over by children even when not clicked. We assume this to be a similar interaction to pointing the mouse to text or images during analysis, scanning, and comprehension or decision-making.

#### **8.2.13.3. In-page Search Engines**

In-page search engines, particularly in Wikipedia and Ask.com were attempted to be used by children when altering a search or expanding a search. When questioned about the search box many of these students were unable to differentiate the parts of the Internet searched by these in-page search boxes and the parts of the Internet searched by Google. Children attempted to use these in-page search boxes in a very similar fashion to that of Google, with complete questions and natural language searches often used.

#### **8.2.13.4. Summary of In-page Interactions**

We noted three significant areas of in-page website interactions that children were observed conducting during our observations in primary and intermediate schools in New Zealand. These were in-page triage and reading actions, interactions with in-page visual features of websites and use of in-page search engines.

As a part of future work, we will analyse in much more depth the content of these videos and make suggestions as to some of the visual features that are common on websites that received certain types of interactions. We will also analyse our rich data to describe common visual or interactive features of websites that appear to cause confusion or misguidance and in so doing propose research requirements and solutions that will assist designers and developers of digital information material for children.

Additionally, we believe eye movement studies and analysis of the visual features of web pages that cause these types of pre-reading analysis noted in Section 8.2.13.1 may produce useful design recommendations.

### 8.2.14. Time on Task

Time is a typical measure for usability studies, and it could be argued that our own is no different. We argue that the speed for which a child completes a task or series of tasks for educational purposes may not be of educational concern and therefore, is a low priority measure for our studies. We offer here time measurements for our studies that serve to illustrate only the length of time that it took on average for task completions during our observation study and should not be generalised or used comparatively in future work. Additionally, these measurements offer no insight into the effectiveness of the search engine or the children's information search abilities.

Using the video footage, we coded the length of time a search took from the time that the child began to type to the point at which the child indicated or declared that they were satisfied that they had completed the task. We rounded the results to the nearest quarter of a minute due to the variability's present amongst participants and in this recording method. We report the average (mean) number of minutes to complete each task in Table 8.17.

When reviewed as composites, the Y7&8 children on average took less time than Year 5&6 children to conduct most of the tasks. Only for the Open Task are the Y7&8 children observed to take longer than the Y5&6 children and the same length of time for the Written Question. When comparing single year levels the Year 8 children took the longest to complete both the Open Task and the Verbal Question. However, for the remaining three tasks either the Y5 or Y6 children represented the longer search times.

**Table 8.17 Average time (mins.) to conduct search tasks**

Y5	Y6	Y5&6		Y7	Y8	Y7&8
4.75	4.75	4.75	Open Task	5.50	6.50	6.00
6.00	5.75	6.00	Verbal Question	5.00	6.25	5.50
4.75	5.75	5.25	Verbal Instruction	4.50	5.50	5.00
5.75	5.25	5.50	Written Question	5.25	5.50	5.50
5.50	4.50	5.00	Written Instruction	3.75	5.50	4.50
n=15	n=19	n=34		n=8	n=8	n=16

Across the year levels, verbal tasks tended to take longer to complete than the written tasks for both questions and instructions. Question tasks also appeared to take longer than instruction tasks for students to complete. Perhaps this is because question tasks required a known answer to a known question while children could determine when they had completed finding “enough” facts or information about a given topic with the instruction tasks.

When we compare the length of time per query to conduct a task, Year 7&8 children made more queries in total and on average when conducting the Open Task, and in turn spent longer on this task than the younger children.

Table 8.18 reports the average (mean) length of time per query to conduct a task.

**Table 8.18 Average time (mins.) per query to conduct search tasks**

Y5	Y6	Y5&6		Y7	Y8	Y7&8
3.75	3.50	3.50	Open Task	3.75	4.25	4.00
2.75	3.75	3.25	Verbal Question	3.25	3.00	3.00
3.25	3.50	3.50	Verbal Instruction	2.00	3.25	2.75
2.50	3.00	2.75	Written Question	1.75	3.00	2.25
2.75	2.75	2.75	Written Instruction	2.75	4.00	3.25
n=15	n=19	n=34		n=8	n=8	n=16

We noted that during this additional time exploring the Open Task, the Y7&8 children delved deeper into the subject they were investigating compared to the Y5&6 children. Often the older children identified a personal information need during their searches. These personal information needs were identifiable by the researcher when the children formulated or reformulated queries with specific lines of inquiry. For example, MY7\_3 used the specific query “when was soccer invented” for the Open Task, identifying soccer as his favourite sport. A second example was FY8\_4, who began her inquiry with piano music as her favourite musician for this task. To investigate this task she started with the query “piano songs sheet music” and after some exploration of the websites returned by this query, she chose to reformulate her query to “Beethoven piano” and then “Beethoven facts”.

These insights provide useful feedback for educators when considering the learning implications of the types of tasks set for children. However, these insights offer little design consideration for the development of children’s search engines.

### 8.2.15. Keyboard Use & Mouse Use

Of interest from an HCI or ergonomic standpoint are physical actions such as those related to the children's use of the keyboard and mouse. Many of the children did not touch type, nor did they typically keep their hands or a hand on the keyboard or mouse during searching or reading of SERP or web pages. This required the child regularly visually to assess the location of the keyboard or mouse, moving eyes from the computer screen to the input devices, and back.

Considering the children's head movements during query creation serves to investigate relationships of our findings to the related work in query expansions and reformulations (see Section 3.2.4.2). To observe this behaviour, we counted the number of times a child looked up from their fingers to review what they were entering into the search box (see Table 8.19) for each task. We did this only for the first query entered for each task.

Y5&6 children made a total of 576 of such head movements (average 3.39 per child) while Y7&8 children made only 261 head movements (average 3.26 per child). Table 8.19 shows a breakdown of the average number of head movements per task. Task did not have a consistent influence on the total number of head movements noted.

**Table 8.19 Keyboard to screen head movements during query creation**

Y5	Y6	Y5&6		Y7	Y8	Y7&8
3.47	2.84	3.12	Open Task	2.13	3.25	2.69
4.20	3.79	3.97	Verbal Question	2.38	4.38	3.38
2.93	3.00	2.97	Verbal Instruction	2.75	3.38	3.06
3.27	2.74	2.97	Written Question	2.25	4.00	3.13
4.40	3.53	3.91	Written Instruction	4.00	4.13	4.06
n=15	n=19	n=34		n=8	n=8	n=16

Table 8.19 shows that all children looked up from the keyboard to the computer screen at least twice before firing a query. For all age groups, the Written Instruction task required the most head movements to check what was being entered. It was during these times that the child was looking at the screen that they were noted to identify query suggestions or query expansions (see Section 8.2.8) that they could use to complete the entering of their query.

### 8.2.16. Interview Results

From the interviews, we have yet another layer of insightful data which is ripe for analysis. Due to the strength of the evidence observed during the observation phase of

the study we have only comprehensively analysed five key questions from the interview phase of the study at this point. To confirm our findings regarding difficulties with information search that were observed we analysed Questions 1 through 5 of the Post-observation Interview (see Figure 8.2).

#### 8.2.16.1. Sense of Ease when Searching

Question 2 and Question 4 asked *What was easy when searching today?* and *What can be easy when searching on a computer?*

Children oozed confidence with seeking and using information on the Internet. FY7\_3 stated, "it was pretty easy just to click on Google and search." Children described searching the Internet as "quick" and "easy" which seems to be emotionally significant for those interviewed. Additionally, children noted that Google seems just to *work*. For example, FY5\_3 "When I wrote 'for kids' and it came up straight away with what I wanted." Children also described numerous websites, such as Wikipedia, YouTube, BBC-Kids as being easy or helpful.

Children described search engine features such as pull-boxes, sidebars, and SERP entry descriptions. When discussing what was easy, children discussed pull-boxes (6/50) and sidebars (2/50) as making their tasks easier during their observation sessions. For example, FY5\_5 stated, "when I wrote how high is Mt Cook, and [the answer in the pull-box] just came up there [pointing at the screen]." FY5\_3 "When [the Google auto-complete] corrects you".

Children described the wealth of information on the Internet and the speed and ease of the Internet as a resource. For example, FY7\_2 noted, "when there are lots of websites, so if it doesn't work, you can look at another one." FY8\_3 described appreciating "when there were lots of websites that had the information, so I could confirm it."

Additionally for Question 2, it was not uncommon for children to interpret this as asking about a particular task that they had completed during their session with the researcher. Tasks, where the children had some prior knowledge of the topic, were often reported as easier such as Mt Cook (5/50). This is highlighted by MY7\_3 who stated: "it was easier to find facts when I already knew some stuff about it, like Mt Cook, which I already knew was the highest mountain in New Zealand." One student also reported the Uranus task as being easy.

### 8.2.16.2. Sense of Difficulty when Searching

Question 1 and Question 3 asked *What was hard when searching today?* and *What can be hard when searching on a computer?*

When describing difficulties that they experienced, children noted spelling<sup>18</sup> (3/50), typing and scanning or reading (3/50) to be difficult at times. Reading and triaging of information was identified by the children as an issue both within the SERP and within the resulting web pages. For example, FY5\_7 described that she would “scan through the text and find the info. Sometimes websites don't have headings, headings which make it easier to find information”. MY6\_8 described disliking “when too many websites don't have what you want, and you keep wasting time reading lots”. Children also noted that finding information within a web page was difficult. Reading, skimming, scanning, and triaging in-page is complex for children. This difficulty was a feature of the discussions for all of the age groups included in this study. For example, MY8\_1 stated: “finding exactly what I wanted to find. You had to go through, scroll through.” MY8\_1 also remarked that “sometimes people don't put the right information on their websites.”

Query creation is a difficult task for children. 13 of 50 children described difficulty constructing queries. For example, MY5\_5 found it difficult to know “what to write into the search box.” FY5\_5 noted “when you can't find the answer to your question. When you first write the fact, and it does not come up. I have to write the fact differently”. MY6\_7 simply replied with “choosing the right thing to type in.” And unfortunately, Google, still, doesn't read minds as explained by MY6\_5: “To get the particular little bit of information that you want. It sometimes doesn't give you what you want. It can't read your mind. You have to search the right thing and tell it what you want”.

Children also noted difficulties with identifying the correct website to visit from the list (16/50). Alongside these observations, children also discussed finding answers or information for their problems on the resulting websites to be difficult. For example, FY6\_11 stated, “it's really hard to find the information sometimes.” MY6\_8 discussed difficulty “finding the right site and knowing what to click.” FY5\_5 noted it can be a problem when “you make the search too long, and it comes up with different things than you want to know.” MY5\_6 said there was “heaps to choose from.”

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<sup>18</sup> While three students noted spelling as a difficulty, additionally, two further students noted spelling when using a computer as easy. Features of auto-correction were the reasons children noted spelling as easy, while features of manual entering of a search query were noted for the reasons for difficulty with spelling.

Sometimes you have to change your question and make it more specific". He had difficulty when the researcher asked him if he could elaborate, MY5\_6 could not describe how to make it more specific. 13 out of 50 children discussed difficulty changing or altering search terms when a search term wasn't producing results.

Additionally for Question 1 as discussed for Question 2 in Section 8.2.16.1, it was not uncommon for children to interpret this as asking about a particular task that they had completed during their session with the researcher. Typically the task about the Cricket World Cup (5/50) or Uranus (4/50) was identified, while only one student reported the possums or Mt Cook tasks as difficult. We hypothesise that this difficulty with certain tasks is due to a lack of prior knowledge or lack of interest in these topics by the participant.

Only two children of the fifty that we interviewed explicitly stated nothing was difficult for them when searching or using a computer.

### 8.2.16.3. Decision Making when Creating a Search

Question 5 asked *How did you decide what to type into the search box today?*

18/50 children described using keywords when answering this question. For example, FY7\_3 stated, "The keywords are what you are supposed to search. Not the whole, you know, you wouldn't really want to put all of that in, so just the main points". She continued, "You probably wouldn't want to put all of it in because you would get less results if it is longer." FY7\_1 stated, "I used to type in the whole question, and Mum and Dad helped me and told me just to use keywords."

20/50 children described using questions to create a search. For example, FY8\_4 said "I just typed in the question. Sometimes, I won't type in the whole question I will just type in something I want an answer to." She continued, "the simpler the question is, the simpler the answer is. If it is too complex, [the search engine] doesn't process it well". FY7\_1 noted that "if keywords do not work then I use the whole question."

5/50 children described typing simply what was asked of them by a teacher, or in this instance the researcher. For example, MY8\_1 stated, "I searched what you told me" and MY8\_2 said, "I used your words."

Additionally, children discussed sentences and attempting to put the search into their own words. MY6\_5 said, "I tried writing things in other words. What would be the best sentence to write."

Seven out of 50 children could not, or chose not to answer this question.

### **8.3. Discussion**

In Chapter 5 and published in Vanderschantz et al. (2014b) we discuss the results of children's self-reported beliefs about their information search as well as teachers reporting of their observation of children's information search (Chapter 6). In those chapters, both children and teachers described a process that started with the construction of a search query in one of three ways (NLQ, NLS, or KW), followed by the decision which page to visit using a SERP, then locating information or an answer on a page, and repeating the process with a reformulated query when the search was deemed unsuccessful, or confirmation was needed. The study described in this chapter scrutinised the query construction phase as well as the search term adjustment phase described by children and teachers. We now discuss the findings of our present study with regard to these two phases and in comparison to related work.

#### **8.3.1. Query Formulation**

We noted in our discussion of the related work (see Chapter 3) that much of the older literature on query construction by children discusses the difficulty children experience when constructing keyword queries and the incorrect use of natural language query formulations, e.g., in (Bilal, 2000; J. Schacter et al., 1998). Our own related research (see Chapters 5 and 6) also showed that children and teachers are both still of the opinion that keyword searches are more appropriate than natural language queries. In those studies, children described the difficulty of identifying the parameters of a good search query. Children reported difficulties to find ways to improve search queries should the initial query not prove successful. They self-reported use of natural language even though they felt that teachers recommend topic word searches as most appropriate. Teachers stated that they taught children not to use natural language queries, including removal of punctuation and small words (see Chapter 6). We find in our present study that children do indeed use both query construction methods.

A clear preference for keyword queries was sound advice for the traditional search engines and digital libraries to which most of the literature refers. The findings of our present study have shown many instances where children successfully found information using both natural language searches and keyword searches. Given the number of children observed in our study who successfully used natural language queries, clearly, these are not search patterns to be shunned. Further assisting children in recognizing when natural language is an effective query process and what to do when natural language searching fails may be necessary as well as highlighting that not all search devices are as robust in their accommodation of natural language queries (e.g., most DLs and OPAC still require keyword searches).

Another finding of our study is the correlation between how a researcher (or teacher) formulates a search task and how a child is likely to formulate the resulting query. Tasks posed as questions more often result in NLQ queries while tasks posed as instructions are more likely to lead to NLS queries. Additionally, keyword constructions were used most often for tasks posed as instructions rather than questions. This should be useful for educators considering the way in which a learning task is being posed to children.

Finally, the older children in our study (Y7&8 students), made approximately 11% less total queries during our observation sessions. Assuming that the number of queries required to answer an information need is a marker for the efficiency of query formulation, the older children seemed more efficient information seekers. This supports the arguments of Gossen et al. (2013) who claim that children's search interface needs change rapidly due to the children's development of cognitive and fine motor abilities.

### **8.3.2. Query Reformulation**

In line with other studies reported in the related work analysis, our present study has found that children do indeed make several query reformulations. Query reformulation is an area that received significant discussion in the literature with many issues remaining unresolved. Related work has observed that adults do not conduct significant number of query reformulations or subsequent searches (Spink & Jansen, 2004), while children older than those in our own study are reported to reformulate search queries a number of times in studies that observed them using dated internet search engines (Bilal, 1998; Bilal & Kirby, 2002). We argue (Vanderschantz et al., 2014b) that mechanisms to explicitly support query formulation and reformulation are not broadly implemented within typical search engines and digital libraries.

Our own related interview studies indicated that children were not able to easily identify promising query reformulation strategies. Both children (Chapter 5) and teachers (Chapter 6) believed children would reformulate a query by constructing an entirely different query string or by adjusting the query string. Teachers also thought that children would seek adult intervention in many situations where a reformulation was necessary. In our present study, we noted that the reformulations were most prevalent when a child started with a search that was too simplified to return targeted results for their information need. We have contributed to the literature in this area by identifying indications of when children reformulated queries during their searches conducted in an educational environment. Reformulations were required more often when the first query construction used a keyword search. Children reformulated keyword searches by qualifying the search that they were constructing. They did this by adding a query qualifier or by converting that search to a NL query. Children were observed to make fewer reformulations with NL because they often already included sufficient query qualification features for the search engine to return results that were easily identifiable for the child as relevant to their needs.

Often the children's difficulties in constructing good search queries has been related to their lack of vocabulary or lack of cognitive structure. Our finding that keyword queries require more reformulations than natural language queries further supports this view.

### **8.3.3. Query Construction Assistance**

Druin et al. (2009) reported that while the children participating in their study were digital natives who had access to and experience with computers for most of their lives, yet the difficulties with spelling and typing of search queries prevented children from successful information search. They found that live spelling and query suggestions present in Google's search box interface did not assist children because the children were looking at the keyboard when typing. These findings differ from our observation of the significant numbers of students who took advantage of the query suggestions in our study. We found instead that the potentially less computer-literate and less vocabulary-aware children were most likely to use the query suggestions. We noted that these younger children and children who appeared less confident in their spelling or vocabulary moved their head from the keyboard to the screen more often than the older children. Thus, the slowing down of the search process and query entry process is likely to enable a child to review these live suggestions.

Druin et al. (2009) also found little use of both the spelling suggestions and related searches on a Google SERP. Nine of our 32 participants used the spelling suggestions (twice as many Y7&8 students as Y5&6 students) Related searches were indeed used seldom in our study (only three overall) while 21 participants claimed to have seen the related searches at some point during their session with the researcher.

It is often discussed that children are likely to give up in frustration or to resort to adult support. Contrary to beliefs of the teachers discussed in Chapter 6 our researcher did not record any instances where a child asked for query construction assistance from the researcher, nor, a teacher or librarian present in the research environment.

#### **8.3.4. Alignment to Reported Internet Search Procedures**

In Chapters 5 and 6, we introduced two models of what children and teachers reported being the way children search for information using a computer. Both the children and teachers in those interviews described searching for information on computers beginning with a new search in Google. Children and teachers stated that query constructions were likely to be very broad and involve a combination of keywords and natural language depending on the child's confidence with the topic. It was next explained that children were required to select a search result, at this point, children discussed deciding if the search had resulted in a potential page to visit or if they should first refine their query. The child would then need to select a search result page from the SERP, teachers, and children agreeing that this often meant clicking the top link or reviewing the list for a specific web page (i.e. Wikipedia). Once the children have clicked through to a page, the task then requires the location of information (or an answer) on the page visited. Children and teachers expected that this would be accomplished by skimming and scanning the text, likely from top to bottom of the page within a website. Once a child has completed their interaction with a page a decision is necessary regarding if the question has been answered. If the child is satisfied with the answer, a second decision is required regarding triangulation and confirmation of the answer using multiple sources. If the student has confirmed their answers with a suitable number of sources, the search would likely be considered completed. If the child required further triangulation of their sources the teachers expected that students would conduct a new search or select from their previously generated search results, list a new page to visit. Teachers described children's ease of distraction by games, in-page links, and tangents that may result in an infinite loop.

While children and teachers discussed slightly different models, (see discussion in Section 6.3.2), the search practices observed during this study are very similar to those models. In our present study, we observed children creating broad search queries and queries that were very similar to the instructions of the researcher. When the child was required to select a search result, it was not common for children to adjust their query before selecting a website. Sidebars and pull-boxes as described in Chapter 7 were observed to be used and were discussed by children in this study, though these were not a feature of the interviews in previous chapters. As expected by children and teachers, children often clicked the top link, and numerous children visited Wikipedia. Once the children had clicked through to a page, we observed rapid scrolling of the page, scanning of the text and images with mouse cursors and fingers and observable head movements during reading, skimming, and scanning. Some children also appeared to read in some depth word for word. Children and teachers described a need for triangulation of information at this point in both models. Evidence of children performing triangulation was observed very little in our study. We observed no describable instances of distraction or tangential surfing behaviour, likely due to the children being observed at the time.

### **8.3.5. Limitations**

In this study, we chose to control for the search engine that children used. This decision was based on the findings of our previous work in Chapters 5 and 6 of this thesis. We chose Google as opposed to Bing or Yahoo! simply because this was the search engine discussed by all children (Chapter 5) and all teachers (Chapter 6) in our interviews. It would be equally possible to implement this study in either Bing or Yahoo! or in fact any other search engine suitable at the time of the investigation. We do not believe that results pertaining to query construction or SERP list triage would be drastically different depending on the search engine used. However, it is likely that the frequency of advertising link clicks, sidebar or pull box use will be different due to the different design features of those alternative search engines as we observed in (Chapter 7). We propose a sensible future study would include a comparison of the results of this study to a replica investigation using Bing, Yahoo!, or another relevant search engine for the demographic being considered.

Analysis of patterns of interaction by children during this study are of interest yet were outside the scope of this research. Future studies that include eye gaze or eye tracking

tools for the study of search engine use by children may provide interesting results to support and further the findings reported here.

## 8.4. Study Conclusions

This chapter presented an analysis of children's query creation, formulation and reformulation activity and query related SERP use in classrooms. Previous investigations into children's query formulation and reformulation were conducted using various methodologies including log analysis, (e.g., Duarte Torres, Hiemstra, & Serdyukov, 2010b), screen capture, (e.g., Bilal, 2000) laboratory study and usability testing, (e.g., Reuter & Druin, 2004). Our own work used observation sessions with individual children in naturalistic environments using a range of search tasks.

This study, similar to those in the related work, indicates the need for educating both children and teachers in how to construct search queries better. We observed that the old paradigm (strong focus on keyword search) no longer holds true for searches in Google. Natural language queries have been successful for the children in our observations. NL queries will not be successful for children in OPAC's and databases that are typically Boolean search engines. Children, therefore, need to be further educated as to when and where to use NL queries and how to successfully construct KW queries in alternative information retrieval systems. Equally, digital libraries, search engines, and OPAC's will need to support natural language queries more robustly in the future to remain relevant in a Google-centric world.

We found that reformulation of queries was needed most for keyword queries that often had insufficient information to achieve appropriate search engine results for the child. To assist children in creating better initial queries, children need to be educated as to how to construct a query that contains sufficient information. As we observed, for Google, this may indeed be a need for education in the creation of natural language queries. Because natural language questions least often required reformulation, we suggest that educating children to use NLQ when searching Google is, at present, the most appropriate advice.

Existing systems that attempt to solve children's IR issues are often research-based prototypes and date visually very quickly and, naturally, do not receive on-going support akin to that of a commercial search engine. For a number of reasons, these dedicated child-centred systems are not used in NZ classrooms, and many are no longer available online. We would advocate for system enhancements that support child-

appropriate information seeking behaviour within commonly available and utilised systems instead of dedicated child-targeted systems.

## 8.5. Chapter Summary

We conducted a user observation study with Year 5&6 and Year 7&8 children in primary and intermediate schools. We identified children's query creation and query reformulation strategies, and the issues they encountered using the Google search engine. The work in this chapter shows there is a need for an inquiry into interfaces that assist with formulating appropriate natural language queries, as well as support for finding synonyms or alternate query terms and query strings when an initial search attempt fails. Additionally, we observed a need for assisting with management of triaged information within the search engine.

This chapter has further addressed Research Question 2 (see Section 1.2), exploring and confirming the issues that children experience when searching for information with the search engines that they have access to.

**RQ2** is concerned with the issues encountered during information search. Our study illustrates how children are searching for information on the Internet using the Google search engine. The children in our study displayed a range of issues when interacting with the search engine to create searches as well as to triage information in the search engine results page lists. These findings provide evidence to support development of an interaction model that supports children's information seeking and can be explored later studies in this thesis.



## **Chapter 9.**

### **KidsQuestions:**

## **Interaction Model and Interface Prototype**

Children are known to have difficulties effectively using the information technologies that are available to them. Our work reported in Chapters 5 to 8 has identified three major difficulties for children: 1) constructing searches, 2) identifying relevant information in search results lists, and 3) finding the information contained in web pages. We introduce in this chapter an interaction model for information search that is tailored to children's inquiry-based learning practices. This interaction model is also implemented as a proof-of-concept in our KidsQuestions prototype.

The chapter is structured as follows: using an approach based on Activity Theory we analyse the details of children's information seeking needs (see Section 9.1). Based on this analysis we then define the requirements for an interaction model for children's information seeking (Section 9.2). Section 9.3 describes the conceptual design of an interaction model for children's information seeking. We introduce a proof-of-concept interface prototype and describe the design (Section 9.4) and implementation of the prototype (Section 9.5). Finally, we discuss our expert review process (Section 9.6), which assisted in the final development of our proof-of-concept interface prototype.

This chapter answers our third research question (see Section 1.2): *what are the requirements for information seeking interfaces that will assist children's digital information seeking?*

## 9.1. Requirements Analysis using Activity Theory

Here we summarise the findings of our previous studies with specific consideration of requirements for an interaction model that supports children's digital information seeking. We use an Activity Theory framework to formalise this process. Activity Theory (see Section 2.1) can successfully be used in Interaction Design, Information Systems, and Human-Computer Interaction research as a tool to assist in both pre-design and post-design analysis of interfaces, systems, and tools (Jonassen & Rohrer-Murphy, 1999; Kaptelinin, Nardi, & Macaulay, 1999; Mwanza, 2002). Additionally, Activity Theory serves as a suitable tool to analyse our interaction model because the pedagogy of the NZ education curriculum at primary and secondary levels is influenced by both socio-cultural theory and constructivism (see Section 2.1.1).

### 9.1.1. Description of the Activity

The activity we are concerned with is that of children conducting an inquiry using an internet search engine to search for information on a given problem. Engestrom (1987) noted that activities are part of a greater whole and that many complex functions combine to produce the desired outcome. We describe here what we have *observed* in our studies rather than what *should* happen in an ideal world. Using Engestrom's Activity System (Engestrom, 1987) we have visualised the interrelated parts of the activity in Figure 9.1. Those used within the system are highlighted in italics.

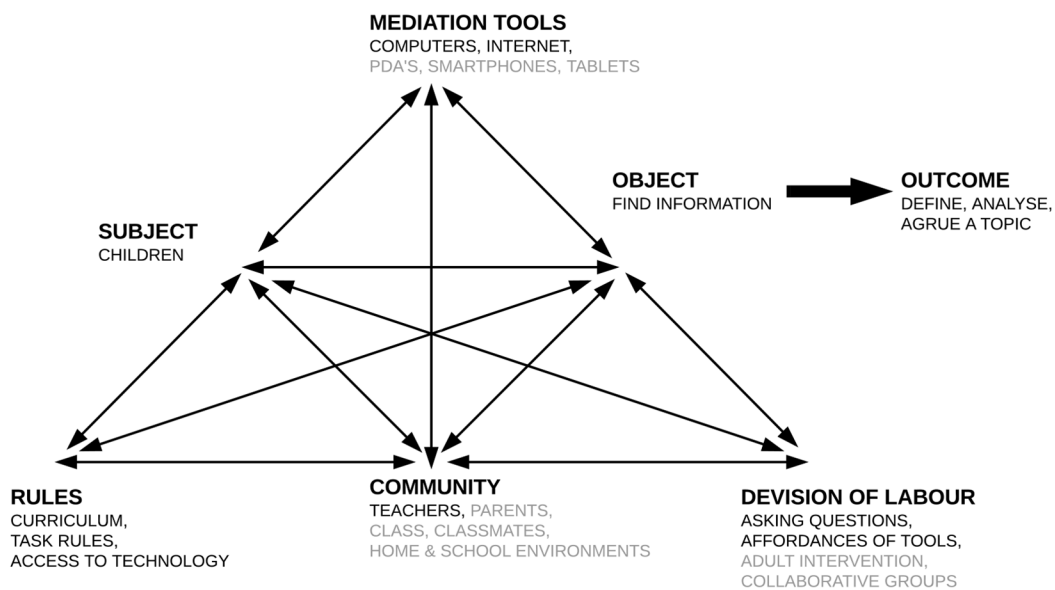


Figure 9.1 Engestrom's Activity System Applied to Children's Information Seeking

We first describe the topmost part of our Activity System. We observed that children (*subjects*) conduct these information searches in the home and the classroom. The

*object(ive)* is to find information on a given problem. Children search for information using a range of ICT (*mediation tools*), typically a computer and the Google search engine.

We now consider the bottom part of the Activity System. Children's information searches are often for school inquiries that are developed to meet the requirements of the curriculum, have rules for how the inquiry is to be completed and depend on access to technology to complete (*rules*). Teachers guide these inquiries and are co-participants in the activity, and work as mentors, guides, and partner problem solvers when required (*community*). While this community also includes parents, classmates, and the home and school environment<sup>19</sup>, these have not been specifically observed or studied in our research. The affordances of the mediation tools along with children's ability to ask questions all assist with the *division of labour*. Adult intervention and assistance, along with group and collaborative information seeking are potential divisions of labour that have not featured in our studies to date.

Ultimately this activity of children conducting an inquiry task using an internet search engine is aimed at the child being able to define, argue and report on a topic (*outcome* in Figure 9.1).

Visualising these features of our activity system provides a lens to view the current situation in children's information seeking that we observed. This overview allows us to develop our understanding of children's information seeking needs when we use the Activity Checklist to scrutinise the findings of our previous studies.

### 9.1.2. Activity Checklist Evaluation

We now use the Activity Checklist (Kaptelinin et al., 1999) to review the findings of our research. Specifically, we will use this checklist to assess the use of internet search engines for information seeking in educational situations as described in our activity system (see Section 9.1.1).

The checklist comprises four categories of questions for investigating an activity: 1. means/ends, 2. environment, 3. learning/cognition/articulation, and 4. development (1999, p. 39). Each category has an associated list of sample questions that are proposed for evaluating the activity thoroughly. Kaptelinin et al. observe that "it would be

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<sup>19</sup> These members of the community presented in grey in Figure 9.1 do not significantly impact the use of a computer to search for information by an individual.

impossible to investigate all the areas it covers without a multiyear study” and instead recommend to explore the “areas represented in the Checklist that are likely to be troublesome or interesting” (Kaptelinin et al., 1999, p. 35).

Table 9.1 outlines those questions of the Activity Checklist that are the most pertinent to our research.

**Table 9.1 Features of the Activity Checklist Pertinent to our Study**

	<b>Category Description</b>	<b>Questions</b>
<b>Means / Ends</b>	This category analyses the fact that people have hierarchies of goals that are required to meet their needs. To assess a technology fully, it must be considered with respect to the goals of the user. The goals the tool was designed to address (the <i>target goals</i> ), as well as the actions it may not be intended to meet, must be assessed.	<p><b>AC_M1:</b> Are all target actions actually supported?</p> <p><b>AC_M2:</b> Is there any functionality of the system that is not actually used? If yes, which actions were intended to be supported with this functionality?</p> <p><b>AC_M3:</b> Are there actions, other than target actions, that are not supported, but users obviously need such support?</p> <p><b>AC_M4:</b> What are the basic limitations of the current technology?</p>
<b>Environment</b>	This category recognises that people are a part of the social, cultural world - their environment. People, as well as the tools and objects of the activity, are considered in this category.	<p><b>AC_E1:</b> Is target technology considered an important part of work activities?</p>
<b>Learning / Cognition / Articulation</b>	This category of the checklist considers the use of tools and how a user can internalize or gain an understanding of the process and the outcome due to the affordances of the tool.	<p><b>AC_L1:</b> Is the whole “action lifecycle,” from goal setting to the final outcome, taken into account and/or supported?</p> <p><b>AC_L2:</b> Does the system provide representations of user’s activities that can help in goal setting and self-evaluation?</p> <p><b>AC_L3:</b> Does the system provide problem representations in the case of breakdowns that can be used to find a solution or formulate a request for help?</p>
<b>Development</b>	This category of the checklist considers the use of tools to effect change or alter actions and operations. The Development category is most pertinent for considering design and development of information seeking interfaces. However, we use it here to describe some of the features of present ISE use.	<p><b>AC_D1:</b> Are users’ attitudes toward the system becoming more or less positive?</p> <p><b>AC_D2:</b> Are there negative or positive side-effects associated with the use of the system?</p>

We now answer each of the questions contained in Table 9.1.

AC\_M1: Are all target actions actually supported?

While ISE's provide tools for searching for information, including; entering queries, adjusting queries, as well as retrieving search results, these mechanisms have been shown in previous chapters (see Chapters 5, 6, and 8) to be difficult for children to use. There may be mechanisms of ISE's that can be improved for children.

In Chapter 3, we discussed information behaviour and the processes involved beyond simply searching for information. For example, Kuhlthau (2004) describes an extensive process which requires the information seeker to follow a number of steps to achieve their information seeking goals. Internet search engines are designed to meet only the actions of the search phase of the information behaviour models only. There may be mechanisms of ISE's that can be included to support search planning, information problem identification, and information triage.

AC\_M2: Is there any functionality of the system that is not actually used? If yes, which actions were intended to be supported with this functionality?

Our interviews with children (see Chapter 5) and teachers (see Chapter 6) revealed that children have difficulty knowing what to do when a search is not working or when a query is not providing the expected results. A potential solution to assisting with a search when a query is not providing results is already implemented in search engines as the *related search* function. In our observation studies in Chapter 8, it was observed that very few children used the related searches provided by the search engine.

We also observed that children are taught to use the Basic Reading Level filtering provided by Google. This functionality served to ensure that web page results returned by the search engine were at a reading level that is appropriate to the child. In our observation study (see Chapter 8) it was found that only one (1 of 32) child used this tool.

Our investigation of the effects of query types returned by the search engines in Chapter 7 showed the positive potential for natural language query use. However, teachers and children in our interviews (see Chapters 5 and 6) seemed to be of the opinion that keyword searches were the most appropriate query construction method when searching for information. Questions are known to be tools used by children and promoted by teachers as part of inquiry methods. Using question-based natural language queries could be beneficial to children's information searching in contemporary search engines,

however, this is not promoted by search engines or teaching. For these reasons promoting natural language queries in search engines may benefit child users.

AC\_M3: Are there actions, other than target actions, that are not supported, but users obviously need such support?

Adjusting a search that is not working is known in the literature as *query reconstruction* and is discussed in our related work in Chapter 3. Children and teachers (see Chapters 5 and 6) described difficulties with query reconstruction in our interview studies. Our observation study (see Chapter 8) revealed that children do reconstruct queries, but we have not identified a common reconstruction process by children and identify a need for reconstruction assistance in future ISE's.

Children in our observation study struggled with identifying which websites they had visited and were observed to visit some websites accidentally more than once (see Section 8.2.11.3). Children visited the same website both during triage for an initial query but also during triage for query reformulations when a new SERP list was presented to them. Some children were aware that search engines change the colour of the link text that has been visited and was mindful of the fact that they were clicking a link they had previously visited while other students were not aware of the conventions or found the conventions too subtle.

Even before a search query is entered support for search planning, information problem identification and information triage would be beneficial to children. These three functions of information behaviour are described in the related work in Chapter 3 but are not observed as features of ISE's analysed in Chapter 7.

AC\_M4: What are the basic limitations of the current technology?

Children in our observation study struggled to identify when links were sponsored or were advertising content that was not relevant to their search (see Section 8.2.11.2). Children also struggled to identify the source of information in the search results list (see Section 8.2.11.3). Children were observed to read the content in a sidebar or pull-box in the search engine but were not able to identify the website in the SERP that this content had been scraped from.

Additionally, as noted previously, children struggle with query construction and reconstruction.

AC\_E1: Is target technology considered an important part of work activities?

In Chapter 4 we identified that children are likely to have access to computing and Internet technology at school whether they are in a suburban or rural school and that there was a high likelihood of Internet access at home in the suburban areas. Desktop and laptop computers were the most commonly available computing device reported by teachers and parents for children across the year levels with tablets relatively highly used at most year levels also.

While there is a discussion of child-specific search engines in the related work (Chapter 3), this was not discussed by any of the children or teachers that we interviewed in Chapters 5 and 6. Google was identified as the search engine used by children and teachers.

AC\_L1: Is the whole "action lifecycle," from goal setting to the final outcome, taken into account and/or supported?

Information seeking frameworks discussed in Chapter 2 and taught by NZ teachers encourage step-by-step strategic processes. Search engines have not been designed to support a number of the steps required to complete an information seeking processes described by Kuhlthau and others (e.g., Eisenberg & Berkowitz, 1990; Gawith, 1988; Kuhlthau, 2004; McKenzie, 2000). ISE's could encompass further information problem-solving functionalities to service children and adult information seekers such as question use, question development, search structuring, and progress recording described in AC\_M3.

AC\_L2: Does the system provide representations of user's activities that can help in goal setting and self-evaluation?

Search engines do not provide suitable orientation tools for children to identify what the child has done already and what they plan to do next. Search engines presently highlight the websites or links that have been previously visited, yet, in Chapter 8 children were observed to repeatedly visit sites they had visited previously. This is also reported in the literature (Chapter 3), and children describe this issue in our interviews (Chapter 5).

AC\_L3: Does the system provide problem representations in the case of breakdowns that can be used to find a solution or formulate a request for help? We argue that the related searches feature of an ISE serves to assist query reconstruction when a search query fails. However, in our observation study (Chapter 8), we noted only

three students using related searches. Additionally, spelling suggestions and corrections are offered by Google and were used by nine of 32 participants in that study. To gain help otherwise, a user would have to conduct a search specifically for their use issue because there is no *help* or *FAQ* easily accessible on the search page of an ISE.

AC\_D1: Are users' attitudes toward the system becoming more or less positive? Children in our interviews in Chapter 5 were especially positive about the use of the Internet for information search. Children (Chapter 5) and teachers (Chapter 6) described the speed of information seeking and the wealth of information sources as a positive feature of information seeking using the Internet. The Internet is a common part of the inquiry-based learning common in the modern classrooms we observed.

AC\_D2: Are there negative or positive side-effects associated with the use of the system?

Issues of frustration and difficulty were described in the interviews introduced in both Chapter 5 and Chapter 6, as well as in the observation studies described in Chapter 8. These frustrations and issues have been detailed in response to AC\_M2, AC\_M3, AC\_M4, AC\_L1, AC\_L2, and AC\_L3 above. Alternatively, of course, the positive attitudes and motivated emotional rewards associated with the ease and speed of finding information as outlined in response to AC\_D1 must be acknowledged.

## **9.2. Requirements for an Interaction Model for Children's Information Seeking**

Having considered our research reported in Chapters 4 to 8 using the Activity Checklist, we now identify requirements for an interaction model that may better serve children's information seeking needs. We propose the following six requirements referred to throughout as R1 through R6:

- R1:** Assistance with Query Construction
- R2:** Identification of Related Search & Query Reconstructions
- R3:** Assistance with Mistaken Repetitious Visiting of Websites
- R4:** Identification of Provenance of Information
- R5:** Alignment with Information Seeking Practices
- R6:** Appropriate Technology Environment

R1: Assistance with Query Construction

Interfaces should assist with the creation of natural language queries. This requirement is evidenced by our answers to AC\_M1, AC\_M2, AC\_M3, and AC\_M4 in Section 9.1.2.

R2: Identification of Related Search and Query Reconstructions

Interfaces should help with the reformulation of queries through the improved identification of related searches and their relevance to a search. Evidence for the need for this requirement is found in our answers to AC\_M1, AC\_M2, AC\_M3, and AC\_M4 in Section 9.1.2.

R3: Assistance with Mistaken Repetitious Visiting of Websites

Interfaces should assist with the clear identification of websites that have already been visited. This is shown by the answers to questions AC\_M1, AC\_M2, AC\_M3, and AC\_M4 in Section 9.1.2.

R4: Identification of Provenance of Information

Internet search engine interfaces for children should assist with the clear identification of content that is advertising or indeed remove advertising content. Linking of pull-boxes or sidebars to their links should be clearly identified when used. Answers to AC\_M4 in Section 9.1.2 support this requirement.

R5: Align with Information Seeking Practices

Interfaces for children should encompass features and functions that align to reported information seeking practices, particularly inquiry-based learning frameworks. Features that allow the user to explore their problem, use questioning techniques, and search planning should be at the fore of the tool. This requirement is evidenced by our answers to AC\_L1, AC\_L2, and AC\_L3 in Section 9.1.2.

R6: Appropriate Technology Environment

Interfaces for children should be Internet accessible systems for desktop computers. Standalone systems such as digital libraries and offline databases have not featured in our findings and thus our recommendation for online systems. Answers to AC\_E1, AC\_D1, AC\_D2, and AC\_E1 in Section 9.1.2 support this requirement.

### 9.3. Conceptual Design

We propose an interaction model for children’s information seeking. We visualise the concept in a wireframe of a search engine search page in Figure 9.2, and a search engine search results list in Figure 9.3. We discuss the requirements and visualizations of our interaction model for children’s information seeking in this section, while development of the proof-of-concept prototype interface is discussed in Section 9.4.

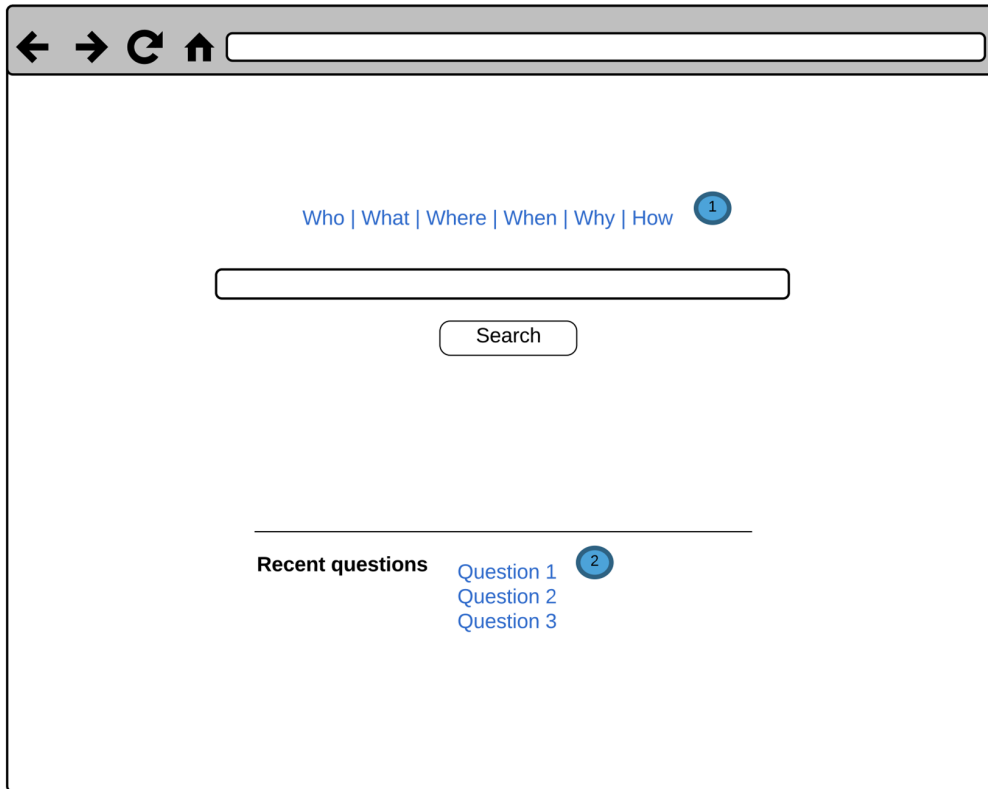


Figure 9.2 Interaction Model of a Search Engine Search Page

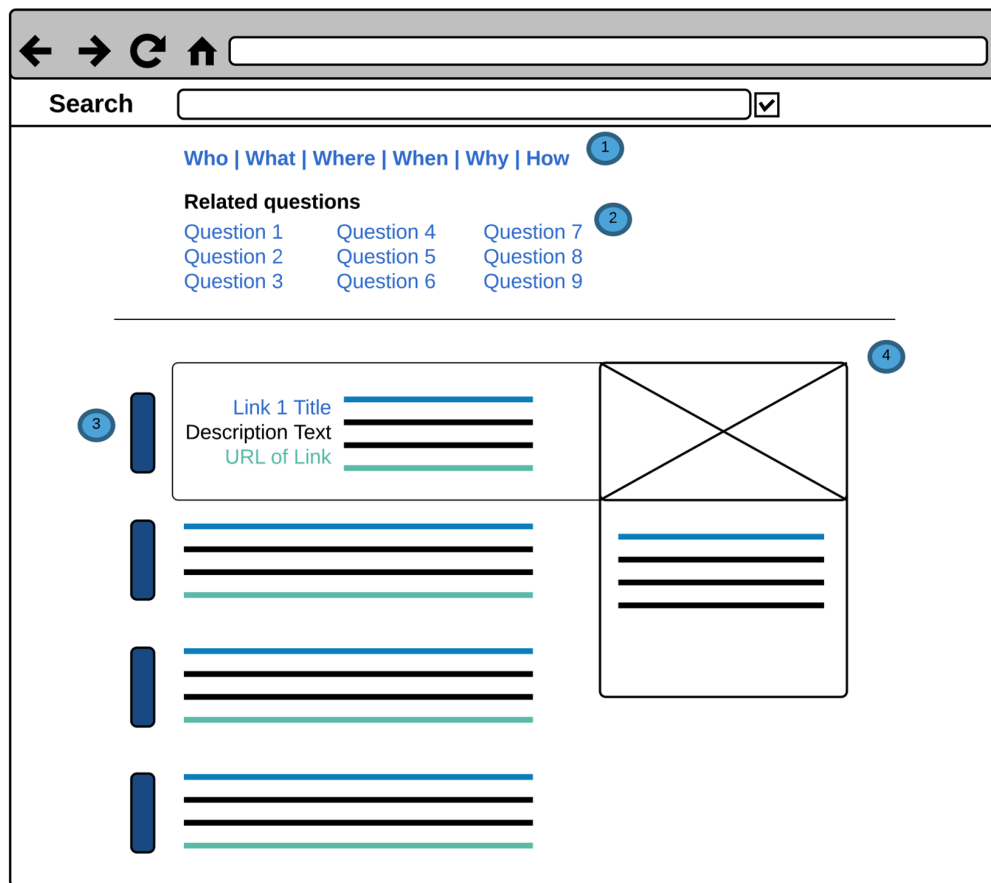


Figure 9.3 Interaction Model of a Search Engine Results Page

#### R1: Assistance with Query Construction

To assist with query creation, we propose three tools for the user that are designed to encourage the use of natural language queries. Specifically, the findings of our previous chapters have suggested that natural language *question* queries will benefit the young user, and therefore this query construction technique should be promoted and supported. The three devices that we have implemented in our interaction model include *question starter ideas* (see 1 in Figure 9.2 and 1 in Figure 9.3) of “what, where, when, why, how.” These question starters are tools that are commonly introduced in early literacy education. Secondly, a set of *recently asked questions* (see 2 in Figure 9.2) is supplied on the search page to inspire the user to consider constructing a query as a question. Additionally, the *related searches* (see 2 in Figure 9.3) commonly found in search engine results pages would be implemented as questions rather than keywords or short query strings.

## R2: Identification of Related Search and Query Reconstructions

To facilitate children's ability to locate the related searches we propose the implementation of these with high visual priority at the top of the SERP so that they do not require scrolling to locate (see 2 in Figure 9.3). These related searches should also be natural language queries, and should promote use of question-based queries. Query expansion features common to search engines as a part of the search box would be retained in an effective interaction model. Additionally, the *recently asked questions* device on the search page (see 2 in Figure 9.2) may also inspire the user to consider how to conduct their initial query as a question.

## R3: Assistance with Mistaken Repetitious Visiting of Websites

To address improving the visual cues associated with representing visited websites, we propose a simple visual switch (see 3 in Figure 9.3) placed beside each result link. These switches would have an *unvisited* state and a *visited* state, which would be more graphic than the text colour change used by most search engines to indicate visited and unvisited websites.

## R4: Identification of Provenance of Information

We propose resolving the disconnection between the information in the sidebar and the link from which it is scraped from through visual design mechanisms which aim to align and highlight the content link (see 4 in Figure 9.3) and we will not include any sponsored or advertising links in our interface prototype.

## R5: Align with Information Seeking Practices

Previously in this section, we described the query construction assistance features that explicitly encourage users to create question-based queries. Identifying one's question is a fundamental part of many of the information seeking frameworks taught in NZ. The inclusion of question starters (see 1 in Figure 9.2 and 1 in Figure 9.3) and recently asked questions (see 2 in Figure 9.2) features may serve two purposes; 1) alleviating the difficulty for a child to move from a question they have developed to a new way of searching for that question using keywords and topic words, and 2) ensuring children are developing questions and identifying their information need as opposed to simply searching without a clearly defined goal or question in mind.

Throughout the interface, we propose repeating the use of the words "question" or "questions" to assist with reinforcing the use of question-based search queries. The starter text in the search box should explicitly direct the user to "Ask your question."

Additionally, rephrasing text such as “Searches related to ...” to “You could ask a question about:” in order to reinforce the use of natural language question queries would be beneficial according to our interaction model.

#### R6: Appropriate Technology Environment

We will focus our implementation on an interface prototype for an internet search engine. To limit variables for the research study we will implement and test the interface on desktop computers and web browsers, however, there are no reasons why our implementation would not work on a tablet or smaller screen mobile device.

### **9.4. Proof-of-concept: Interface Prototype**

In order to evaluate our interaction model for children’s information seeking we have developed the KidsQuestions prototype that implements our interaction model.

Many researchers (e.g., Beheshti, Bilal, Druin, & Large, 2010; Gossen, 2013; Reuter & Druin, 2004) have developed child-specific search engines to address similar issues to those that we address in this thesis. Children’s search engines have not been found to be used by the children or teachers that we have worked with and therefore, we have chosen to develop an enhanced version of the Google search engine, rather than a child-specific search engine. We chose Google as opposed to Bing or Yahoo! to enhance because this was the search engine discussed in Chapters 5 and 6 by most children and teachers in our studies. It would be equally possible to implement the features of our interaction model that we explored in this search engine enhancement using either Bing or Yahoo! or, in fact, any other internet search engine. For these reasons, many design cues were taken from the Google search engine. Google’s typographic choices such as typeface, type size, type colour as well as user interface features of buttons, button sizes, button colours and button placement were used to guide our interface design. The two core pages of a search engine are the search page and the search engine results page (SERP). For reference, we show the search page and the results page in Google and KidsQuestions side-by-side in Figure 9.4 and Figure 9.5 respectively.

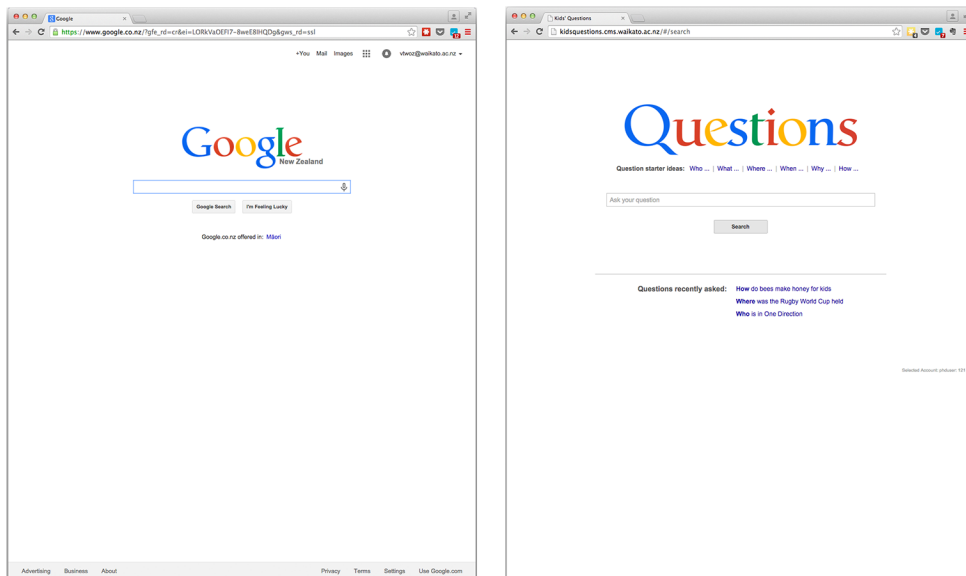


Figure 9.4 Comparison of the Google and KidsQuestions Search Pages. Google and the Google logo are registered trademarks of Google Inc., used with permission.

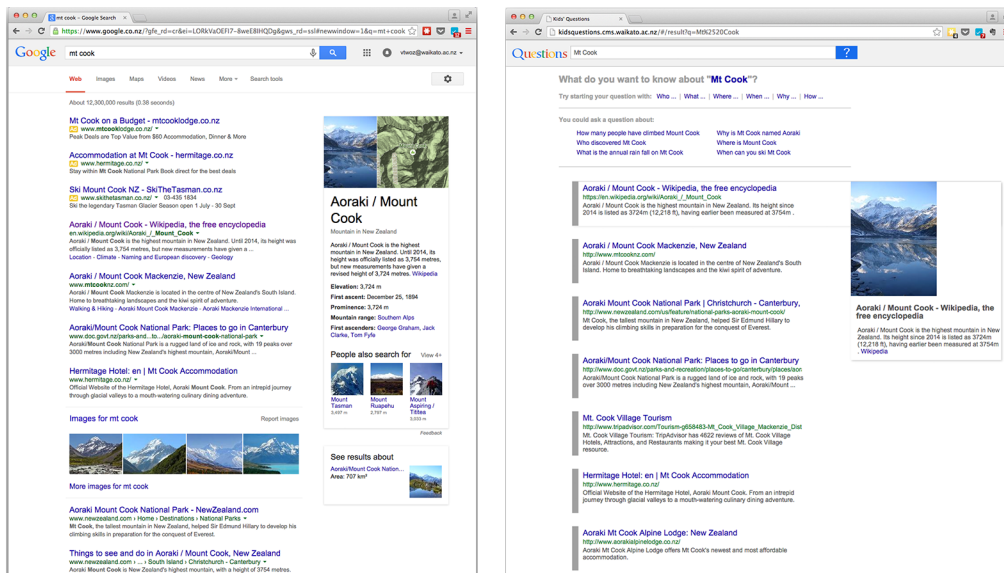


Figure 9.5 Comparison of the Google and KidsQuestions search interface Results Pages. Google and the Google logo are registered trademarks of Google Inc., used with permission.

We have focused our design on an interface prototype for a desktop computer. We expect that the features of our conceptual design would be equally suitable for small screen devices with some need for visual design consideration at deployment on mobile devices.

### 9.4.1. KidsQuestions Search Page

Here we discuss the visual design decisions for the Search Page of the KidsQuestions interface (see Figure 9.6). This is the first page users will see when they interact with the search engine.

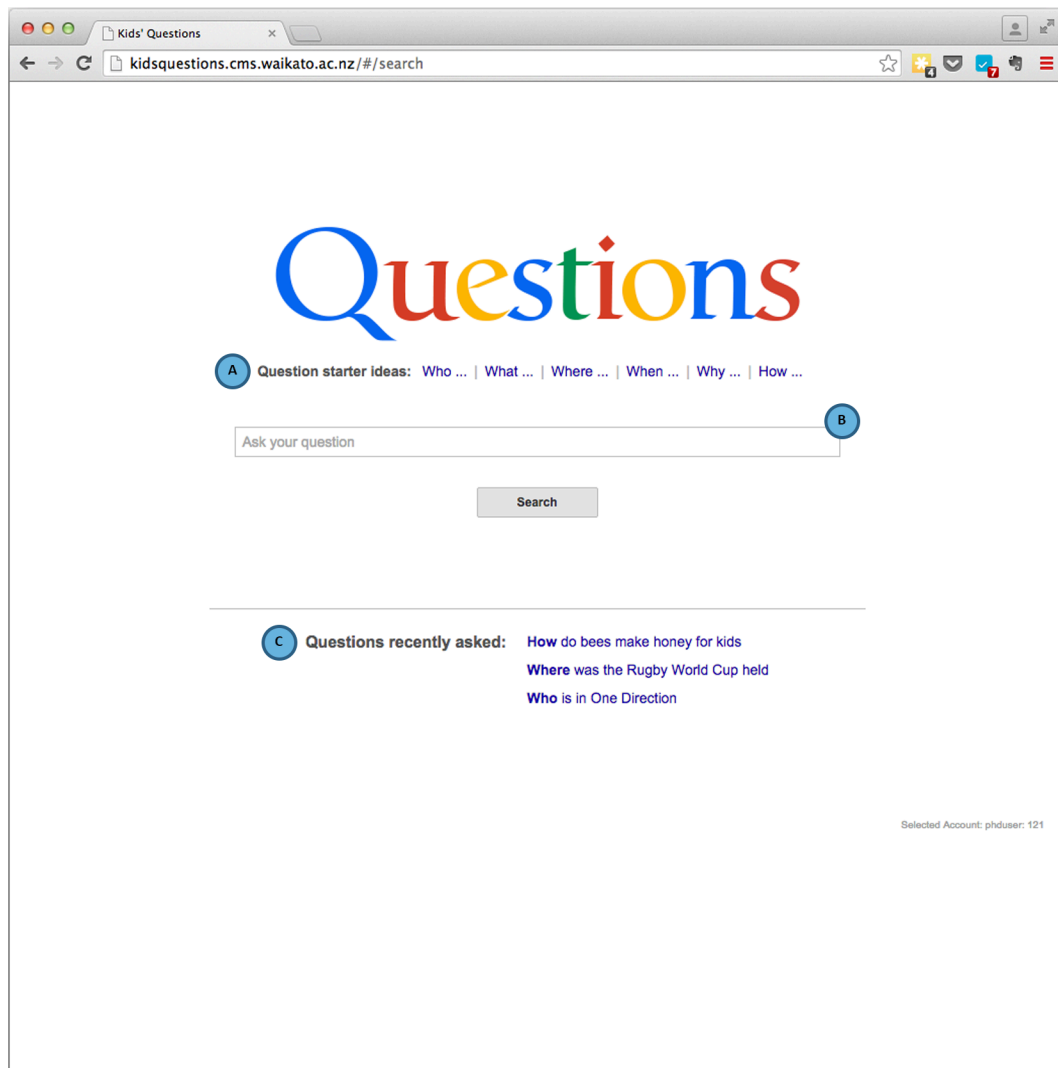


Figure 9.6 KidsQuestions search page

To ensure, we do not mislead test participants we have used the logotype *Questions* in place of the *Google* logotype. Our intention is to test enhancements to an existing search engine rather than propose a child-specific search engine, and as we are not affiliated with any search engine manufacturers, we altered the branding to ensure clear differentiation between our interface prototype and the Google search engine. With our intention to test enhancements in mind, we expressly acknowledge no ownership of the design cues that have intentionally been developed to appear visually similar to the Google aesthetic.

During the design of KidsQuestions, we have considered the size and placement of elements that require clicking with a mouse. We do this to ensure clickability of interactive elements by children who at younger age groups are known to have less dexterity than adults. We placed the search button in a similar location to the Google interface, however, we have made the button larger than the search button used by

Google. Throughout the interface text and text links are also made approximately 1 to 2 point sizes larger than text employed by Google to ensure readability by young readers.

The Question Starters Ideas, the concepts of which we discussed in Section 9.2, are placed directly below the Questions logo (see A in Figure 9.6). They are set in blue to indicate that they are interactive. The question starters are prefaced with the text “Question starter ideas:”. When a user clicks, one of these question starters the word clicked is placed as the first word in the search box. If there is already a question starter word as the first word in the search box, then this is replaced by the new question starter. If no question starter is present, but a text string is already in place, the new starter word is placed before the existing text string. Finally, if the search box is empty, then the question starter is placed within the search box. Focus is given to the search box when a question starter is clicked.

The search box (see B in Figure 9.6) is similar in location and size to the Google search box with the addition of the text “Ask your question.” As with Google, we have implemented a drop down query expansion service. However, differing from Google, we do not implement an auto search feature. We hold firing the query until the user has completed typing their query or has explicitly chosen their query from the expansion list and has manually clicked the search button or has hit the enter button on the keyboard. We do this to ensure that the user is in full control of their search and is aware of what they are searching for. We implement this with the hypothesis that this will slow down children when searching and ensure a more mindful process by the child.

The Recently Asked Questions (see C in Figure 9.6) that we discuss in Section 9.2 are placed below the search box and search button. These are set in blue as per the other clickable text within the interface, and the question word is bolded to reinforce the use of these words within queries typed by the user. When a user clicks one of these recently asked questions, the string is placed into the search box and awaits the user to edit the string or to fire the search. If the text is already present within the search box, the text string of the recently asked question that is clicked replaces this. Three questions are drawn from a database to present to the user each time this page is loaded.

### 9.4.2. KidsQuestions search interface Results Page

Here we discuss the decisions made during the visual design of the search engine results page (SERP) of the KidsQuestions search interface (see Figure 9.7). This is the page users are presented with after the user has fired a search.

As with text on the KidsQuestions Search Page, text and text links on the KidsQuestions SERP are also made larger than text used by Google. The text used for titles, URLs and descriptions for each result list entry are approximately 1 to 2 point sizes larger than that employed by Google at the time of this interface design. While leading is similar to that used by Google the space between result list entries is larger for the KidsQuestions search interface simply because of the increase visual space created by the implementation of the Triage Toggles.

We move the search bar to the top of the screen in a very similar nature to that implemented by Google. We use a question mark as the icon for the search button on this screen as opposed to a magnifying glass used by Google. We do this to reinforce the idea of asking a question.

Below the search bar, we placed an instructional block designed to assist with reformulating search queries (see A in Figure 9.7). This block contains a reminder of the search constructed by the user with the question ‘What do you want to know about “search query string”?’ and is coupled with the question starter ideas device. The question starter ideas device functions in exactly the same way as it does on the Search Page but uses a slightly different text instruction “Try starting your question with:”

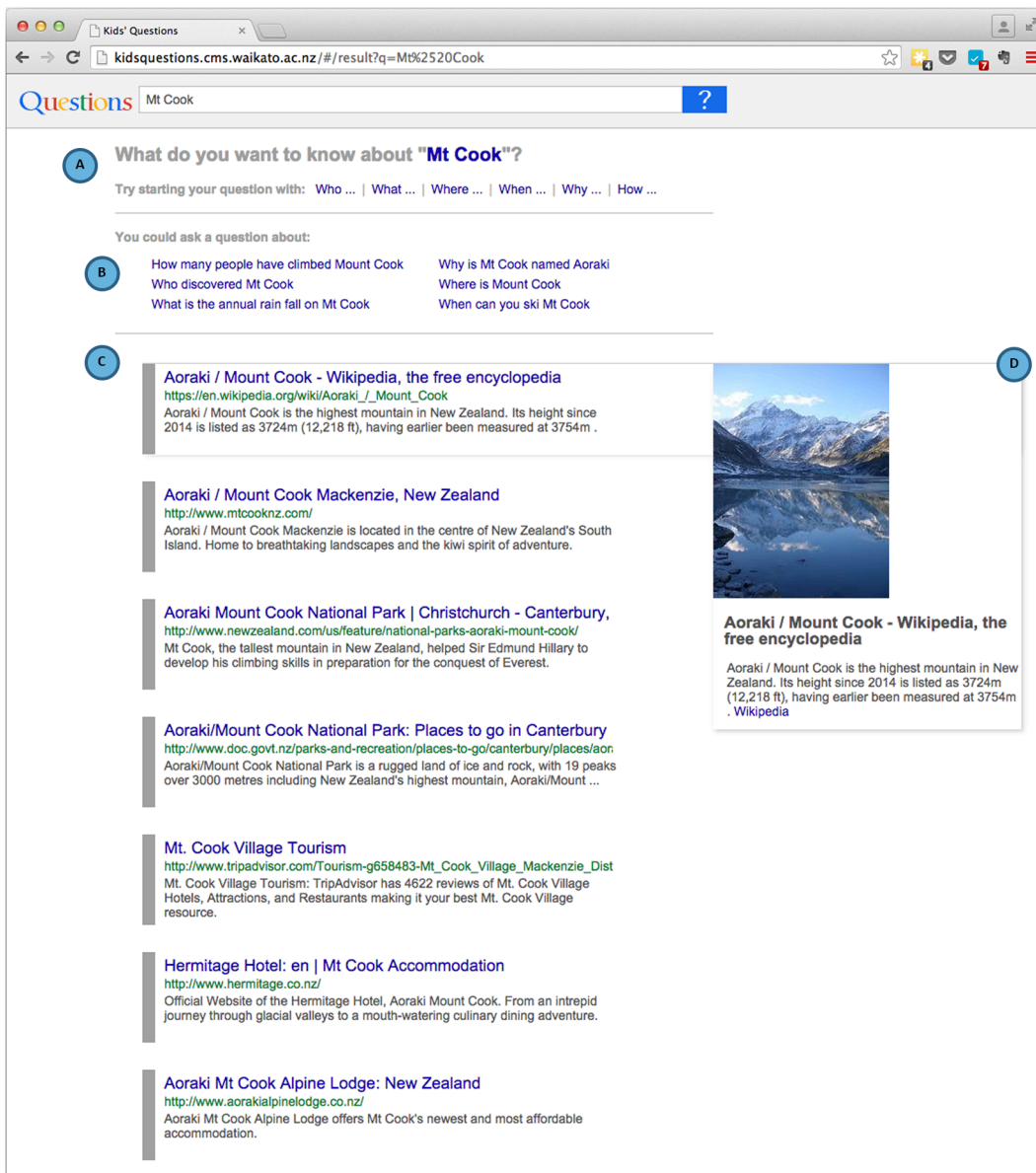


Figure 9.7 KidsQuestions search interface results page

Below the instructional block we present the related searches block (see B in Figure 9.7). We instruct the user how to use these devices with the instruction: “You could ask a question about:” These related questions are blue to indicate that they are clickable. As per the Recently Asked Questions found on the Search Page when one of these Related Questions is clicked the entire string is placed in the search box and the search box is given focus. This string replaces any text in the search box. The search is not fired until the user clicks enter on the keyboard or uses the question mark search button. We restrict the number of related questions to six simply to ensure that this content block does not push search results too far down the screen on small screen devices such as mobile tablets or small laptops. If the search engine is unable to return a list of related questions, this block is not displayed by the search engine as seen in Figure 9.9.

The entry list toggles that we discuss in Section 9.2 are implemented as small vertical bars placed to the left-hand side of each result list entry (see C in Figure 9.7). Care was taken to develop a visual device that was large enough to be clickable, yet far enough away from the text to ensure no visual distraction when reading the link entry. In developing this device, it occurred to us that we could add additional value to this device. To encourage triage and pre-evaluation of websites to visit we have implemented a *to-visit* state (yellow) and to assist with remembering websites that contained information that was useful to the user we have also implemented a *remember* state (blue with the text “remember”). These four states can be seen in Figure 9.8.

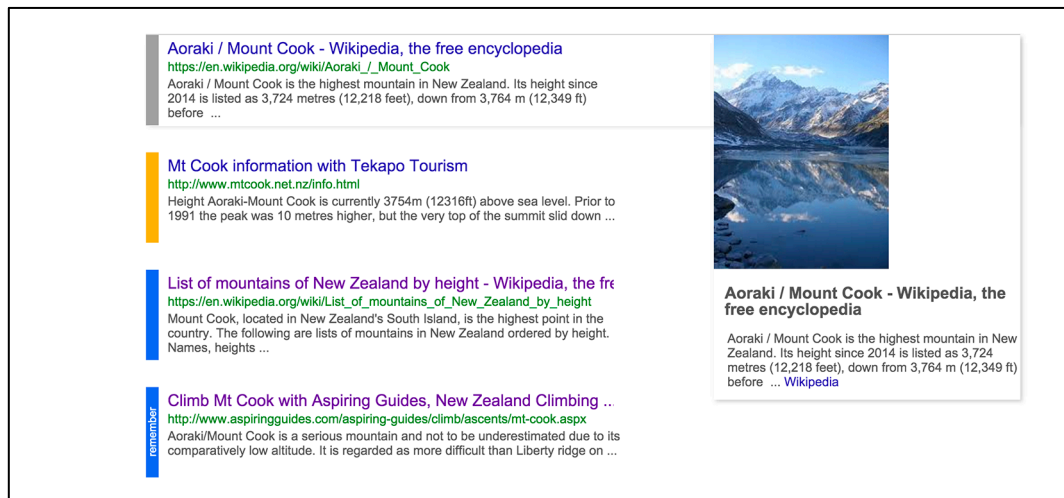


Figure 9.8 KidsQuestions triage Toggle Switches

While we have not implemented sidebar and pull bar content in our prototype in exactly the way that it is used by Google, we have implemented a sidebar which attempts to complete a small part of the service that Google’s’ sidebars and pull-boxes complete. An informational sidebar is created using content scraped from Wikipedia when the first entry in the SERP list is a Wikipedia entry (see D in Figure 9.7). The sidebar is populated with one to two images when extractable from the Wikipedia entry. The sidebar presents and formats the title, and the first paragraph of the Wikipedia entry. Creating a clear union of sidebar and entry in the SERP list for the site where information is scraped from was a central goal of the design of this device and thus the bordering of the SERP entry and the sidebar. If the search engine is unable to return a sidebar, this block is not displayed by the search engine as seen in Figure 9.9.

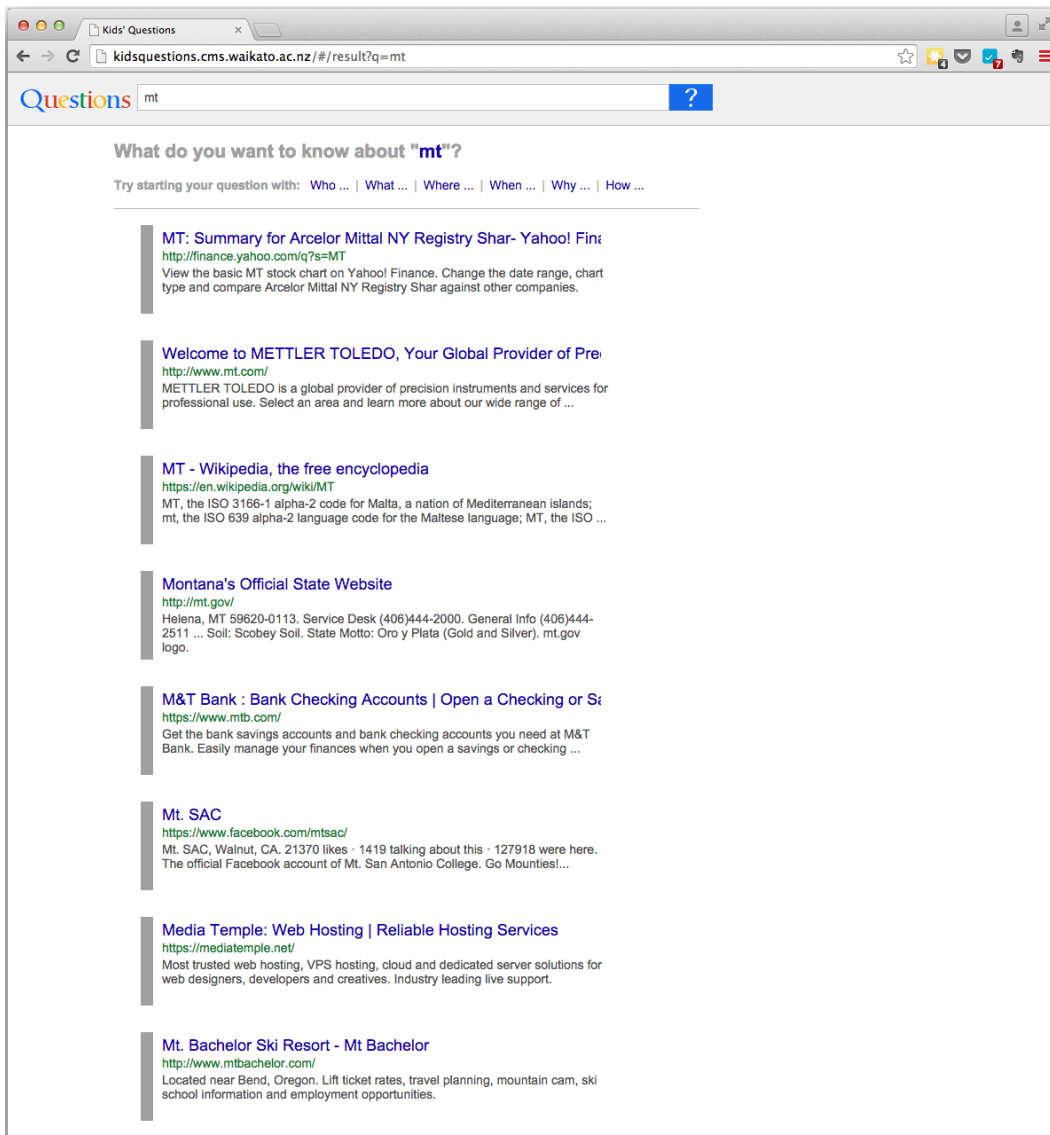


Figure 9.9 KidsQuestions search results page with no sidebar & no related questions

We have removed all advertisements from our prototype to ensure unhindered results list review. Various search engines do an adequate job clarifying the difference between sponsored and non-sponsored advertisements, and there is a myriad of design considerations that may aid in clear differentiation for children. However, we have taken the stance that sponsored content is something that we would prefer not to include in an interface targeted at children, and thus it has been excluded from our prototype and the present study.

## 9.5. Implementation Details

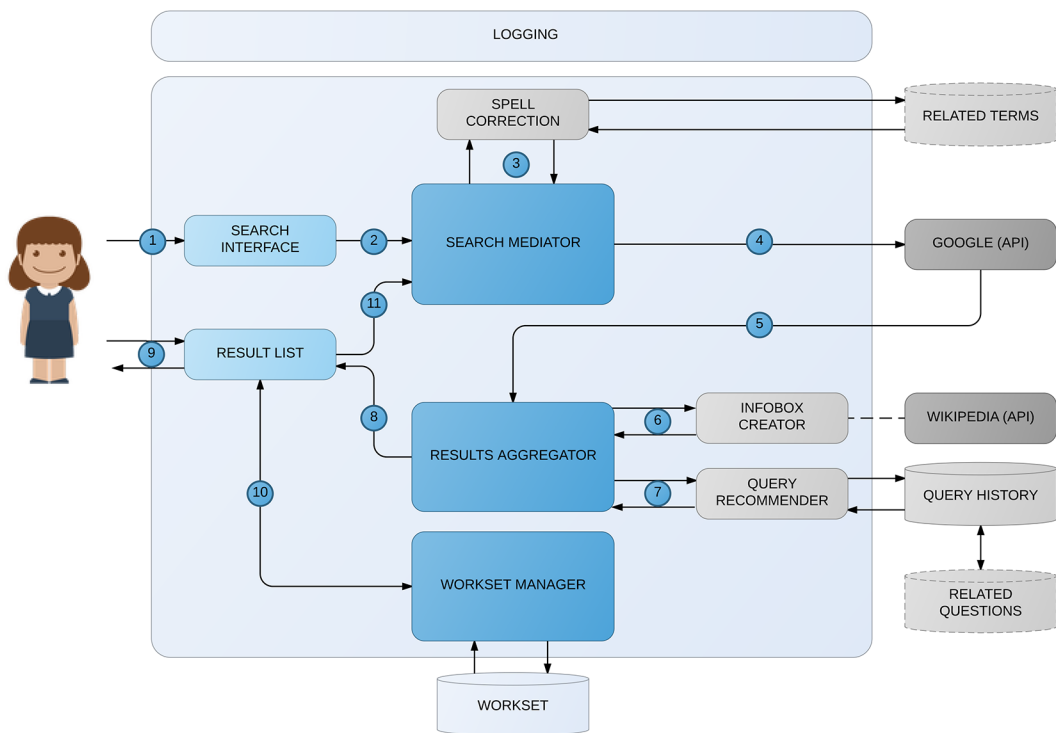
We illustrate the software architecture of KidsQuestions (shown in Figure 9.10) by describing the flow of information and the processes required to undertake a basic use case scenario.

### 9.5.1. Use Case Scenario

A young user working on an Internet-connected device at school or at home considers their information need. They open the search page of the KidsQuestions search interface in their browser of choice. The child would then enter a new search query based on their own evaluation of their need. Alternatively, the child might choose to use one of the *Question Starters* or *Previously Asked Questions* provided by KidsQuestions to assist with their query formation. Once the user executes the query, the search results page is displayed to the user. The user would then undertake one of the following three options:

- Option A:** reformulate query by hand or using the related questions feature,
- Option B:** plan search and triage the result list using the Toggle Switches,
- Option C:** visit a link without adjusting a toggle switch.

This use case scenario is discussed in more detail through a step-by-step walk through in Section 9.5.2 describing these options in some detail.



**Figure 9.10 KidsQuestions architecture and Data Flow. Interface pages = light blue. Software Components = dark blue. Simulated Components = light grey. External processes handled by an API = dark grey.**

### 9.5.2. Architecture and Walk-through

Here we describe the architecture of KidsQuestions using a step-by-step walk through of the system components shown in Figure 9.10. The numerical labels refer to the data flow between software components.

**Step 1:** The user enters a search query into the Search Interface of KidsQuestions, the dataflow labelled (1) in Figure 9.10. The search is conducted by the system only after the user explicitly sends off the query using the search button. This manual sending off of the search query (instead of automatic search) ensures that a user has completed considering the search query that they wish to use and that any editing of this query has finished before the search is run.

**Step 2:** The query is sent to the *Search Mediator* component as a text string. At current, the Search Mediator only triggers spelling correction, labelled (3) in Figure 9.10. This component was included to allow for future processes such as query expansion.

**Step 3:** The query string is sent to the *Spell Correction* component. Spelling correction is simulated in our prototype: we have implemented a workaround in the form of a database of related terms, which assesses miss-spelled words against a list of recognised alternatives, and spelling errors are corrected automatically. This is done in order to ensure that spelling issues do not hinder the user. In a deployable software, this spelling correction would be fully implemented to provide miss-spelling notification to the user as well as spell correction options. The spell correction component sends the corrected query string back to the Search Mediator.

**Step 4:** The Search Mediator submits the corrected query string to the Google API. The Google API is the interface to the Google Custom Search Engine, which processes the query and then passes the search results to the *Results Aggregator* labelled (5) in Figure 9.10. The Google API also passes the query string to the Results Aggregator.

**Step 5:** The search results along with the query string are sent to the Results Aggregator as a JSON object. The Results Aggregator initiates two components, the *InfoBox Creator*, labelled (6), and the *Query Recommender*, labelled (7) in Figure 9.10.

**Step 6:** The Results Aggregator passes the JSON object to the InfoBox Creator component. The InfoBox Creator assesses if the first entry in the JSON object is a Wikipedia page. If so, the sidebar (see Figure 9.7) content is retrieved from the JSON object. For the purposes of our interface prototype, we have simulated the sidebar content creation by providing the “snippet” text and the thumbnail provided by the “thumbnailUrl” found within the JSON object to the Results Aggregator. In a deployable software, the sidebar content would instead be scraped from Wikipedia using the Wikipedia API. The Wikipedia API would return appropriately filtered content from Wikipedia, the Wikipedia page title and

one or two images to the InfoBox Creator. This content would then be provided to the Results Aggregator where the sidebar is created.

If the first entry is not a Wikipedia result the sidebar is not generated for display to the user (see Figure 9.9).

**Step 7:** The Results Aggregator sends the query string text to the Query Recommender, labelled (7) in Figure 9.10. In a fully deployable software, this component would search the *Query History* database that would contain both a library of historic queries as well as appropriately populated related queries. The Query Recommender would assess if the user's query matches an entry in the Query History database. If the query string matches an entry, the list of related queries would be returned to the Query Recommender.

For the purposes of our interface prototype and to ensure a consistent experiment control for our observation studies we have implemented a database of predefined *Related Questions*. Therefore our simulation of the Query History component results instead in the Query Recommender retrieving the list of Related Questions from a series of text files using a list of Regular Expressions to match user queries against. If a regular expression match is made using the Related Questions database the six related questions that apply are pulled from these text files and returned to the Query Recommender (see Figure 9.7). The query recommender sends the appropriate queries and the order to present the queries to the Results Aggregator.

If there are no appropriate Related Questions to show the system simply displays the Question Starter prompts (see Figure 9.9).

**Step 8:** The Results Aggregator generates the HTML code required for the web page based on Steps 5, 6, and 7, and creates the *Results List*. The Results List uses CSS and JavaScript to style the HTML for this completed SERP. The generated web page is displayed to the user within the web browser, labelled (9) in Figure 9.10.

**Step 9:** The user can now see the SERP in their web browser. They are now able to engage with the SERP in three ways: Option A, they can reformulate their search query by hand or using the related questions feature; Option B, they can plan their search and triage the result list using the Toggle Switches; Option C, they can visit a link without adjusting a toggle switch.

The user may conduct Option A by adjusting their search query manually by entering a new or altered query into the search box, or they may select a query from the list of Related Questions (see Figure 9.7). Should an adjusted query be fired by the user, the Search Mediator is re-engaged, labelled (11) in Figure 9.10, and the loop repeats as above.

If the user begins interacting with the Results List by manipulating a Toggle Switch (Option B), or by visiting a website (Option C) the *Work Set Manager*, labelled (10) in Figure 9.10, is passed variables that record the state of the Toggle Switches (see Figure 9.7) that have been manipulated.

**Step 10:** The Work Set Manager is implemented to store the states of the Toggle Switches during a user session. These states include *unvisited*, *visited*, *tovisit*, and *remembered*. Work set information is also stored in the database labelled *Work Set* for logging purposes for the study reported in Chapter 10.

**Step 11:** Should an adjusted query be fired by the user (Option A), the Search Mediator is sent the query string and the loop repeats as above.

### 9.5.3. Network Implementation

A client-facing webserver (not shown in Figure 9.10) handles all static HTML content for KidsQuestions. Standard institutionally implemented authentication and authorization security layers reside between the client and this webserver.

Behind this is an Apache Tomcat instance, which is "an open source software implementation of the Java Servlet, Java Server Pages, Java Expression Language and Java Web Socket technologies" (The Apache Software Foundation, 2015). Most of the processing of our software is executed in this Tomcat instance.

### 9.5.4. Logging

For our user studies reported in Chapter 10, three basic user statistics were logged: a database logs all submitted user queries, the website links a user selects (including the page and position on the page of the link) and when a Toggle Switch (see Figure 9.7) is activated or deactivated. This logging component is handled separately from the KidsQuestions system because it is not integral to the prototype as it is implemented to aid data gathering.

## 9.6. Expert Review

Prior to a user study with children (reported in Chapter 10), we conducted an informal usability, experience, and visual communication review of the KidsQuestions search interface with five experts. The five experts were familiar with the conceptual design and usability design of digital interfaces for varied target markets. The goal of the expert review was to gain the first indication of any usability issues with the KidsQuestions search interface.

The expert review was conducted as a heuristic evaluation and brief cognitive walkthrough of typical usage scenarios for the KidsQuestions search interface. Each expert was informally invited to spend 10 minutes with the researcher to individually review the interface. During each review, the experts were first invited to use the system while observed by the researcher, next the researcher introduced the expert to any features they may not have interacted with, and finally, the researcher invited discussion of issues perceived by the experts. The experts tended to use a talk aloud protocol and answered the open questions of the researcher during the observations and after the utilization of the tool. As this was an informal invitation to offer insight, no recording of observations was made.

The review revealed a small number of visual and aesthetic improvements, but no design flaws in the behaviour of the KidsQuestions search interface. These improvements were addressed before the interface was introduced to children. The experts were generally positive about the visual design and the usability of the search engine and the enhancements proposed.

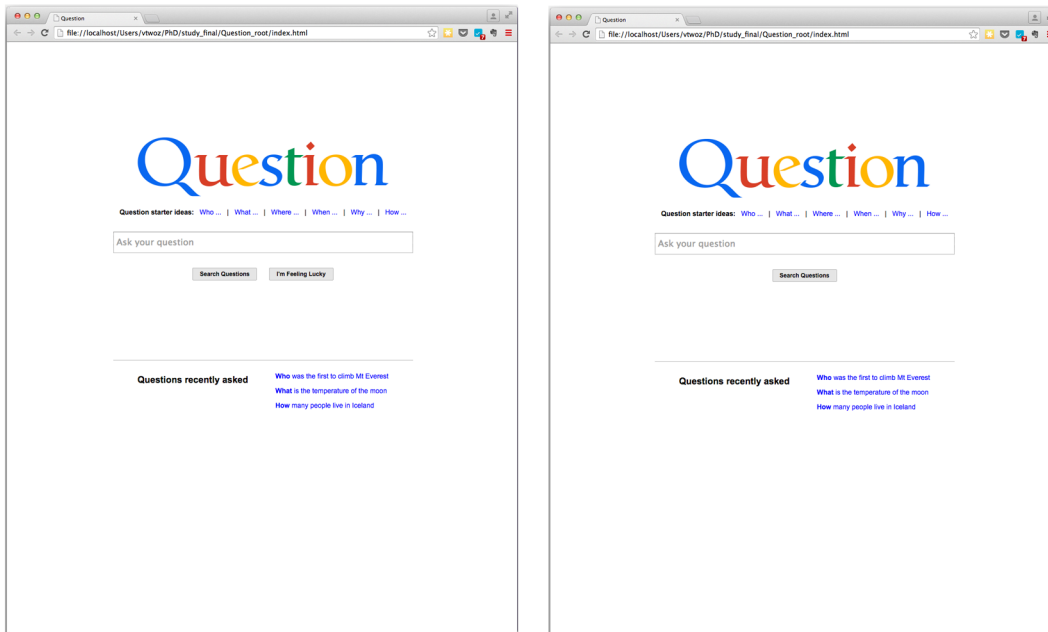
The few issues noted by the reviewers were in summary:

- "I'm Feeling Lucky" button should be removed
- Question Starter ideas should appear above the search box
- Ellipses should be added to the Questions Starters
- Related Searches should be natural language question queries not keyword queries

In response to these issues, the following changes were made to the KidsQuestions search interface prior to the usability study described in Chapter 10.

The "I'm Feeling Lucky" button was considered counter to the goals of this research as it did not encourage the use of Questions, did not facilitate the opportunity for query or

topic expansion, nor did it encourage search results list triage and decision making. Additionally, we did not see this button used by subjects in our study described in Chapter 5. Therefore, this button was removed from the interface and the search button made bigger and centred below the search box. See Figure 9.11 to review the design changes implemented with this expert review in mind.



**Figure 9.11** Removed "I'm Feeling Lucky" before (left) and after (right) expert review.

The placement of the question starter ideas was questioned by a couple of the experts. It was considered that these could work either above or below the search box. We have considered both presentations and have moved the question starter ideas above the search box improving the eye flow of the page and encouraging consideration of these question starters before a query was entered (see Figure 9.12).

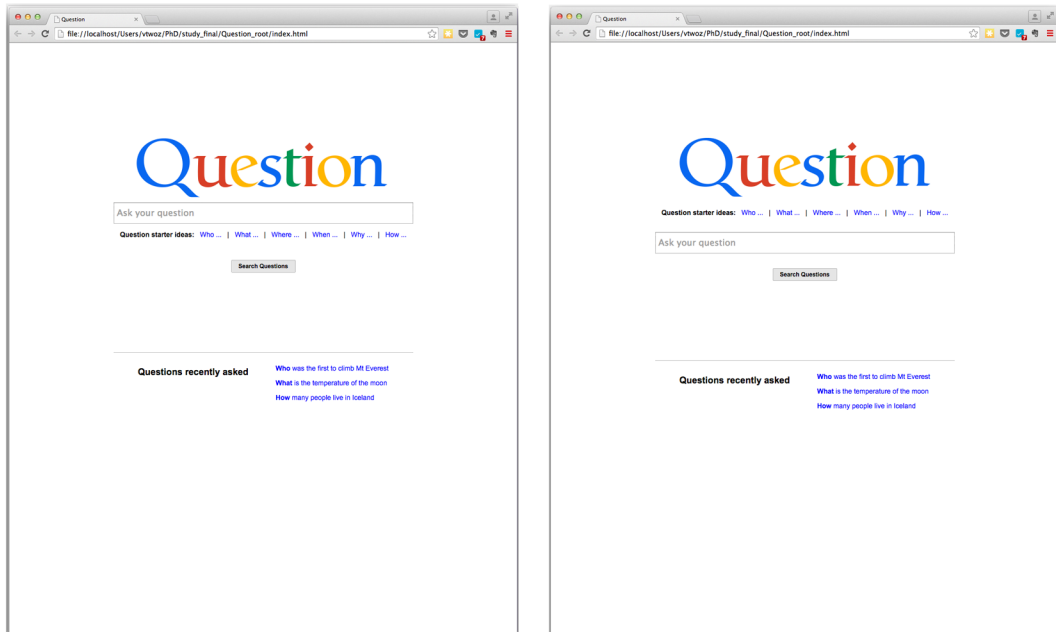


Figure 9.12 Question starter ideas before (left) and after (right) expert review

One expert noted that the use of ellipses might draw users to the Question Starters. This small suggestion was considered a positive improvement to the interface and ellipses were added to the Question Starters to indicate the requirement for additional information provided by the user as well as to draw attention to the clickability of these devices (see Figure 9.13).

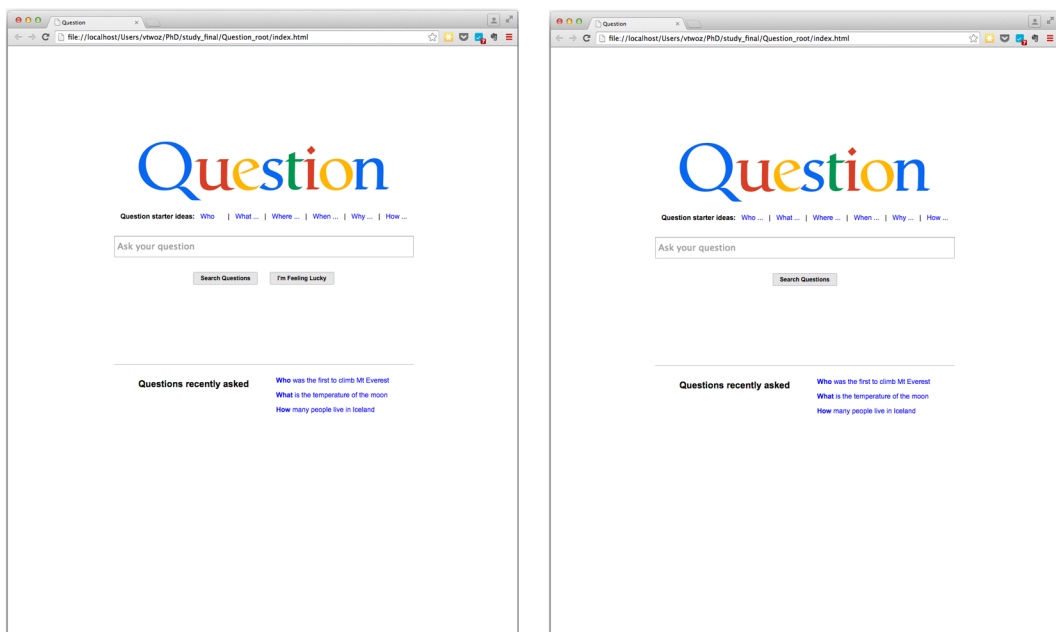


Figure 9.13 Question Starter ideas ellipses before (left) and after (right) expert review

Reviewers expressed that the inclusion of the Related Searches at the top of the results page was a positive design enhancement. However, the experts felt that the cognitive

load required to rephrase a keyword query into a natural language query would be difficult. It was felt that the likelihood would be that a user would click the Related Search, which would then appear in the search box, and the query would be fired by the user without manual user adjustment of the query from a keyword to a question. Therefore, we abandoned our initial use of the Bing API from which we were receiving and including the related-search entries and instead implemented the manual Question-based related-searches described in Section 9.5. See Figure 9.14 to review the design changes implemented with this expert review in mind.

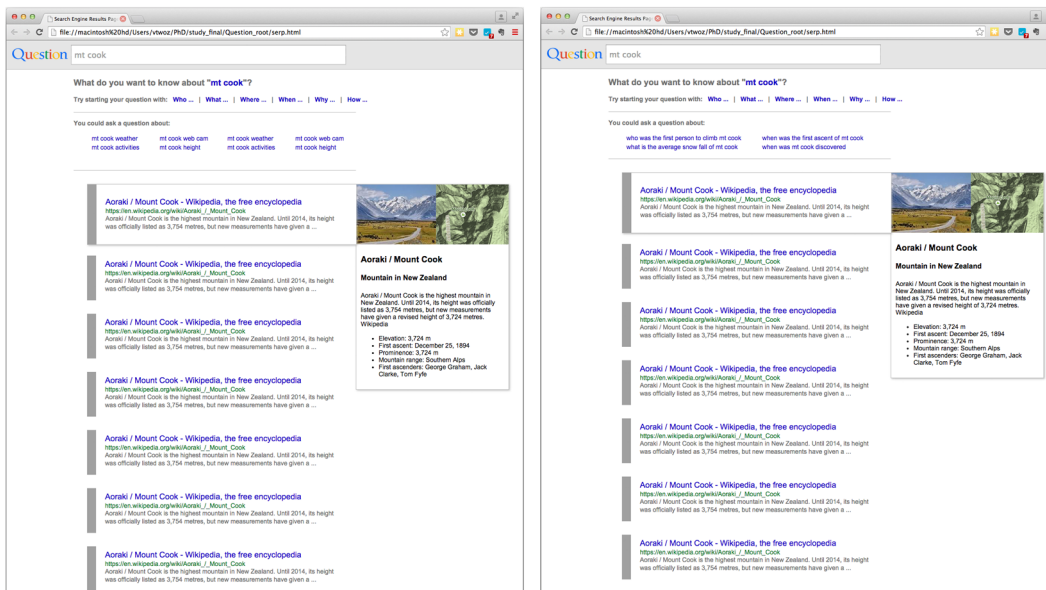


Figure 9.14 Related searches implementation before (left) and after (right) expert review

## 9.7. Chapter Summary

This chapter provided a requirements analysis for an internet search engine that can better assist children’s information search. Uniquely, this chapter reports an analysis using the Activity Checklist (Kaptelinin et al., 1999). Finally, this chapter details the conceptual design and implementation design for KidsQuestions a prototype information seeking interface that aims to assist children’s information search and use.

This chapter has further addressed Research Question 3 (see Section 1.2) and provided a requirements analysis for an interaction model for children’s information seeking. These requirements were used to design and develop an interaction design that has been implemented in the proof-of-concept interface prototype, KidsQuestions. The results of exploring use of KidsQuestions with children are discussed in Chapter 10.

## Chapter 10.

### KidsQuestions in the Field: A Usability Study

The previous chapter introduced our interaction model for children's information seeking. To evaluate the interaction model, we developed the KidsQuestions prototype that implements our interaction model. This chapter discusses our final study, which explores children using the KidsQuestions prototype.

This study aims to replicate the study described in Chapter 8, while using our interface prototype, KidsQuestions. For this reason, the method outlined in this chapter is very similar to that of Chapter 8. We aim to verify whether any of the issues we identified are resolved when children use KidsQuestions.

The chapter is structured as follows: Section 10.1 details the method developed for this study conducted in suburban schools in the Waikato region of New Zealand in mid-2015, while results of these observations are reported in Section 10.2. Finally, we discuss and conclude the findings of this chapter (Sections 10.3 to 10.5).

This chapter answers our final Research Question (see Section 1.2): *does the interface prototype introduced in this thesis assist with children's digital information seeking?*

#### 10.1. Study Method

A series of structured naturalistic observation studies were conducted in the third school term of 2015; they explored how children perform a search task for digital information using an internet search engine. The method described here mimics the method for our related observation study described in Chapter 8. The observations were conducted at

three schools using the school computers and web browsers that the children were familiar with.

Observations were carried out in library or classroom environments while teachers, librarians, and classes shared the spaces. Basic demographic information was gathered with a short pre-study interview at the beginning of each observation, and a post-study interview was also conducted. The observation study consisted of a set of five search tasks administered by the researcher (see Section 10.1.2). These tasks replicate those used in the related observation study reported in Chapter 8.

The observations involved three distinct phases, pre-observation survey (see Section 10.1.1), task-based user observations (Section 10.1.2), and post-observation interviews (Section 10.1.3).

Observation and interview sessions typically took between 30 and 45 minutes. On average, the younger children spent longer with the researcher than the older children as they generally took longer answering interview questions and conducting searches. These observation studies took place in the third school terms of 2015.

The observations and interviews were video-recorded, and additional handwritten notes were taken in-situ. Video footage was captured over the shoulder of the participant so that the screen was visible to the camera, yet the participant was not identifiable. Head movements, mouse movements, text, entered onto the screen, and mouse click and location information were recorded. The researcher conducted post-observation coding as well as quantitative and qualitative analysis. A combination of video, audio, and field notes were used for the analysis reported in this chapter. Additionally, the research prototype captured some data entered by each participant as detailed in Section 9.5.4 of Chapter 9 and reported in 10.2 of this chapter.

Audio from the video recording was not always reliable or able to be accurately transcribed due to background noise. Interview answers were analysed based on a combination of audio that was transcribable as well as written field notes.

### **10.1.1. Phase 1 Pre-observation Survey**

Basic demographic information was gathered with a short pre-study survey at the beginning of each observation. We asked each child how old they are; and what year level at school they are. We noted their gender; and what school they attended.

During this pre-observation survey and before the tasks were introduced, the children were encouraged by the researcher to conduct themselves as they would have had a teacher set the topics of investigation for them during an ordinary school task.

An example of the researcher's field notes and script for the interviews that were used for demographic information collection and the post-observation survey is located Appendix E. These field notes sheets, contained the script for the interviews that were used for demographic information collection and post-observation interviews as well as for the administration of the tasks.

### 10.1.2. Phase 2 Task-based User Observation

The observation study consisted of a set of five search tasks (see Figure 8.1) administered by the researcher. Each child was asked to conduct the search tasks in order.

1	Do you have a favourite book or sport or musician? ... Right, can you please search for information about ...	<i>Open Task</i>
2	Where do possums live and are they a pest in New Zealand?	<i>Verbal Question</i>
3	Mount Cook is a mountain in the South Island of New Zealand, let's find out about Mount Cook.	<i>Verbal Instruction</i>
4	How many rings does Uranus have, and what are they made of?	<i>Written Question</i>
5	The Cricket World Cup will be held in New Zealand in 2015, find out about the Cricket World Cup.	<i>Written Instruction</i>

**Figure 10.1 Search tasks**

These tasks were developed to be educationally appropriate for children in these school year levels. We designed these tasks based the results of our interviews with teachers (see Section 6.2.1.1), our investigation of the NZ Curriculum (Ministry of Education, 2007), and informal expert review by a teacher who has experience working with senior primary school children as well as teacher education. Other than a single word change, these tasks are the exact tasks that were conducted for the study described in Chapter 8.

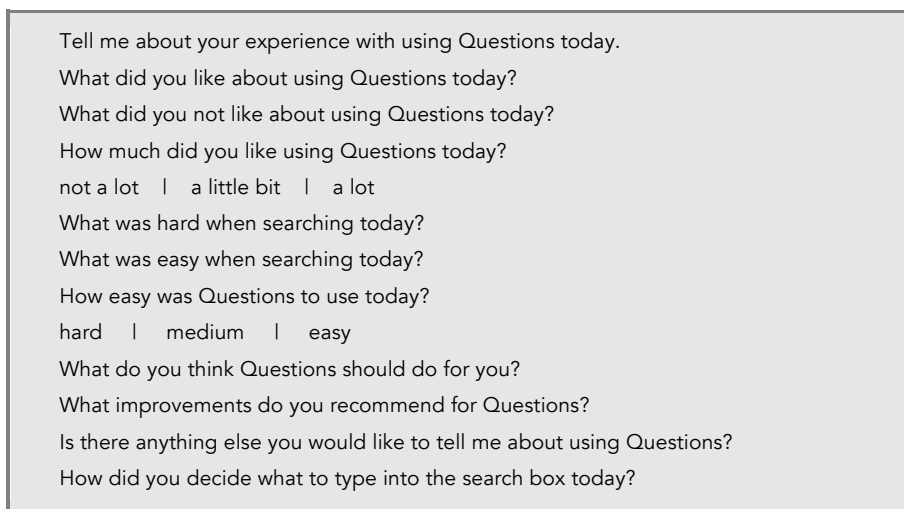
Different to the study reported in Chapter 8, we altered the wording of the two instruction tasks (Task 3 and Task 5) as follows: the words "find facts about" was reworded, and the words "find out about" were used. i.e. Where we had the instruction "Mount Cook is a mountain in the South Island of New Zealand, lets find *facts* about

Mount Cook.” as the instruction task for the study outlined in Chapter 8, in this chapter instead we use the instruction “Mount Cook is a mountain in the South Island of New Zealand, let's find *out* about Mount Cook.” We have made this change to ascertain if there is any influence in the use of the Query Qualifier “facts” by the use of the term “facts” in the instruction by the researcher or teacher. The phrase “find out about” is a colloquially acceptable term in NZ and is something easily understood by children. We do not consider this word change to be responsible for any change in the number of query types during this study.

Tasks 1, 2 and 3 were read aloud to the child with all instructions given verbally by the researcher. Tasks 4 and 5 were both given to the children as a printed hand-out. The tasks were completed using workstations provided by the school that the children were familiar with. Each school provided different workstations. However, all were desktop Apple OSX or Windows 7 computers running the Google Chrome web browser and the KidsQuestions search interface.

### 10.1.3. Phase 3 Post-observation Interviews

At the completion of the user observation phase, the researcher administered a short interview with 11 questions. Each child was asked each question in order.



Tell me about your experience with using Questions today.  
What did you like about using Questions today?  
What did you not like about using Questions today?  
How much did you like using Questions today?  
not a lot | a little bit | a lot  
What was hard when searching today?  
What was easy when searching today?  
How easy was Questions to use today?  
hard | medium | easy  
What do you think Questions should do for you?  
What improvements do you recommend for Questions?  
Is there anything else you would like to tell me about using Questions?  
How did you decide what to type into the search box today?

Figure 10.2 Post-observation interview

### 10.1.4. Participant Recruitment

Participants in our present study included boys and girls from two NZ primary schools and a single NZ intermediate school. These three schools were the same schools that participated in the studies described in Chapters 5, 6, and 8. As with our previous

interview study (see Chapter 5) and observation study with children (Chapter 8), our goal was to identify a sample of male and female children being taught by a range of teachers at more than one school within the given year levels of Year 5 to 8 (see Section 5.1.1 for discussion regarding targeting this age group).

Two primary school principals, and one intermediate school principal, in the Waikato School District, gave their permission to have their school take part. We refer to the schools as Schools A, B, and C, which are, rated as Decile 4, 5, and 9, respectively.

The children were invited by the principals of these three schools to gain parental permission to participate in this study. We specifically requested four boys and four girls from each of the year levels Y5, Y6, Y7, and Y8.

Each principal, or their delegate, identified 16 children (8 male, 8 female) from their school to participate in this study. Those children took home the participant information sheet found in Appendix E for their parents to consider their inclusion in this study. No children whose parents did not give consent participated in this study. Where possible if a child was not given permission to take part in the study an alternative child was selected, and their parental consent was sought. In total, 27 boys and 27 girls participated in this study.

Recruitment of candidates for this study was conducted by similar means to those conducted for interview participants in Chapter 5 and observation participants recruited for the study described in Chapter 8. The same three schools that participated in the studies described in Chapters 5, 6, and 8 were approached and agreed to participate in this study. Children who had participated in previous studies were excluded from participation for this study because they had already conducted these search tasks using a different search engine and this may have resulted in skewed results.

### **10.1.5. Participants**

Our observations study was conducted in the Waikato School District, which is located in the central North Island of NZ. The Waikato School District has 252 schools at primary or intermediate school level (Education Counts, 2013). Two primary schools and an intermediate school took part in our study, with the permission of each schools' principal.

The children at these three schools are taught in composite classrooms. Thus, the students came from classrooms of Y5&6 students and Y7&8 students. Children in Years 5&6 attended a Full Primary School while children in Year 7&8 attended an Intermediate School. The children in Y5&6 were aged between 9 and 11 years old. The children in Y7&8 were aged between 11 and 14 years old.

Table 10.1 shows an overview of all 54 participants.

**Table 10.1 Participants' ages**

<b>ID</b>	<b>Age</b>	<b>Year level</b>	<b>Gender</b>	<b>ID</b>	<b>Age</b>	<b>Year level</b>	<b>Gender</b>
FY5_1	9	5	F	FY6_3	11	6	F
FY5_2	9	5	F	FY6_6	11	6	F
FY5_3	9	5	F	FY6_7	11	6	F
FY5_5	9	5	F	FY7_1	11	7	F
FY5_6	9	5	F	FY7_2	11	7	F
FY5_7	9	5	F	FY7_3	11	7	F
FY5_8	9	5	F	FY7_4	11	7	F
MY5_1	9	5	M	FY7_6	11	7	F
MY5_2	9	5	M	MY6_5	11	6	M
MY5_3	9	5	M	MY6_7	11	6	M
MY5_4	9	5	M	MY6_8	11	6	M
MY5_5	9	5	M	MY7_1	11	7	M
MY5_6	9	5	M	MY7_2	11	7	M
MY5_7	9	5	M	MY7_4	11	7	M
MY5_8	9	5	M	MY7_5	11	7	M
MY5_9	9	5	M	FY7_5	12	7	F
FY5_4	10	5	F	FY8_2	12	8	F
FY6_1	10	6	F	FY8_5	12	8	F
FY6_2	10	6	F	MY7_3	12	7	M
FY6_4	10	6	F	MY8_1	12	8	M
FY6_5	10	6	F	MY8_3	12	8	M
FY6_8	10	6	F	MY8_4	12	8	M
MY6_1	10	6	M	MY8_5	12	8	M
MY6_2	10	6	M	FY8_1	13	8	F
MY6_3	10	6	M	FY8_3	13	8	F
MY6_4	10	6	M	MY8_2	13	8	M
MY6_6	10	6	M	FY8_4	14	8	F

We received a total of 54 participants (27 male and 27 female). All children were aged between 9 years old and 14 years old and all children were in School Years 5, 6, 7 or 8. As with all studies reported in this thesis, we have anonymised all participants and given unique participant ID's to each child. Throughout this chapter, we refer to individual students by their ID, which can be read to indicate gender, Year level, and a unique

number identifier, i.e., FY5\_1 is a Year 5 female. While we use a consistent naming procedure throughout this thesis, FY5\_1 in this chapter should not be considered to be the same participant as FY5\_1 in another chapter

## 10.2. Results

We discuss here the results of our observation study of children’s Internet search using KidsQuestions. We report the results of our analysis of data from both observations and interviews. Due to the small numbers of participants, we do not attempt to give statistical significance to the representative numbers that we present. A cursory investigation of student gender, student age or year level and interactions related to verbal or written instruction has revealed no significant observations and we, therefore, leave a detailed analysis of this aspect for future work.

Similar to presentation in Chapter 8, tables in this chapter present the results per school year and, additionally, per school year level composite (grey header). For smaller numbers, only the two school year level composites were reported. The conditional colour formatting was created separately for each column (smaller numbers are blue, progressing through grey and yellow to larger numbers that are green); the colours imply no value judgement.

### 10.2.1. Numbers of Queries

We coded the queries that children constructed as follows. We recorded a query once the child hit enter or clicked the search button. When a child started a query and changed their mind before hitting enter, we coded and counted only the query that was submitted.

Taken together Y5&6 children made a total of 350 queries while Y7&8 children made only a total of 262 queries. Overall, the 54 children worked through 270 tasks, posting 612 queries. We present a breakdown of queries per task in Table 10.2.

**Table 10.2 Total number of queries per task**

Y5	Y6	Y5&6		Y7	Y8	Y7&8
32	37	69	Open Task	31	19	50
34	48	82	Verbal Question	30	28	58
29	31	60	Verbal Instruction	31	21	52
37	34	71	Written Question	24	25	49
32	36	68	Written Instruction	34	22	56
n=17	n=16	n=33		n=11	n=10	n=21

The average (mean) number of queries during the entire observation session for Year 5 children was 9.44, for Year 6 children was 11.8, for Year 7 children 13.8 was the average and for Year 8 children 11.4 was the average number of queries. Taken together the average number of queries constructed by Year 5&6 children was 10.63 and 12.60 by Year 7&8 children. In conclusion, Y7&8 children averaged approximately 2 queries more than Year 5&6 children when considering the observation as a whole.

We report our further analysis of the numbers of queries made for each task in Table 10.3. In all tasks, Y7&8 children averaged more queries than the Y5&6 children.

**Table 10.3 Average number of queries per task**

Y5	Y6	Y5&6		Y7	Y8	Y7&8
1.94	2.41	2.21	Open Task	2.82	1.90	2.38
1.88	3.06	2.62	Verbal Question	2.73	2.80	2.76
1.63	2.00	1.79	Verbal Instruction	2.82	2.10	2.48
2.19	2.06	2.15	Written Question	2.18	2.40	2.29
1.81	2.29	2.03	Written Instruction	3.27	2.20	2.76
n=17	n=16	n=33		n=11	n=10	n=21

When we compare the total number of queries and average number of queries per task and across the entire study for use of KidsQuestions reported here compared to use of Google reported in Section 8.2.1 we see similar results with the older children making more queries on average to the younger children while, the younger children made more queries total. The higher number of queries in total by younger children is of course due to the greater number of younger children participating in each study. This finding is indicative that KidsQuestions does not hamper a child’s desire to explore an area in full any more than Google does. Nor have the enhancements impacted the need for more or fewer queries for the tasks tested by our study.

### 10.2.2. Query Types

We were interested in what search strategies the children use to create queries when given the freedom to construct their own search queries. We, therefore, coded all of the queries that a child made for each search task. The results reported in this section are for both initial query formulations and query reformulations.

We identified that children used the five following query construction strategies:

- Natural language sentences (NLS);
- Natural language questions (NLQ);
- Simplified Searches or Keyword (KW);
- Two Part Searches (2PS); and
- Query Enhancements (qualifiers and refiners).

Children in our study did not construct Boolean search queries. Boolean operators were present only as part of NLS and NLQ. We assume the children in our study had no understanding of Boolean Logic and that they had not been taught to use Boolean operators.

### 10.2.2.1. Natural Language Queries

We coded two types of queries using natural language (NL), natural language sentences (NLS) and natural language questions (NLQ). We recorded as NL queries those queries that were constructed using language too complex to be considered a keyword query. This included the use of punctuation and non-keyword text within the query string. An example of an NLS is the query by FY5\_5: “interesting facts about mount cook”. This query was coded as an NLS because it contains the non-keyword text “about” and its construction differs from the simplified keyword search (KW) entered by MY6\_7: “Mount Cook Facts”. An example of a NLQ is the query by MY6\_3: “how many rings does uranus have”. Table 10.4 summarizes the number of children who created an NLS query (col 1–3) or a NLQ query (col 4–6) for the given search task. We can see that if a task was set as a question the child is likely to enter a question, see rows for Verbal Question (49 children) and Written Question (54 children). For verbal and written instructions this ‘mirroring’ of the task pattern as NLS is not as pronounced with 13 children using NLS for the Verbal Instruction and 11 using NLS for the Written Instruction tasks.

**Table 10.4 #Children who created NLS and NLQ**

	NLS			NLQ		
	Y5&6	Y7&8	Total	Y5&6	Y7&8	Total
Open Task	8	5	13	20	16	36
Verbal Question	2	3	5	31	18	49
Verbal Instruction	7	6	13	14	10	24
Written Question	3	1	4	33	21	54
Written Instruction	10	1	11	20	13	33
	n=33	n=21	n=54	n=33	n=21	n=54

When we compare the use of natural language questions (NLQ) by children we see the much higher use of NLQ by children when they use KidsQuestions compared to when they use Google, which we reported in Section 8.2.2.

**Table 10.5 NLQ use in KidsQuestions compared to Google**

	NLQ KidsQuestions			NLQ Google		
	Y5&6	Y7&8	Total	Y5&6	Y7&8	Total
Open Task	20	16	36	10	3	13
Verbal Question	31	18	49	27	9	36
Verbal Instruction	14	10	24	1	1	2
Written Question	33	21	54	27	15	42
Written Instruction	20	13	33	6	3	9
	n=33	n=21	n=54	n=34	n=16	n=50

In Table 10.5 the left-hand table shows that for every task children made more NLQ queries in KidsQuestions than they did in Google. A central goal when designing KidsQuestions was to encourage the high use of NLQ when searching which is indicated in these findings.

#### 10.2.2.2. Keyword Queries

We counted the times that children shortened the question or instruction given for the task into a simplified set of keyword search terms (see Table 10.6). For example, MY5\_9 searched for “rugby school”, FY5\_6 searched for “mount cook” and FY5\_3 searched for “ed hillary”.

**Table 10.6 #Children using simplified keyword search**

	KW		
	Y5&6	Y7&8	Total
Open Task	12	5	17
Verbal Question	6	4	10
Verbal Instruction	23	16	39
Written Question	0	3	3
Written Instruction	11	13	24
	n=33	n=21	n=54

It seems the children were more likely to use simplified queries when the task is not set as a question but rather as an instruction. Higher numbers of children at all year levels created simplified queries when exploring the Open Task (17), Verbal Instruction (39) and Written Instruction (24) than when exploring the two question-based tasks. When we compare these results with the use of Keywords during the same tasks using Google as reported in Section 8.2.2.2 we see lower numbers of Keywords for the Open, Verbal Question, and Written Question tasks. We see an identical number of Keywords used for

the Written Instruction task (24 by 54 and 50 participants respectively) and slightly more Keywords used for the Verbal Instruction (39 compared to 32 by 54 and 50 participants respectively) tasks when the children used KidsQuestions. However, we must consider the higher number of participants in our present study which means that if we were to consider the number of Keyword queries per participant, the result would be much closer for these two tasks than the raw numbers suggest.

**10.2.2.3. Two-part Searches**

The questions developed for both the verbal question task and the written question task required the child to find information about two inter-related features of a topic. For example, the Verbal Question asked, “Where do possums live, and are they a pest in New Zealand?” This approach is similar to the one used in Bilal’s (2000) studies of children’s use of the now defunct Yahoooligans!. We were interested to see if students typed exactly what they heard or read, or if they simplified the search into two-part queries (see Table 10.7 with colour coding across both tables). We do not report here 2-part queries if a child reformulated after attempting first to enter the entire question.

**Table 10.7 #Children separating question into 2-parts vs. using only 1<sup>st</sup> part to answer question**

	2PQ			1st of 2PQ		
	Y5&6	Y7&8	Total	Y5&6	Y7&8	Total
Verbal Question	14	12	26	5	4	9
Written Question	17	9	26	2	5	7
	n=33	n=21	n=54	n=33	n=21	n=54

In this study using KidsQuestions we see very similar results to children’s use of Google reported in Section 8.2.2.3. When we consider children, who separated their question into a two part question or when they were able to find the solution to their search using only the first part of a two-part search the differences in each study are negligible. This suggests that KidsQuestions has neither hampered children’s ability to break a question into appropriate parts nor has it encouraged children to do so when such a search problem presents itself.

**10.2.2.4. Specific Search**

When given freedom to investigate a broad topic such as Mt Cook or the Cricket World Cup, we analysed if children would identify a specific feature of the topic to investigate. We consider this a measure of a child’s identification of a personal information need. In Table 10.8 we report the number of children who constructed a specific query for either the Verbal Instruction task or Written Instruction task.

**Table 10.8 #Children who investigated specific topics**

	Specific		
	Y5&6	Y7&8	Total
Verbal Instruction	13	12	25
Written Instruction	24	15	39
	n=33	n=21	n=54

25 of 54 children constructed specific investigations for the Verbal Instruction and 39 of 54 constructed specific investigations for the Written Instruction. Examples of the specific searches conducted included K18, who searched “can you ski on Mt Cook” for the Verbal Instruction task and K19 who searched “how many country’s participated in cricket world cup 2015” for the Written Instruction search.

When we compare these results to the investigation of specific topics during the same tasks using Google as reported in Section 8.2.2.4 we see much higher numbers of children conducting specific searches when using KidsQuestions. For the Verbal Instruction task in our related study only, 10 children conducted specific investigations in Google compared to 25 in KidsQuestions and for the Written Instruction task, only 14 conducted specific investigations in Google while 39 did so in KidsQuestions. Of these 25 children who created a specific investigation in for the Verbal Instruction task, 14 of them used a Related Question during reformulation and 14 of the 39 children who created specific investigations in the Written Instruction task used a Related Question during reformulation. This implementation of the Related Questions feature in KidsQuestions has contributed to the increase in specific investigations conducted by children in our present study compared to our study using Google.

### 10.2.3. Query Reformulations

Query reformulations were examined to understand what children do if their first search query does not resolve their investigation. When children broke the Verbal Question and Written Question into two parts, this was not counted as query reformulation. While children who reformulated did not necessarily only reformulate their query once, we report here only the first reformulation that was required. Equally, we report the reformulation for only the initial search conducted when children split their Question search tasks into 2-part searches.

Table 10.9 shows the total number of children in each composite that reformulated a query for one of the tasks. Considering that there are higher numbers of Year 5&6 participants in our study, it is equally as likely that a primary school child or an

intermediate school child will need to reformulate their query, independent of the task that was set.

Only four students conducted all five of the search tasks without reformulating a query. All other students needed to reformulate at least one of their queries in order to complete the full set of observation tasks set by the researcher. This is one less student than in our related study using Google.

**Table 10.9 #Children who reformulated their search per task**

	Reformulations		
	Y5&6	Y7&8	Total
Open Task	17	12	29
Verbal Question	14	9	23
Verbal Instruction	13	13	26
Written Question	12	7	19
Written Instruction	21	13	34
	n=33	n=21	n=54

If we consider the fact that each child was required to make at least one query per task, there were a possible 165 initial queries made by Year 5&6 children and a possible 105 initial queries made by Year 7&8 children. With this in mind, Year-5&6 students reformulated 77 of their 165 initial queries, while Year 7&8 students reformulated a total of 55 of their 105 initial queries. Therefore, a total of 132 queries were reformulated during this study. This compares to 112 queries that were reformulated in our study using Google as reported in Section 8.2.3. For all tasks children using KidsQuestions reformulated queries more often than children using Google. Additionally, more Year-7&8 children reformulated using KidsQuestions than using Google with a total of 54 reformulations by Year-7&8 children across the whole KidsQuestions study compared to only 37 reformulations across the entire Google study.

#### 10.2.4. Successful Queries

As can be seen from the discussion in Section 10.2.5, children reformulated queries and made multiple queries when seeking answers to their problems in each of the observation tasks. For this reason, we have analysed what the successful queries were per task. Table 10.10 shows the final, or “landing”, query after any possible reformulations occurred. These are the queries for which the children decided that they had completed the search tasks. Tasks 2 and 4 (verbal and written question) overwhelmingly were resolved by the use of natural language questions, while verbal and written instruction tasks were likely to be completed as either a KW or a NLQ. Again, the successful query

for the first part of a search task is reported where a child chose to break the question tasks into two separate searches. A comparison with starting queries and overall strategies is provided later in this chapter.

**Table 10.10 Type of final query selected by children**

	KW	NLQ	NLS
Open Task	13	29	10
Verbal Question	6	47	1
Verbal Instruction	24	22	9
Written Question	0	52	2
Written Instruction	13	35	7
Total	56	185	29

When we compare these results to the successful queries used during the same tasks using Google as reported in Section 8.2.4 we see lower numbers of Keywords and natural language sentences for the for all tasks and an increase in natural language question queries being the successful query. The decrease is quite significant with a total of 89 KW's proving successful in the original study compared to only 56 in this study, 66 NLS being successful compared to 29 in this study and only 95 NLQ in the related study with an increase to a total of 185 successful in this study. Here again, we see evidence of KidsQuestions increasing the use of NLQ as was sought in our design of the software. Additionally, these results are indicative of the strength of NLQ in assisting children to find solutions to the tasks that they feel satisfies the requirements of the brief.

### 10.2.5. Query Types and Query Changes

Table 10.11 and Table 10.12 give two views of all of the “single-part” or “first-part” queries, indicating query types, initial query, and the successful queries. We can see that overall NLQ queries are most used initially, and also that keyword queries dominate the reformulations.

**Table 10.11 Initial queries compared to successful queries**

	KW	NLQ	NLS
Initial Query	85	154	31
Successful Query	56	185	29

For comparison, we coded here only the single-part tasks and the first part of the 2-part tasks. After the 270 initial queries had been posted, these may have been changed, extended or reformulated in any of the other ways we discussed above. Equally, the original query, of course, may not have been reformulated at all.

These results are similar to the results presented in Section 8.2.5. In both Google and here in KidsQuestions that the number of initial queries of KW or NLS is higher than the number of successful queries for each query type. The difference in this study compared to the related study using Google is that there are a greater number of initial queries that are already NLQ when children are using KidsQuestions (154 initial NLQ queries) compared to when children are using Google (80 initial NLQ queries). In both KidsQuestions and Google, we see an increase in the number of NLQ from the original query to the successful query.

Table 10.12 shows an overview of all single-part queries according to year level, task and query type.

**Table 10.12 Initial queries compared to successful queries per composite**

		Initial Query		Successful Query	
		5&6	7&8	5&6	7&8
Open Task	KW	10	4	7	3
	NLQ	16	13	16	13
	NLS	6	3	6	3
Verbal Question	KW	4	4	3	3
	NLQ	27	16	29	18
	NLS	2	1	2	1
Verbal Instruction	KW	23	13	16	8
	NLQ	5	4	13	9
	NLS	6	4	6	4
Written Question	KW	0	3	0	0
	NLQ	32	17	31	21
	NLS	1	1	1	1
Written Instruction	KW	13	11	6	7
	NLQ	14	10	21	14
	NLS	6	1	13	11

When comparing starting queries, changes, and landing queries, we observe that while initially 31 Natural language sentences (NLS) were created, almost the same number (29) NLS were successful. The biggest increase was in the use of Natural language questions (NLQ): initially, 154 NLQ were formulated and finally 185 NLQ were successful. Keyword (KW) queries went from initially 85 KW to finally only 56 KW proving successful.

Here we compare the number of children that reformulated a query per task (see Table 10.13 col 1) to the number of reformulations and an average number of reformulations (see col 2 & 3) made per task. We know that the question tasks required the least number of reformulations. This is likely due to the fact that most often children created NLQ as the first query for these question tasks and NLQ queries appeared to be the least reformulated query type.

**Table 10.13 #Query reformulations per task**

	Queries Reformulated	#Reformulations	Average #Reformulations
Open Task	29	59	2.03
Verbal Question	22	31	1.41
Verbal Instruction	27	55	2.04
Written Question	19	18	0.95
Written Instruction	34	71	2.09
<b>Total</b>	<b>131</b>	<b>234</b>	

The number and average number of reformulations by children using Google compared to children using KidsQuestions are relatively similar. There is no indication that the enhancements implemented in KidsQuestions have made query reformulation any harder for children based on reformulation counts. In Section 10.2.9.2 we show how many of the children who reformulated each task did so using the Related Questions feature of KidsQuestions.

## 10.2.6. Query Enhancement

In Chapters 5 and 6 we note that when learning to search, primary school children are taught to use two query enhancement techniques, that we term query qualifiers and query refiners.

### 10.2.6.1. Query Qualifiers

Query qualifiers that children are taught include strategies such as the addition of “for kids”, “for children” or “kids” to a search query to assist with the return of results, which are aimed at children. Additionally, children are often encouraged to “find facts” or “interesting facts” about a broad concept during an investigation. During their educational practices, teachers are known to model search queries that append the addition of the word “facts” as another commonly taught query qualifier. Differing from the question posed in the study described in Chapter 8 this question did not explicitly use the word “facts”. We were interested to see how many students used the query qualifiers of either “facts” or “children” (see Table 10.14).

Table 10.14 #Children used qualifiers: “facts” or “kids”, “for kids”, “children”, “for children”

	"facts"			"children"		
	Y5&6	Y7&8	Total	Y5&6	Y7&8	Total
Open Task	0	0	0	0	0	0
Verbal Question	1	0	1	1	1	2
Verbal Instruction	14	8	22	1	1	2
Written Question	0	0	0	0	0	0
Written Instruction	4	3	7	2	2	4
	n=33	n=21	n=54	n=33	n=21	n=54

We noted less use of query qualifiers “facts” or “kids” in this study using KidsQuestions compared to our related study using Google as reported in Section 8.2.6.1. We hypothesize that the increased use of NLQ as an initial query and the increased change of query to a NLQ compared to a KW may be the reason for the lower need for query qualifiers in the present study. It is possible that our subtraction of the word “facts” from our instruction has also resulted in the lower number of iterations of the word facts. There is no indication that the increase in NLQs is due to the removal of the word “facts” from the instruction given by the researcher. Additionally, in Section 10.2.9.1 we will show the significant number of children using a Question Starter to create a query is more likely to be the reason for the decrease in KW queries that used the word “facts” than simply the removal of the word “facts” from the researchers’ instruction to the child.

### 10.2.7. Query Refiners

When learning to search, primary school children are taught to use what we term query refiners. Query refiners include methods for shortening queries to keywords, by avoiding “small words”, avoiding punctuation marks, specifying the information need within a broad concept, and the use of Google Advanced Search’s Reading Level Filters.

#### 10.2.7.1. Punctuation

More punctuation was used during query formulation using KidsQuestions than using Google. Nineteen participants used a question mark at the end of a question when using KidsQuestions compared to only three when using Google in our related study. One student used a full stop when no students used full stops in Google, and nine students used a comma while only one had used a full stop during our related study using Google (see Section 8.2.7.1).

### 10.2.8. In-page Interactions

In our related study and described in Section 8.2.12 we noted a range of interactions that occurred on websites. While these cursory findings are interesting and bear further investigation, we have not attempted to count or make judgments on these interactions within this thesis as they are felt to be outside the scope of this thesis. We have not noted any new or different in-page interactions in the study reported in this chapter and therefore, direct you to Section 8.2.12 for discussion of the interactions that we observed in both studies.

### 10.2.9. Search Engine Enhancement Use

We report here the participants' use of the search engine enhancements that were implemented as the KidsQuestions search interface. These enhancements were the implementation of Question Starters, Related Questions, Recently asked Questions and Toggle Switches.

#### 10.2.9.1. Question Starters

52 of the 54 participants used a question starter (see Section 9.4.1) at some point during their observation. One female and one male Year Six student (FY6\_6 and MY6\_1) were the only two participants not to use a question starter.

Fourteen children specifically discussed liking the related questions feature when answering Question 2 of the post-observation interview *What did you like about using Questions today?* (see Section 10.2.10.1). FY7\_4 experimented very early on in her observation study. During her first task (the Open Task) she clicked a question starter and exclaimed 'oh, that looks helpful!'. FY7\_3 stated Questions was "good with the prompts, lots of people struggle with searching. It helped me because you can keep track. And, question starters are a good idea because if you are doing an inquiry you use who, what where, etc." Additionally, FY7\_2 simply said, "one of my favourite things was the Question starters - they are really good."

#### 10.2.9.2. Related Questions

46 of the 54 participants used a related question (Section 9.4.2) from the options presented on a SERP page at some point during their observation.

Seven children specifically discussed liking the related questions feature when answering Question 2 of the post-observation interview *What did you like about using Questions today?* (see Section 10.2.10.1).

FY5\_4 emphatically stated “I liked everything about Questions because it helped me to find answers. The Related Questions were interesting to learn new questions to ask.” Similarly, MY6\_3 stated it was hard “not finding things I wanted, but the Related Questions made it easier.” Finally, MY5\_8 stated, “I liked the toggles, but what I really liked was the related questions.”

In the related study reported in Chapter 8, we counted how many children used the Related Searches feature presented in the Google SERP, and also asked follow-up questions in the post-observation interview. No students at the Y5&6 level and only three students at Y7&8 level used a related search during that study, compared to 46 children who were seen to use our Related Questions feature at some point during this observation study. No Y5&6 students claimed to use Related Searchers during their normal search habits, and only two Y5&6 students sometimes claimed to use related searches. Only one Y7&8 student claimed to use this feature during their typical search activities; six more Y7&8 students sometimes claimed to use related searches.

To investigate if the Related Questions feature of KidsQuestions was influential in increasing the use of NLQ queries during our study we have further analysed the query reformulations that we report above.

**Table 10.15 #Children who reformulated by using a related question**

	#Reformulations	#Related Questions
Verbal Question	22	9
Verbal Instruction	27	14
Written Question	19	1
Written Instruction	34	14
	n=54	n=54

We can see from Table 10.15 that a high proportion of the students that reformulated each task did so using a Related Question. The outlier in this table appears to be the Written Question task, which showed only 19 children reformulated and only 1 child used a Related Question when reformulating. When we consider the options presented as Related Questions for this task not one offered a search related to the rings of Uranus and thus the likelihood of these being used during a reformulation to answer this specific question is low. The low number of reformulations here is also due to the high number of

children who initiated this search with a NLQ query for their first query and were able to find a suitable solution using this query.

#### 10.2.9.3. Recently Asked Questions

21 of the 54 participants used a recently asked question (Section 9.4.2) from the options presented on the search page at some point during their observation.

FY6\_4 stated “writing down the question, thinking about what to type in” was hard when answering our Interview Question 5 (see Section 10.2.10.3). However, she continued this statement by saying “that’s why the recently asked questions, etc. made it easier”. Five children specifically discussed liking the recently asked questions feature when answering Question 2 of the post-observation interview *What did you like about using Questions today?* (see Section 10.2.10.1).

#### 10.2.9.4. Toggle Switches

39 of the 54 participants used the Toggle Switches (Section 9.4.2) at some point during their observation.

Twelve children specifically discussed liking the Toggle Switches feature when answering Question 2 of the post-observation interview *What did you like about using Questions today?* (see Section 10.2.10.1). FY6\_8 discussed in her post-observation interview the “toggles; I thought they really helped, ... they helped me remember which site I wanted to go on.” MY5\_4 stated that he liked the “question starters and the things on the side (toggles) because Google doesn’t have those and if your laptop died it would be easy to go back.”

#### Repeat Link Visits

Our implementation of these Toggle Switches was after the finding of the study reported in Chapter 8 that children visited the same link more than once during a search. We counted only the number of times a student visited the same link before adjusting their search query and only for the first query that they created for each task. A total of 5 children visited the same link twice during their first query creation. This is approximately one-third the number of children to revisit a link during a search compared to the study reported in Chapter 8. In that related study 14 children visited the same link more than once (see Section 8.2.11.3). Similar to that study, the children who visited the same link twice were not just the younger children. We noted that three Year 5 children, one Year 6 child, and one Year 8 child visited the same link more than once.

There was not an opportunity for the researcher to question the student about this second visit of a link.

### 10.2.10. Interview Results and Discussion

From the interviews, we have yet another layer of insightful data for analysis. As with the interviews in Chapter 8, due to the strength of the evidence observed during the observation phase of the study we have only analysed five key questions from the interview phase of the study at this point. To confirm our findings regarding the effects of our search engine enhancements that were observed we have analysed Questions 2 through 11 of the Post-observation Interview (see Figure 10.2).

#### 10.2.10.1. Likability of KidsQuestions

Question 2, Question 3 and Question 4 asked *What did you like about using Questions today?*, *What did you not like about using Questions today?*, and *How much did you like using Questions today?*

The response to these questions was particularly positive. Only three children [MY5\_4, MY5\_7, and MY6\_7] chose not to or were unable to, describe something that they liked about KidsQuestions when answering Question 2. 31 of the children responded noting that KidsQuestions was “easy” to use. For example, FY8\_5 stated that KidsQuestions was “easier than Google because Google comes up with a million things when you search using this it is more reliable.” Additionally, KidsQuestions was described as “fun” (2), “simple” (1), “helpful” or “it helped” (6). 11 children described “liking” KidsQuestions or a particular feature of KidsQuestions. When answering Question 2, 14 children noted that the Question Starters were helpful while 7 children discussed the Related Questions as being helpful, 12 children discussed the Toggle Switches and 5 children also discussed using the Recently Asked Questions.

Only 8 out of the 54 participants were able to describe something they did not like about KidsQuestions. The things that these eight children discussed included; the websites not having the answers (4), the search engine not correcting spelling issues in the same way as Google does (1), typing (1) and clicking on a related question or and needing to click enter (2).

Of these four different issues raised by the children, only two of these issues are within our control as the developers of KidsQuestions. Spelling correction notifications have not

been implemented in our prototype presently due to the availability of library and API's that we had at our disposal at the time of development of this testing software (see Section 9.5 for further details of our Search Mediator). In future iterations or deployment software, spelling corrections would be notified rather than simply implemented for the user. The second issue regarding the requirement to click the Search Button or Magnification Button after a decision has been made or after a user has clicked a Related Question was an intentional design decision. We implemented this design decision in an attempt to put the control of when to carry out a search into the users hands, rather than the systems hands. Interestingly, three children noted this requirement for the second click as a positive when they answered Question 2. The remaining 47 participants did not have anything they could describe that they did not like, with 13 of those 34 children who specifically said there was "nothing" they did not like about KidsQuestions. For example, FY5\_2 stated, "nothing! I really liked it." and FY8\_1 stated there was "not anything, I think it is a good search engine."

When asking the children to answer Question 4 (*How much did you like using Questions today?*) the researcher presented the children with the probe of "not a lot," "a little bit," "a lot." 45 out of 54 participants selected "a lot" from the three options presented to them, while 7, selected "a little bit" and 2 asked to choose "somewhere between a little bit and a lot." This significantly positive response indicates that children were confident and comfortable using this system to conduct the searches required for the observation study. We take heart in this positive reaction for future development of this system.

While we did not ask the children to compare KidsQuestions to Google within these or any questions in the interview, 24 children did favourably compare our enhanced search engine to Google when answering Questions 2 or 3. For example, MY7\_1 stated that KidsQuestions was "easier than using Google, with the Question Starters. On Google, you don't have them, and I really like the grey bars, sometimes people forget about which one [website] they are on. If we had those, it would be really easy to go back."

#### 10.2.10.2. Sense of Ease when Searching

Question 6 and Question 7 asked *What was easy when searching today?*, and *How easy was Questions to use today?*

For Question 6, eight children chose not to answer or gave no answer. Twenty children described the Question Starters feature and ten children described the Related Questions as features of KidsQuestions that were easy. For example, MY8\_4 "when I typed the

question it had the other ones, and I could click the 'who', 'what', or 'where' and it would swap it.", and MY7\_4 who stated, "the Question Starters and Related Questions gave ideas for searching and for what to type." FY8\_3 qualified this by saying "the things you did helped brainstorm good questions. The things you added, it just sort of helps." Ten children discussed the Toggle Switches assisting with remembering websites visited and required to visit. For example, FY8\_2 stated that she liked "remembering the site you went on. Cause of the remember thing - that was probably my favourite part", and FY5\_3 who described "planning websites to visit and remembering which websites I have visited" was easy. Improving the ease with which children plan their searches and make link choices compares to the results of our related study presented in Section 8.2.16.2 where 16 children were noted to describe difficulty identifying the right website to visit.

One student also noted that KidsQuestions automatically fixed his spelling mistakes and that made things easy for him during his searching that day [MY5\_4]. This compares to the results of our related study presented in Section 8.2.16.2 where three children described spelling difficulties.

One student stated that Wikipedia was something easy when searching today. Finally, one student noted that the cricket world cup task and a second (1) student noted the possums task was easy while another student (1) noted that her open task search for Netball was easy. This compares to the results of our related study presented in Section 8.2.16.1 where children also noted confidence with that the possum task was easy.

Three students felt that KidsQuestions did not return results that were outside the scope of what they were looking for, for example, MY7\_5 stated "it gave me exactly what I searched up. It doesn't give something else."

When asking the children to answer Question 7 (*How easy was Questions to use today?*) the researcher presented the children with the three probes: "easy", "medium", or "hard." 43 out of 54 participants selected "Easy" from the three options presented to them, while 10, selected "Medium" and 1 asked to choose "somewhere between Medium and Easy." This significantly positive response indicates that children were confident and comfortable using this system to conduct the searches required for the observation study. We take heart in this positive reaction for future development of this system.

### 10.2.10.3. Sense of Difficulty when Searching using KidsQuestions

Question 5 asked *What was hard when searching today?* 12 students were not able to or chose not to describe something that was hard, while only 8 children were not able to, or chose not to describe something that was easy.

When describing what was hard when searching today, 14 of 54 children discussed identifying the right website to visit from the list as being difficult. For example, FY8\_3 stated “trying to find a website that gave you information” while FY8\_2 said “finding the right sites” and MY5\_9 stated it was difficult to “find the right website. The related questions helped.” When we compare to the results of our related study presented in Section 8.2.16.2 we see that in that study 16 of 50 children were noted to describe difficulty identifying the right website to visit.

Six children described developing the question or search term was difficult. For example, MY7\_1 stated “thinking about the question you want to search about. The question starters really helped so you could think about what you could search.” This compares to the results of our related study presented in Section 8.2.16.2 where 13 children were noted to describe difficulty developing search terms. Only one student noted that being precise was often difficult when creating a search query while another (1) student reported that coming up with alternative ideas is difficult. This is significantly less than the 13 children in our related study reported in Section 8.2.16.2 who discussed difficulty changing a search term.

Two children noted spelling was difficult, and one child described typing into the search engine also proving difficult while one student also pointed out that sometimes the words on websites could be difficult to understand or read. This compares to the results of our related study presented in Section 8.2.16.2 where three children described spelling and no children described typing as difficult during their observations.

Three children also noted ensuring that the information found on the websites was accurate or correct was challenging and required attention on their behalf. Similarly, one child pointed out that sometimes websites contained information that was not what was being sought. Six children described one of the tasks as difficult (1 possums, 3 Mt Cook and 2 Uranus). This compares to the results presented in Section 8.2.16.2 of our related study where children also noted difficulty with some of the tasks, though in that study it was most typical for children to discuss the Cricket World Cup or Uranus, likely due to a lack of prior knowledge or lack of interest in these topics by the participant.

Finally, four children explicitly stated that nothing was difficult, for example, FY7\_6 specifically stated: “not much was too hard. Everything that was here helped make it easier. Everything here makes it a lot more helpful than Google.” This compares to the results of our related study presented in Section 8.2.16.2 where two children described nothing to be difficult.

Many of the difficulties described by the children above are not features of KidsQuestions that have caused undue or new issues for children thus we propose that our search engine enhancements have not introduced new difficulties for children. One student did note that it took him some time to fully understand the newly implemented features of the website, describing difficulty “at first figuring out the added abilities, what do they do”, however this same student continued by noting that “by testing them, they started to make sense” [MY7\_3]. Only one child noted that he had to remember to click after selecting a Related Question or Recently Asked Question, and this took some getting used to. However, we note in Section 10.2.10.1 that three children discussed positively the requirement to click before a query is processed by the search engine.

As with any new system, it takes time to develop an understanding of the features of the system and how they work. In our study, we allowed children to explore the system for three tasks before teaching them how to use the features of KidsQuestions that were different to other search engines. The practice of teaching children how to use a search engine is not unusual in the context of New Zealand schools as searching is something that is modelled and taught in the early years of New Zealand primary schools. The need for these features to be taught should they become implemented is reinforced by the comment by FY6\_3 who stated: “it was medium easy to use until you showed me that highlighting thing [Toggle Switches], then it was really easy!”.

#### 10.2.10.4. Recommendations for KidsQuestions

Question 8 and Question 9 asked *What do you think Questions should do for you?* and *What improvements do you recommend for Questions?*, while Question 10 asked *Is there anything else you would like to tell me about using Questions?*.

When answering Question 9, 27 children could not or chose not to offer recommendations for improvements to KidsQuestions. Further, five children specifically said that there was nothing that they would recommend improving. Four children asked for more Recently Asked Questions. One student suggested that being able to design

personalised backgrounds, such as is possible with Google Gmail accounts would be useful. One child suggested that adding an ability to place a “warning” on a site, by way of a red Toggle Switch would be helpful. Two students suggested voice input and another (1) student suggested image search functions. One student suggested that “a area where all the remembered websites and orange websites go - like view history” [MY6\_4] would be useful while another student stated while answering this questions that the remembered websites would be really helpful “if your laptop died” [MY5\_4]. Two students explicitly stated when answering Question 9 that this website was easy to use, stating that “some people don't know what to write, this website will be good for projects” [MY8\_1], while FY7\_1 stated “it's really easy and efficient. I think people would get used to it easy. Easier than Google.”

When asked if there was *anything else you would like to tell me about using Questions?* 40 children did not have anything to note. However, of the remaining 14 children the responses were extremely positive. Six children used the word “easy” or “easier”. For example MY7\_3 “I found it easier to use than the normal search engine cause it had other ways to search than normal searching.” FY7\_4 “It was really easy. The questions helped too. I used them by thinking ‘I should start a question’.” FY5\_7 “It was really easy which was helpful because I'm not the best at searching things up.” FY8\_2 “It is a lot easier than Google - especially for younger people.” Three children described KidsQuestions as helpful, for example, FY5\_7 stated: “it was really easy which was helpful because I'm not the best at searching things up.” Two children compared KidsQuestions to Google in answering this question; MY5\_4 said “if I were to choose I would use this over Google because it's got better quality answers and is faster,” while MY6\_3 simply stated, “it's awesome, I really hope this gets added to Google.” Finally, FY7\_2 simply stated, “it's great, and I hope it gets published soon” and FY5\_4 said, “it was really good. Actually, it wasn't complicated to use, everything linked up and there were suggestions to help you out.”

#### 10.2.10.5. Decision Making when Creating a Search

Question 11 asked *How did you decide what to type into the search box today?* 8 of 54 children described using keywords when answering this question. This is down from 18 of 50 who described using keywords in our previous study using Google (see Section 8.2.16.3).

20 of 54 children described using questions to create a search. For example, MY6\_1, who said that he looked at the “keywords and questions and put those in” and FY5\_1, who stated that she “thought about the question and put into a question or sentence.”

7 of 54 children described typing what was asked of them by a teacher, or in this instance the researcher. For example, FY6\_5\_1 stated, “I wrote the question I got told to write” and MY6\_7 who stated “I took exactly what was asked, what I would normally do”.

Additionally, two children discussed attempting to put the search into their own words. For example, FY8\_2 discussed “looking at the question, searching the most important part about it”, and MY8\_3 stated that he “looked at the question, put into my own words with the keywords.”

Six children discussed the Question Starters while two children discussed the Related Questions and one child discussed the Recently Asked Questions. For example, FY8\_3 stated that she “looked at the starter ideas to help me understand what my question was about,” while, FY6\_1 stated, “The questions (Related Questions) and the Question Starters helped.”

15 of 50 children could not or chose not to answer this question.

#### 10.2.10.6. Additional Interview Notes

During the observation study or when answering a question for the post-study interviews six children asked if they could use KidsQuestions outside of the study environment. For example, FY5\_3 asked “how do I get it on my computer? It’s much better than Google” and MY8\_3 asked, “is it available?”

### 10.3. Discussion

The study described in Chapter 8 scrutinised the query construction and the search term adjustment phases of the information search process by children using Google. Our present chapter replicated the study in Chapter 8 using KidsQuestions. Our aim was to assess how the enhancements to the Google search engine that we implemented in KidsQuestions might assist with children’s information search. We now discuss the findings of our present study with regard to these two phases and in comparison to related work and to our own research discussed in Chapter 8.

**Table 10.16 Comparisons of Google study to KidsQuestions study**

	Google	KidsQuestions	Reporting
Sense of Ease	✓	✓	10.2.10.2
Sense of Difficulty	✓	✓	10.2.10.3
Query Formulation	✓	✓	10.3.1
Query Reformulation	✓	✓	10.3.2
Repeat Link Visits	✓	✓	10.3.3
Time on Task	✓	✓	10.3.4.1
Basic Reading Level Filter	✓	x	10.3.4.2
Query Suggestions	✓	x	10.3.4.3

We highlight in Table 10.16 the comparable features of the two search engines that we have observed children using in our research as well as the measurable activities performed by these students during our studies. A check mark in the column of the corresponding search engine indicates if this search engine feature or user behaviour was noted in that system, while a cross notes no ability to compare. The reporting column serves to guide you to the appropriate section of this chapter to review our reporting of the relevant feature.

### 10.3.1. Query Formulation

We noted earlier in our discussion of the related work that much of the older literature on query construction by children discusses the difficulty children experience when constructing keyword queries and the incorrect use of natural language query formulations, e.g., in (Bilal, 2000; J. Schacter et al., 1998). Our own related research (Chapter 5 and Chapter 6) also shows that children and teachers are both still of the opinion that keyword searches are more appropriate than natural language queries. The findings of our study reported in Chapter 8 has shown many instances where children successfully found information using both keyword searches and using natural language searches, especially when using natural language question queries.

Our KidsQuestions interface was designed to encourage the development and use of natural language question queries and the findings outlined in Section 10.2.4 of this chapter show an increased number of NLQ queries performed by children using KidsQuestions. This is especially relevant when we consider the increased number of NLQ queries when we counted the successful queries is also much higher for this study using KidsQuestions compared to the study using Google. This large number of NLQ for successful queries (final queries entered by children in our study prior to declaring a search successful or complete) is a further indication of the strength of NLQ as a search

strategy for children. Additionally, the discussion of the Question Starters and the Related Questions as features of KidsQuestions that were easy or helpful further supports the effectiveness of this interface in supporting children's information seeking.

### **10.3.2. Query Reformulation**

In line with other studies reported in the analysis of the related work (Chapter 3), our present study has found that children do indeed make several query reformulations. Query reformulation is an area that received significant discussion in the literature with many issues remaining unresolved. We argue (Vanderschantz et al., 2014b) that mechanisms to explicitly support query formulation and reformulation are not broadly implemented within typical search engines and digital libraries. To this end, we implemented the Related Questions feature as well as the Recently Asked Questions feature of KidsQuestions. We had positive feedback (see Section 10.2.9.2 and Section 10.2.9.3) from students about both of these features as well significant use of the Related Questions feature in KidsQuestions compared to the use of Related Searches in Google reported in Section 8.2.9.

In our earlier study reported in Chapter 8, we noted that the reformulations were most prevalent when a child started with a search that was too simplified to return targeted results for their information need. In this instance, we might consider that the first query failed to return the results the child was looking for and thus the need for reformulation was due to initial search failure. This was often the case when the first query construction used a keyword search. We again noted that initial KW queries required reformulation more often and that NLQ queries were the least reformulated queries. Implemented features that encourage NLQ, as well as education in the use of NLQ, may alleviate some need for reformulations due to search failure. This may further introduce a need for reformulation only for expansion or exploration of a search area.

### **10.3.3. Repeat Link Visits**

In line with other studies reported in the analysis of the related work (Chapter 3), our study reported in Chapter 8 has found that children do indeed visit the same website repeatedly and often mistakenly. To assist with this and the planning phase of information seeking we implemented a Toggle Switch function on the SERP page of KidsQuestions.

The Toggle Switch feature was discussed favourably by students in the interview portion of the study. Additionally, a reduced number of children were counted to have visited the same link twice during their first query creation in this study compared to our related study using Google.

#### **10.3.4. Comparisons Not Made to the Study Reported in Chapter 8**

This study provided an opportunity for side-by-side comparison to measures reported for the previous observation study using Google (see Chapter 8). We have chosen to not directly compare three of the measures, which we discuss here.

##### **10.3.4.1. Time on Tasks**

Time on task was reported as part of the study detailed in Chapter 8 (see Section 8.2.14). As we reported in Section 8.2.14, time on task measurements for that study served to illustrate only the length of time that it took on average for task completions during that observation study, and the results could not be generalised or used comparatively in future work. Additionally, those measurements offered no insight into the effectiveness of the search engine or the children's information search abilities. For this reason, we do not attempt to measure or report here time on task for this study as it is incomparable and outside the scope of this study.

##### **10.3.4.2. Google Basic Reading Level**

In our interview studies (reported in Chapters 5 and 6, and (Vanderschantz et al., 2014b)), both students and teachers reported using Google Basic Reading Level filters as a method for simplifying the searches returned by Google. In the time since the study conducted and reported in Chapter 8 this feature has been removed from Google. As there was no API available and due to this feature being removed from Google, reading-level-filtering was not implemented in KidsQuestions. We can, therefore, not report any comparisons of this feature.

##### **10.3.4.3. Query Suggestions (Google's Related Searches Tool)**

For the study reported in this chapter, we have not counted how many children used the query suggestions or query expansions given by the search engine. KidsQuestions implements query suggestions using a Google API, which operates in a manner very similar to the Google search engine observed in the study described in Chapter 8. For this study, we were more interested in how the enhancements and additional query suggestions and expansion tools would be used. It can be expected that these additional

related question suggestion tools for which use is detailed in Section 10.2.9 will have affected the query suggestion tool use.

### 10.3.5. Limitations

KidsQuestions bears further analysis and testing with both children and adults in lab studies and longitudinal studies. We observed a range of interaction patterns by children using websites during this study and the study reported in Chapter 8 that, while of interest, are outside the scope of this thesis.

## 10.4. Study Conclusions

KidsQuestions did increase the use of natural language question queries by children at all age levels. NLQs proved to be successful in assisting children in finding the solutions they required as is seen when NLQs were the most often successful query type. Children made a total of 102 NLQ queries when searching using Google and 196 NLQ queries when searching using KidsQuestions.

The search engine enhancements implemented in KidsQuestions all contributed to positive experiences for the participants as well as improved search as measured throughout our study. The related questions feature resulted in more use by children than the related searches feature in Google. This could be due to the location of the feature on the web page, or teaching by the researcher, or simply the effectiveness of the implemented feature. There were less repeat link visits in KidsQuestions, possibly due to the implementation and teaching of the use of the Toggle Switches. Finally, KidsQuestions has not had any measurable negative impact on children's search.

### 10.4.1. Activity Checklist Evaluation

We are again using Activity Theory as a lens to review the findings of this study. As in Section 9.1.2, we use here the Development category of the Activity Checklist to discuss six of the Activity Checklist sample questions (Kaptelinin et al., 1999, p. 39).

AC\_D1: What are the consequences of implementing the target technology on target actions?

Our KidsQuestions interface was designed to encourage the development and use of natural language question queries. We counted the successful queries that children produced using KidsQuestions and showed that more of these were NLQ queries in this

study compared to in the study using Google. Therefore, the implementation of enhancements that encouraged NLQ, such as the Question Starters, the Recently Asked Questions, and the Related Questions features of KidsQuestions produced increased use of NLQ as desired.

AC\_D2: Did expected benefits actually take place?

Two central aims of this study were to encourage the use of NLQ and to reduce the number of mistaken repeat visits to websites. We observed both the increased use of NLQ and the decreased mistaken repeat visits to websites.

AC\_D3: Did users have enough experience with the system at the time of evaluation?

For an initial study of KidsQuestions, we believe the students did have enough experience with this system for us to draw this range of conclusions. In the *future work* section of Chapter 11, we discuss our plans for further studies investigating the advantages of KidsQuestions with children and adults.

AC\_D4: Did the system require a large investment of time and effort in learning how to use it?

An additional advantage of our system is that we have chosen to implement enhancements to the Google search engine that will be suitable for expert and novice users alike. For this reason, additional training of this tool was not required at the outset of this study. Our study reported here was specifically implemented in such a way that no instruction of the new features of KidsQuestions was introduced to the participants until they had worked with the tool to complete half of the study tasks.

AC\_D5: Are users' attitudes toward the system becoming more or less positive?

Children in our interviews were especially positive about the use of the Internet for information search (see Chapters 5 and 6). Children and teachers in those chapters describe the speed of information seeking, and the wealth of information sources found on the Internet as a positive. Additionally, in this study using KidsQuestions we had particularly positive reviews of the system by the participants in the interview portion of the study (Section 10.2.10).

AC\_D6: Are there negative or positive side-effects associated with the use of the system?

When we further consider the Likability and Sense of difficulty portions of the Interviews of children using KidsQuestions reported in we find that children appeared to report less frustration with information seeking compared to their typical experiences and ultimately notably positive experiences using KidsQuestions.

## 10.5. Chapter Summary

We conducted a user observation study using KidsQuestions in NZ primary and intermediate schools. This chapter presented results of a study that provides insight into the potential success of implementing our interaction model in an interface prototype for children's information seeking.

This chapter addressed Research Question 4 (see Section 1.2) by providing an analysis of our interface prototype, KidsQuestions, and addressing how an interaction design for information seeking that is tailored to children's inquiry-based learning practices can assist with children's information search. Children in our study used more NLQ query constructions, used the related questions feature more in KidsQuestions than we observed in our similar study with Google and revisited websites less often.

**RQ4** is concerned with observing how our information seeking interface prototype addresses the issues encountered by children during information search. Our study illustrated how children searched for information on the Internet using our prototype interface, the KidsQuestions search interface. The children in our study had fewer issues in constructing and reformulating search queries. Additionally, children discussed their pleasure in using this system. Finally, fewer visits to the same website were observed than when we conducted the similar study reported in Chapter 8.



## **Chapter 11.**

### **Summary and Conclusions**

This thesis focused on supporting children's digital information seeking and hypothesized that a system specifically designed to align with the inquiry-based pedagogies common in education today would be beneficial for children's digital information search.

The research reported in this thesis confirmed our hypothesis. We observed that our interaction model for children's information seeking as implemented in the KidsQuestions prototype assisted children's searching.

Section 11.1 gives a summary of this thesis and describes the path that was followed during the research project. Section 11.2 summarises our answers to our research questions, and Section 11.3 outlines the contributions of this thesis. Section 11.4 gives directions for future work and Section 11.5 draws final conclusions regarding children's digital information seeking for information online.

#### **11.1. Summary**

This thesis began by analysing related research on children's information seeking to identify requirements for an interactive concept for children's classroom and educational use of information seeking technologies. Chapter 2 presented an overview of pedagogy and learning theory pertinent to this thesis and the literature pertaining to educational technology. We followed with a discussion of the related approaches from the fields of computer science, information science and library science in Chapter 3.

Chapter 4 described our initial survey that investigated the ages at which children used information technology in the home and in the classroom. This survey explored digital information use as well as the comparative use of print sources for information search. We found a slightly higher use of technology for information seeking in the senior primary school and intermediate school compared to the junior primary school. This higher use of technology coupled with evidence from the literature of children's cognitive development and expectations of educational ability at these ages was the reason for our focus of further research for this thesis with Years 5&6 and 7&8.

We found a high use of a range of technologies both in the home and at school (see Chapter 4). Subsequent studies could therefore have been conducted in either environment; we chose to focus on the in-school use of information technology due to the relative ease of participant recruitment compared to seeking in-home participants in the age ranges targeted and because of the common use of these technologies during typical educational pursuits.

Next, we conducted a set of studies that were designed to reveal children's and teacher's perceptions of information seeking in primary and intermediate schools (see Chapters 5 and 6). For both the children and teachers interviewed, digital search was often understood to be synonymous with searching the Internet (in particular, using Google). These interviews clearly indicated the significant use of Google and the absence of dedicated children's search engines, digital libraries, eBooks or digital encyclopaedias. We identified difficulties with search procedures in print and digital information. We modelled the reported procedures of children searching for information.

Chapter 7 explored the design practices common to three internet search engines. We used a lab-based experiment to explore the range of presentation devices employed by ISEs when returning a search engine results page. We followed this visual analysis of search engines with an observation study of children using Google to perform a series of search tasks. Chapter 8 presented an analysis of children's query creation, formulation and reformulation activity and query related SERP use in classrooms. We used observation sessions with individual children in naturalistic environments using a range of search tasks.

From the findings of Chapters 5, 6, and 8 we identified three major difficulties for children: 1) constructing searches, 2) identifying relevant information in search results lists, and 3) finding the information contained in web pages. Based on these observations

and the lack of child-centred search tools we argued that rather than developing dedicated children's search tools, an interaction design which enhances rather than replaces an internet search engine interface and aligns with children's information seeking practices will assist with children's digital information seeking. Following our argument, we designed an interaction model and then implemented an interface prototype (see Chapter 9).

Finally, as reported in Chapter 10, we conducted a user observation study using our KidsQuestions interface prototype, in primary and intermediate schools. The search engine enhancements implemented in KidsQuestions all contributed to positive experiences for the participants as well as improved information search as measured throughout our study.

## **11.2. Answers to the Research Questions**

This section summarises the answers to our four research questions, RQ1 to RQ4.

### **11.2.1. When and how are Children**

#### **Conducting Digital Information Seeking? (RQ1)**

We found that children interact with ICT and digital reading from the early years of the NZ education system. Chapter 4 noted an increase in the use of digital reading materials, as well as in the use of technology for searching for information at the upper primary and intermediate year levels.

To further refine the answer to this question we coupled this finding with the reporting of the literature discussed in Chapter 2 on the pedagogy of the NZ education system and the discussion of the developmental psychology literature describing cognitive development. This has led us to resolve that our further work in this thesis was best served investigating the specific needs of the Year 5 through Year 8 New Zealand student. We hypothesised that the children in this range of education levels are seen to use this technology as part of their educational pursuits and are likely to be cognitively developing at a stage that would benefit from our investigations.

We found from our survey studies that children are using information seeking technologies in the home, in the classroom, and in the public library. The interview studies with children and teachers further confirmed that information seeking in the

classroom and for classroom-based activities is extremely common, particularly with the inquiry-based teaching model common in schools. The limited Internet and technology access experienced by some children in the home, particularly in rural areas as highlighted in our survey reported in Chapter 4, supports our reasoning for investigating children's classroom based information seeking behaviours.

We discovered a broad range of access to hardware for digital information seeking including small screen tablet computers and cell phones, as well as desktop and laptop computers used across the age ranges surveyed. It became apparent in interviews with children and teachers that the majority of digital information seeking was conducted on desktop computers and laptops compared to touch screen devices. Additionally, it was clear that the software search tool of choice was Google for the majority of information seeking activities. We found no use of child-centred search engines or digital libraries in use in NZ schools. We have no data for why these children do not use child-centred tools.

### **11.2.2. What are the Issues Children Encounter**

#### **when using Digital Information Seeking Technology? (RQ2)**

Though there are a wide variety of technologies being used in today's classrooms and homes, it is not clear how these technologies are facilitating information seeking for children, nor is it clear if children can use these systems effectively. Chapter 2 and Chapter 3 show that open questions remain on such fundamental issues as to which information seeking strategies children employ, how they construct queries, and if the strategies that are taught are effective for modern search engines. Numerous issues have been identified with children's information search by researchers globally and with a range of internet search engine and digital information technologies. Few recommendations have been proposed, and few solutions have been deployed within the classroom.

Our studies (detailed in Chapters 5, 6, and 8) confirmed three major difficulties experienced by children with (1) formulating and reformulating searches and search queries, (2) identifying relevant information in search results lists, and (3) finding the information contained in web pages. Managing information is a difficult task at the best of times, and the children too discussed this. Additionally, a model of the digital information search process was described by the children and teachers, and descriptions of the various issues encountered were retold.

### **11.2.3. What are the Requirements for Information Seeking Interfaces that will Assist Children’s Digital Information Seeking? (RQ3)**

To begin answering this question, we conducted a visual analysis of contemporary search engines expected to be typically available to children (Chapter 7). In this study, we described the types of web page content differences and visual presentation differences that resulted from different search query constructions. The use of natural language query structures produced results such as sidebars and pull-boxes as well as limited advertising, all of which would be useful to children’s information seeking. Additionally, the observation study of children’s use of one of these contemporary search engines was conducted (Chapter 8). This study confirmed the issues that children experience when conducting information seeking in the classroom

From the studies undertaken in Chapters 4 to 8, we developed a list of six requirements for an interaction model for children’s information seeking. These six requirements are: 1) assistance with query construction; 2) identification of related search and query reconstructions; 3) assistance with mistaken repetitious visiting of websites; 4) identification of provenance of information; 5) alignment with information seeking practices; 6) appropriate technology environment. To evaluate our interaction model we have designed and developed an interface prototype, KidsQuestions that implements our interaction model.

### **11.2.4. Does the Interface Prototype Introduced in this Thesis Assist with Children’s Digital Information Seeking? (RQ4)**

Our study reported in Chapter 10 illustrates how children search for information on the Internet when using our interface prototype, the KidsQuestions search interface. The children in our study had fewer issues in constructing and reformulating search queries. Additionally, children discussed their pleasure in using this system. The related questions feature of KidsQuestions resulted in more use by children than the related searches feature in Google. Finally, fewer visits to the same website were observed than when we conducted the similar study reported in Chapter 8, which we attribute to the implementation and teaching of the use of the Toggle Switches. KidsQuestions has not had any measurable negative impact on children’s search. Together these results indicate

that our interface prototype, KidsQuestions does indeed assist with children's information search and warrants further investigation in moving forward.

## **11.3. Contributions**

This section summarises the contributions made by this thesis to the field of children's information search.

### **11.3.1. Synthesis of Work in Related Domains**

Our analysis of the related work from the areas of education, information science, and computer science provides insight into the problem space and points to the gaps in the literature of children's seeking information in today's digital environment. The review of the related work has offered insight into the range of work that has covered this area in a short period of approximately twenty years. It must be emphasized that there is a relative lack of research in the recent five years in the field of children's information seeking on the Internet with modern search engines and no studies in the NZ primary and intermediate environment in this period of time.

### **11.3.2. Clarification of Information Seeking Needs of Children**

Our research presented in Chapters 4 through 8 has given a clear picture of the educational information seeking needs and issues of school children in the primary and intermediate school. In the survey results presented in Chapter 4, we observed the levels of access to technology and the technologies used by children. We highlighted the issues of information access for rural school children compared to suburban school children. Additionally, we identified the seeming loss of knowledge on how to solve information problems using printed sources compared to knowledge of digital information seeking and highlighted the use of Google for virtually all digital information seeking by these children.

In Chapters 5, 6, and 8, interview and observation studies identified how Year 5 to Year 8 children still struggle with many of the information seeking issues reported in the related work. The three central difficulties for children were: 1) constructing searches, 2) identifying relevant information in search results lists, and 3) finding the information contained in web pages. We modelled the reported information seeking processes of children in Chapters 5 and 6.

### **11.3.3. Analysis of Internet Search Engine Interfaces**

Chapter 7 reports the findings of our evaluation and analysis of the interfaces of three contemporary internet search engines. We observed that the visual design and presentation of SERP result link entries is consistent across search engines. We concluded that further studies reported in this thesis could therefore be based on any one of these search engines. Google was found to include less advertising and offer additional visual devices (such as pull-boxes and sidebars) that could assist young information seekers.

A valuable outcome of the analysis reported in Chapter 7 was the identification of the significant visual presentation and content differences that affect all of the ISE's when the range of query construction methods tested are employed. Natural language queries provided positive results in all ISE's for children's digital information seeking. We proposed naming conventions for common elements of SERPs that previously lacked consistent definitions.

### **11.3.4. Conceptual Design of an Interface Prototype for Children's Information Seeking**

We used Kaptelinin's Activity Checklist to evaluate our research and to develop a list of six requirements for an interaction model that supports children's digital information seeking (see Chapter 9). Using the findings of our research we developed the conceptual design of our information seeking interface prototype, KidsQuestions that implemented our interaction model.

### **11.3.5. Evaluation of our Information Seeking Interface Prototype**

Our evaluation (Chapter 10) showed that KidsQuestions was successful at meeting our requirements for an interaction model for children's information seeking. KidsQuestions assisted query construction and identification of related search and query reconstructions by increasing the use of natural language question queries by children at all age levels. The related questions feature resulted in more use by children than the related searches feature in the study of Google in Chapter 8. There were fewer repeat link visits in KidsQuestions, possibly due to the implementation and teaching of the use of the Toggle Switches. Finally, KidsQuestions has not had any measurable negative impact on children's search and provides an opportunity for future testing and evaluation.

## **11.4.Future Work**

We recommend future work on this research with particular consideration of longitudinal measures and larger participant cohorts. We suggest study methods including log analysis and alternative non-invasive observation methods to allow for scaling of data collection and analysis.

### **11.4.1. Web Page Design Analysis**

A number of in-page user interactions were noted in Section 8.2.12 of this thesis. Deeper analysis of the video footage and consideration of the visual design features of websites in which these interactions occurred was deemed outside the scope of this thesis. The richness of the data available in these recordings of studies using Google in Chapter 5 and studies using KidsQuestions in Chapter 10 bear further analysis and consideration to assist website designers in the development of websites for children's successful reading, triaging and information discovery use. Further studies by colleagues interested in children's and adults' information triage on websites are recommended.

### **11.4.2. Further Analysis**

Activity Theory was a central lens through which we approached the analysis in this thesis. In particular, Activity Theory was used to analyse the work that we completed in developing our interaction model in Chapter 7 as well as to review the results of our observation study in Chapter 10. It was chosen primarily because the pedagogy of the NZ education curriculum at primary and secondary levels is influenced by both socio-cultural theory and constructivism (see Section 2.1.1). An additional consideration was the work of Kaptelinin and Nardi which shows the usefulness of Activity Theory in HCI and Interaction Design research (see for example, Kaptelinin, 1996; Kaptelinin & Nardi, 2006; Kaptelinin et al., 1999).

The wealth of data provided by the studies conducted for this thesis provide numerous opportunities to review the work conducted using alternative lenses such as Design Science and Complexity Theory (Hasan, 2006) in the future.

### **11.4.3. Testing KidsQuestions with Adults**

A central goal in the development of our interface prototype has been to ensure that the features we have implemented do not negatively impact adult or expert users. Additionally, we believe that adults may too benefit from the enhancements that we have

implemented in our prototype. We suggest user studies of KidsQuestions with adults that replicate that completed in Chapter 10 of this thesis. Longitudinal investigations of the use of KidsQuestions with adult participants are also recommended.

#### **11.4.4. Longitudinal Analysis of KidsQuestions**

As we observed in Section 3.2.2, many studies involving investigating information systems and interface designs for children have been very small and typically of short-term nature. We propose a longitudinal study with our interface prototype with children and adults. There are a number of benefits in making this interface prototype available to a small selection of children for an extended period of time. This study would involve close collaboration with schools and individual teachers to select an appropriate time to deploy this interface prototype into the classrooms and homes of the participants selected for use during a significant inquiry project undertaken as part of a child's education. It is expected that we would gather logged information pertaining to the feature use of the interface prototype alongside diary and interview information with the students, teachers and parents involved.

#### **11.4.5. Supporting Teachers**

Factors of children's information behaviour practices during education and school warrant continued investigation. Further focus on ways that classroom teachers can be better supported will ensure classroom practices align with contemporary information seeking with modern ICT. Promoting the finding that natural language question queries can be more successful than keyword searches in the modern search engine would be an initial step in supporting classroom teachers today.

### **11.5. Conclusion**

We have approached the issue of children's information seeking from the unique perspective of how children are taught to structure their information seeking processes. This differs from the common approach of developing children's graphical user interfaces through design devices such as colour, avatars, or results list simplification. Instead, KidsQuestions is a proof-of-concept that an interaction design for an internet search engine interface that aligns with inquiry-based learning frameworks can assist with children's digital information seeking.

The features of search engine enhancements explored in this thesis indicate ways in which search engines – Google, Bing, and Yahoo! included – could facilitate children’s query creation, query expansion and triage of information. Finally, although KidsQuestions was designed particularly with children in mind, the features implemented will be beneficial to adults and children alike and future work will investigate the use of our prototype with adults.

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## **Appendix A.**

### **Material for Questionnaire Study (Chapter 4)**

This appendix contains all related material for the exploratory survey study reported in Chapter 4:

- Ethical Approval Letter from the Human Research Ethics Committee of the Faculty of Computing and Mathematical Sciences at the University of Waikato, dated 25 October 2012;
- Principals Information Sheet, which each principal received and signed before participant recruitment begun;
- Parents Survey, sent home with individual children;
- Teachers Survey, distributed to teachers by principals.

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THE UNIVERSITY OF  
**WAIKATO**  
*Te Whare Wānanga o Waikato*

25 October 2012

Nic Vanderschantz et al  
C/- Department of Computer Science  
**THE UNIVERSITY OF WAIKATO**

Dear Nic

**Request for approval to conduct a research evaluation involving human participants**

I have considered your request to carry out a research study *Improving Children's Knowledge Acquisition with eBooks and Digital Libraries* to be conducted in nominated primary and intermediate schools in the Waikato, by teachers in classrooms and also by parents of children selected by their teacher, in their respective homes.

The primary purpose of the research is to investigate how children access information and read in a digital environment.

The procedure described in your request is acceptable.

I note that publications and reports will not contain any personal data of the participants and their identities will be kept anonymous. Collected information will be kept as paper records and electronically until the completion of the project, at which stage the analysed data will be kept FCMS data archive and destroyed after the submission of your PhD thesis.

The research participants' information sheets, consent forms and questionnaires meet the requirements of the University's human research ethics policies and procedures.


I therefore approve your application to perform the evaluation.

Yours sincerely,

A handwritten signature in blue ink that reads "Lyn Hunt".

**Lyn Hunt**  
Human Research Ethics Committee  
School of Computing and Mathematical Sciences

**Figure A.1 Study Ethics Approval**



THE UNIVERSITY OF  
**WAIKATO**  
*Te Whare Wānanga o Waikato*

## Principal's Information Sheet

<<Date>>

We would like to invite «Principal\_First» «Principal\_Last» and «Name» to take part in a research project investigating children's on-screen knowledge acquisition. This research is being conducted as part of on-going research into reading materials for children and the design of effective reading materials for learning.

**Benefits**  
By being a contributing partner in this research, your school may benefit from innovations that occur in the design of on-screen reading material for young readers. Teaching staff at the school may also benefit from early insight into the results of this investigation through access to reports and papers generated. Please request access to reports, papers and summaries via email to Nicholas Vanderschantz should you wish to receive these once they become available.

**Research Relevance**  
This research sets out to investigate how children access information and read in a digital environment.

To date, there has been limited research and investigation about how children read and find information on-screen, and the visual design of children's on-screen reading media for effective learning. An increasing amount of children's reading material is on a small screen. With the increase of personal hand-held devices, a greater amount of reading material is available at all times. Through development of a greater understanding of how children find information, it is envisaged that this research may encourage better practices in the design of reading material for children.

**Research Method**  
I would ask that you invite through a suitable staff forum, 1 teacher at each year level to complete a short 2 page questionnaire (attached for your benefit). Each of these teachers, once they have agreed to participate, would also identify 3 male and 3 female students in their classroom to take home a second document that invites the parent to complete a similar 4 page questionnaire (also attached for your benefit). Each questionnaire will take approximately 5 to 10 minutes to complete. Teachers and parents should feel that they are able to return the forms uncompleted.

The Faculty of Computing and Mathematical Sciences Ethics Committee, University of Waikato, has approved this project. This research will uphold and abide by the research regulations of the University of Waikato.

**What will happen to the information collected?**  
The information collected will be used by the researchers to write research papers for submission to conferences or academic journals and will contribute to Nicholas Vanderschantz' PhD. The researcher and supervisor will be the only people with access to the data collected from this research activity. The data will be stored on a password protected computer in Nicholas Vanderschantz' office at the University of Waikato and paper records will be kept as well. This office and computer are accessible only to the researcher. At completion of the data analysis the data will be housed in the FCMS data archive until submission of Nicholas' PhD, approximately 2018. After the completion of the project, all documents will be destroyed. No participants will be named, nor will any identifiable information be used in the publications.

**Declaration to participants**  
If your staff and the parents of pupils take part in the study, you and your staff and the parents of pupils have the right to:

- Refuse to answer any particular question
- Ask any further questions about the study during your participation.
- Request access to a summary of findings from the study when it is concluded.

If you have any questions or concerns about the project, either now or in the future, please feel free to contact either:

<b>Researcher:</b> Nicholas Vanderschantz Phone: (07) 838 4656 Email: vtwoz@cs.waikato.ac.nz	<b>Supervisors:</b> Dr Annika Hinze Phone: (07) 838 4052 Email: hinze@waikato.ac.nz	Dr Sally Jo Cunningham Phone: (07) 838 4402 Email: sallyjo@waikato.ac.nz
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I «Principal\_First» «Principal\_Last», Principal of «Name» consent to the conducting of this research project as outlined above.

Signed \_\_\_\_\_ Date \_\_\_\_\_

Figure A.2 Principals Information Sheet

**Teachers Participant Information Sheet  
(for you to retain – page i)**



Dear Teacher

The principal or their delegate of «Name» has invited you to participate in a research project conducted by Nicholas Vanderschantz, Lecturer of Computer Graphic Design at the University of Waikato.

**We invite you to please take the time to consider the following and if you agree, we would appreciate you completing this small two-part questionnaire and returning this to your school within 2 to 3 working days. We also invite you to nominate the parents of 6 children in your class to be invited to consider taking part in this study using the alternative questionnaires in your pack. We thank you kindly if you choose not to participate and request that you return this pack uncompleted to your principal or their nominee.**

Thank you

**Nicholas Vanderschantz**

**Project Title**

Improving Children's Knowledge Acquisition with eBooks & Digital Libraries

By being a contributing partner in this research your school may benefit from innovations that occur in the design of on-screen reading material for young readers. Teaching staff at the school may also benefit from early insight into the results of this investigation through access to reports and papers generated.

**Purpose**

This research is being conducted as part of on-going research into reading materials for children and the design of effective reading materials for learning.

**What is this research project about?**

This research sets out to investigate how children access information and read in a digital environment.

**What will you have to do and how long will it take?**

This research activity will be performed as a questionnaire and will take about 5 to 10 minutes to complete.

**What will happen to the information collected?**

The information collected will be used by the researchers to write research papers for submission to conferences or academic journals and will contribute to Nicholas Vanderschantz PhD. The researcher and supervisor will be the only people with access to the data collected from this research activity. The data will be stored on a password protected computer in Nicholas Vanderschantz office at the University of Waikato and paper records will be kept as well. This office and computer are accessible only to the researcher. At completion of the data analysis the data will be housed in the FCMS data archive until submission of Nicholas PhD, approximately 2018. After the completion of the project, all documents will be destroyed. No participants will be named, nor will any identifiable information be used in the publications.

Please return completed questionnaire in the sealable envelope provided.

**Declaration to participants**

If you take part in the study, they have the right to:

- Refuse to answer any particular question.
- Ask any further questions about the study during your participation.
- Be given access to a summary of findings from the study when it is concluded.

**Who's responsible?**

If you have any questions or concerns about the project, either now or in the future, please feel free to contact either:

**Researcher:**

Nicholas Vanderschantz  
Phone: (07) 838 4656  
Email: vtwoz@cs.waikato.ac.nz

**Supervisors:**

Dr Annika Hinze  
Phone: (07) 838 4052  
Email: hinze@waikato.ac.nz

Dr Sally Jo Cunningham  
Phone: (07) 838 4402  
Email: sallyjo@waikato.ac.nz

«Name»

i

**Figure A.3 Teachers Survey - Page i**

**Teachers Research Questionnaire**  
**(please return pages 1 to 3)**



**Improving Children's Knowledge Acquisition with eBooks & Digital Libraries**

I have read the **Participant Information Sheet** for this study and I understand the details of the study. My questions about the study have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I also understand that by completing and returning this questionnaire that I give my consent for the researcher to use all data completed for questions I have chosen to answer.

**Questionnaire**

**Please refer to the following technology terms as relevant to this questionnaire:**

**Tablet:** ipad / android tablet / windows tablet / leappad etc

**Smartphone:** all touch screen phones - iphone / android / windows phone etc

**PDA:** personal small touch screen devices - ipod touch / windows pda etc

**Computer:** all laptop and desktop computers

**Reading:** blogs / websites / books / articles / news papers / stories etc (*not instructions*)

**Find Information:** search / browse / reference

**Please leave multi-choice questions unanswered if no option is applicable.**

**Personal Information about you**

Gender M/F ..... Years Teaching ..... Year Level You Teach .....

**Please use your knowledge of your class this year to answer the following questions. There is no requirement to interview or question students in your class to answer these questions.**

1) Please list what technology children in your class have access to at home that is used to complete work for your classes.

2) Please list what technology children in your class have access to at school that they use to complete school work.

3) Please list what technology children in your class use for entertainment at school.

«Name»

1

Figure A.4 Teachers Survey - Page 1

- 4) From your knowledge of pupils in your class this year:
- a. Do you think children in your class read ebooks *for pleasure at home*?  
 none     some     most     all
- b. Do children read ebooks *for pleasure in your classroom*?  
 none     some     most     all
- c. Do you think children in your class read ebooks *for education at home*?  
 none     some     most     all
- d. Do children read ebooks *for education in your classroom*?  
 none     some     most     all
- 5) From your knowledge of pupils in your class this year:
- a. What do you think *some* children in your class use to read for pleasure at home?  
*(as many as appropriate)*  
 tablet     PDA     smartphone     computer     eReader     print books
- b. What do *most* children use to read for pleasure in your classroom?  
*(as many as appropriate)*  
 tablet     PDA     smartphone     computer     eReader     print books
- c. What do you think *some* children in your class use to read for education at home?  
*(as many as appropriate)*  
 tablet     PDA     smartphone     computer     eReader     print books
- d. What do *most* children use to read for education in your classroom?  
*(as many as appropriate)*  
 tablet     PDA     smartphone     computer     eReader     print books
- 6) From your knowledge of pupils in your class this year:
- a. What do you think *some* children in your class use to find information at home?  
*(as many as appropriate)*  
 tablet     PDA     smartphone     computer     printed books
- b. What do *most* children use to find information in your classroom?  
*(as many as appropriate)*  
 tablet     PDA     smartphone     computer     printed books
- 7) From your knowledge of pupils in your class this year:
- a. What do you think *some* children in your class use to play games for education at home?  
*(as many as appropriate)*  
 tablet     PDA     smartphone     computer
- b. What do *most* children use to play games for education in your classroom?  
*(as many as appropriate)*  
 tablet     PDA     smartphone     computer

«Name»

2

Figure A.5 Teachers Survey - Page 2

8) From your knowledge of pupils in your class this year:  
 a. Do *some* children use the internet? (*as many as appropriate*)  
 at home for pleasure     at school for pleasure  
 at home for education     at school for education

b. Do *most* children use the internet? (*as many as appropriate*)  
 at home for pleasure     at school for pleasure  
 at home for education     at school for education

9) From your knowledge of pupils in your class this year:  
 What does the school provide for in school use? (*as many as appropriate*)  
 tablet     PDA     smartphone     computer     eBooks

10) From your knowledge of pupils in your class this year:  
 What does the school provide for in home use? (*as many as appropriate*)  
 tablet     PDA     smartphone     computer     eBooks

11) From your knowledge of pupils in your class this year:  
 What does the school require for in home use? (*as many as appropriate*)  
 tablet     PDA     smartphone     computer     eBooks

12) From your knowledge of pupils in your class this year:  
 Do *most* children use a computer library catalogue to search for books at the school library?  
 (*as many as appropriate*)  
 at home     at school

13) Have you set tasks (assignments/essays/projects/homework) this year where a child must find information from a source (book/internet/ebook/dictionary/etc) of their choosing?  
 yes     no

**If yes please answer a. b. & c. below:**  
 a. approximately how many tasks in a given week ..... given term .....

b. what sources would a child have used to complete this task at school?  
 (*as many as appropriate*)  
 internet     library catalogue     printed book     eBook

c. what sources would a child have used to complete this task at home?  
 (*as many as appropriate*)  
 internet     library catalogue     printed book     eBook

***Please return this with the completed questionnaires from the children's parents you selected within 2 to 3 working days. Please use the envelope supplied.***

«Name» 3

Figure A.6 Teachers Survey - Page 3

**Parents Participant Information Sheet  
(for you to retain – page i)**



Dear Parent

The principal of «Name» has agreed for research into reading materials for children to be undertaken in your child's school. The teacher of your child has been given permission to invite 6 parents to participate in a research project conducted by Nicholas Vanderschantz, Lecturer of Computer Graphic Design at the University of Waikato.

**We invite you to please take the time to consider the following and if you agree we would appreciate you completing this small two-part questionnaire and returning this to your school within 2 to 3 working days. Should you choose not to participate, we thank you kindly and ask that you return your questionnaire uncompleted to you child's school.**

Thank you

**Nicholas Vanderschantz**

**Project Title**

Improving Children's Knowledge Acquisition with eBooks & Digital Libraries

**Purpose**

This research is being conducted as part of on-going research into reading materials for children and the design of effective reading materials for learning.

**What is this research project about?**

This research sets out to investigate how children access information and read in a digital environment.

**What will you have to do and how long will it take?**

This research activity will be performed as a questionnaire and will take about 5 to 10 minutes to complete.

**What will happen to the information collected?**

The information collected will be used by the researchers to write research papers for submission to conferences or academic journals and will contribute to Nicholas Vanderschantz PhD. The researcher and supervisor will be the only people with access to the data collected from this research activity. The data will be stored on a password protected computer in Nicholas Vanderschantz office at the University of Waikato and paper records will be kept as well. This office and computer are accessible only to the researcher. At completion of the data analysis the data will be housed in the FCMS data archive until submission of Nicholas PhD, approximately 2018. After the completion of the project, all documents will be destroyed. No participants will be named, nor will any identifiable information be used in the publications.

The information provided will be treated confidentially. Please return completed questionnaire in the sealable envelope provided.

**Declaration to participants**

If you take part in the study, they have the right to:

- Refuse to answer any particular question.
- Ask any further questions about the study during your participation.
- Be given access to a summary of findings from the study when it is concluded.

**Who's responsible?**

If you have any questions or concerns about the project, either now or in the future, please feel free to contact either:

**Researcher:**

Nicholas Vanderschantz  
Phone: (07) 838 4656  
Email: vtwoz@cs.waikato.ac.nz

**Supervisors:**

Dr Annika Hinze  
Phone: (07) 838 4052  
Email: hinze@waikato.ac.nz

Dr Sally Jo Cunningham  
Phone: (07) 838 4402  
Email: sallyjo@waikato.ac.nz

«Name»

i

**Figure A.7 Parents Survey - Page i**

**Parents Research Questionnaire**  
**(please return pages 1 to 4)**



**Improving Children's Knowledge Acquisition with eBooks & Digital Libraries**

I have read the **Participant Information Sheet** for this study and I understand the details of the study. My questions about the study have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I also understand that by completing and returning this questionnaire that I give my consent for the researcher to use all data completed for questions I have chosen to answer.

**Questionnaire**

**Please refer to the following technology terms as relevant to this questionnaire**

**Tablet:** ipad / android tablet / windows tablet / leappad etc

**Smartphone:** all touch screen phones - iphone / android / windows phone etc

**PDA:** personal small touch screen devices - ipod touch / windows pda etc

**Computer:** all laptop and desktop computers

**Reading:** blogs / websites / books / articles / news papers / stories etc (*not instructions*)

**Find Information:** search / browse / reference

**Your Personal Information**

Gender M/F

Occupation                      Your spouses occupation

Gender / Year Level of each of your children (ie. M/Y2)

**Please complete these 2 pages about yourself:**

1) What technology do you have access to at home?

2) What technology do you use to complete work for your occupation?

3) What technology do you use for entertainment?

**Please leave multi-choice questions unanswered if no option is applicable.**

4)    a. Do you read ebooks for pleasure at home?

yes       no

      b. Do you read ebooks for pleasure at work?

yes       no

      c. Do you read ebooks for your occupation at home?

yes       no

      d. Do you read ebooks for your occupation at work?

yes       no

«Name»

1

**Figure A.8 Parents Survey - Page 1**

- 5) a. What do you use to read for pleasure at home? *(as many as appropriate)*  
 tablet     PDA     smartphone     computer     eReader     print books
- b. What do you use to read for pleasure at work? *(as many as appropriate)*  
 tablet     PDA     smartphone     computer     eReader     print books
- c. What do you use to read for your occupation at home? *(as many as appropriate)*  
 tablet     PDA     smartphone     computer     eReader     print books
- d. What do you use to read for your occupation at work? *(as many as appropriate)*  
 tablet     PDA     smartphone     computer     eReader     print books
- 6) a. What do you use to find information at home? *(as many as appropriate)*  
 tablet     PDA     smartphone     computer     printed books
- b. What do you use to find information at work? *(as many as appropriate)*  
 tablet     PDA     smartphone     computer     printed books
- 7) Do you use the internet? *(as many as appropriate)*  
 at home for pleasure     at work for pleasure  
 at home for work     at work for work
- 9) What does your work provide for in work use? *(as many as appropriate)*  
 tablet     PDA     smartphone     computer     eBooks
- 10) What does your work provide for in home use? *(as many as appropriate)*  
 tablet     PDA     smartphone     computer     eBooks
- 11) a. Do you use a computer library catalogue to search for books from the public library? *(as many as appropriate)*  
 at home     at work     at the library
- 

«Name»

2

Figure A.9 Parents Survey - Page 2

**Please complete these 2 pages for the child that brought this questionnaire home:**

**Personal Information (of the child that brought this questionnaire home)**  
Gender / Year Level (ie. M/Y2)

1) What technology does your child have access to at home?

2) What technology does your child use to complete school work?

3) What technology does your child use for entertainment?

4) a. Does your child read ebooks for pleasure at home?  
 yes     no

b. Does your child read ebooks for pleasure at school?  
 yes     no

c. Does your child read ebooks for education at home?  
 yes     no

d. Does your child read ebooks for education at school?  
 yes     no

5) a. What does your child use to read for pleasure at home? *(as many as appropriate)*  
 tablet     PDA     smartphone     computer     eReader     print books

b. What does your child use to read for pleasure at school? *(as many as appropriate)*  
 tablet     PDA     smartphone     computer     eReader     print books

c. What does your child use to read for education at home? *(as many as appropriate)*  
 tablet     PDA     smartphone     computer     eReader     print books

d. What does your child use to read for education at school? *(as many as appropriate)*  
 tablet     PDA     smartphone     computer     eReader     print books

6) a. What does your child use to find information at home? *(as many as appropriate)*  
 tablet     PDA     smartphone     computer     printed books

b. What does your child use to find information at school? *(as many as appropriate)*  
 tablet     PDA     smartphone     computer     printed books

7) a. What does your child use to play games for education at home? *(as many as appropriate)*  
 tablet     PDA     smartphone     computer

b. What does your child use to play games for education at school? *(as many as appropriate)*  
 tablet     PDA     smartphone     computer

«Name» 3

Figure A.10 Parents Survey - Page 3

- 8) Does your child use the internet? *(as many as appropriate)*  
 at home for pleasure       at school for pleasure  
 at home for education       at school for education

- 9) What does the school provide for in school use? *(as many as appropriate)*  
 tablet       PDA       smartphone       computer       eBooks

- 10) What does the school provide for in home use? *(as many as appropriate)*  
 tablet       PDA       smartphone       computer       eBooks

- 11) a. Does your child use a computer library catalogue to search for books from the school library? *(as many as appropriate)*  
 at home       at school       at the library
- b. Does your child use a computer library catalogue to search for books from the public library? *(as many as appropriate)*  
 at home       at school       at the library

***Please return this with your child to their teacher within 2 to 3 working days. Please use the envelope supplied.***

«Name»

4

**Figure A.11 Parents Survey - Page 4**

## **Appendix B.**

### **Material for Interview Studies (Chapter 5 & Chapter 6)**

This appendix contains all related material for the interview studies with children and teachers reported in Chapter 5 and Chapter 6:

- Ethical Approval Letter from the Human Research Ethics Committee of the Faculty of Computing and Mathematical Sciences at the University of Waikato, dated 17 July 2013;
- Principals Information Sheet, which each principal received and signed before participant recruitment begun;
- Parents Information Sheet, which outlines the study goals and procedure as well as the participant's rights;
- Research Consent Form, which each participant's parent signed before a participant met the researcher;
- Researchers Notes (children), containing instructions and interview script;
- Teachers Information Sheet, which outlines the study goals and procedure as well as the participant's rights;
- Research Consent Form, which each teacher participant signed at the beginning of their session;
- Researchers Notes (teachers), containing instructions and interview script.

Computing and Mathematical Sciences  
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17 July 2013

Nic Vanderschantz  
C/- Department of Computer Science  
THE UNIVERSITY OF WAIKATO

Dear Nic

**Request for approval to conduct a research evaluation involving human participants**

I have considered your request to carry out a research study *Teachers' Observations of Children's Information Search Tasks* to be conducted in nominated primary and intermediate schools in the Waikato, by teachers in classrooms and also with children selected by their teacher.

The primary purpose of the research is to investigate how children access information and read in a digital environment.

The procedure described in your request is acceptable.

I note that interviews with children will be conducted within the class rooms and will be audio recorded.

Publications and reports will not contain any personal data of the participants and their identities will be kept anonymous. At completion of the data analysis the data and audio recordings will be housed in FCMS data archive and destroyed after the submission of your PhD thesis.

The research participants' information sheets, consent forms and questionnaires meet the requirements of the University's human research ethics policies and procedures.

I therefore approve your application to perform the evaluation.

Yours sincerely,



**Lyn Hunt**  
Human Research Ethics Committee  
School of Computing and Mathematical Sciences

Figure B.1 Study Ethics Approval



THE UNIVERSITY OF  
**WAIKATO**  
*Te Whare Wānanga o Waikato*

**Principal's Information Sheet**

(date)

We would like to invite {first name last name} and {school name} to take part in a research project investigating children's on-screen knowledge acquisition. This research is being conducted as part of on-going research into reading materials for children and the design of effective reading materials for learning.

**Project Title**  
Teachers Observations of Children's Information Search Tasks

**Benefits**  
By being a contributing partner in this research, your school may benefit from innovations that occur in the design of on-screen reading material for young readers. Teaching staff at the school may also benefit from early insight into the results of this investigation through access to reports and papers generated. Please request access to reports, papers and summaries via email to Nicholas Vanderschantz should you wish to receive these once they become available.

**Research Relevance**  
This research sets out to investigate how children access information and read in a digital environment.

To date, there has been limited research and investigation about how children read and find information on-screen, and the visual design of children's on-screen reading media for effective learning. An increasing amount of children's reading material is on a small screen. With the increase of personal hand-held devices, a greater amount of reading material is available at all times. Through development of a greater understanding of how children find information, it is envisaged that this research may encourage better practices in the design of reading material for children.

**Research Method**  
I would ask that you invite through a suitable staff forum, 1 or 2 teachers at each year level 5, 6, 7 & 8 to participate in a 20 minute semi-structured interview with the researcher (attached for your benefit). Each of these teachers, once they have agreed to participate, would also identify 3 male and 3 female students in their classroom to take home a second document that invites the parent to give permission for their child to participate in a similar 20 minute semi-structured interview with the researcher (also attached for your benefit). Teacher interviews would take place at your school in a location designated by yourself and at a time suitable to yourself and the teacher. Pupil interviews would take place in the classroom, when the teacher is present in the room (but not necessarily sat in on the interview), enabling a student to request advice or guidance from their teacher should the need arise. Teacher and student interviews would be audio recorded and hand written notes taken by the researcher.

The Faculty of Computing and Mathematical Sciences Ethics Committee, University of Waikato, has approved this project. This research will uphold and abide by the research regulations of the University of Waikato.

**What will happen to the information collected?**  
The information collected will be used by the researchers to write research papers for submission to conferences or academic journals and will contribute to Nicholas Vanderschantz PhD. The researcher and supervisor will be the only people with access to the data collected from this research activity. The data and audio recordings will be stored on a password protected computer in Nicholas Vanderschantz office at the University of Waikato and paper records will be kept as well. This office and computer are accessible only to the researcher. At completion of the data analysis the data and audio recordings will be housed in the FCMS data archive until completed submission of Nicholas PhD, approximately 2018. After the completion of the project, all documents and audio recordings will be destroyed. No participants will be named, nor will any identifiable information be used in the publications.

**Declaration to participants**  
If your staff and the parents of pupils take part in the study, you and your staff and the parents of pupils have the right to:

- Refuse to answer any particular question
- Ask any further questions about the study during your participation.
- Request access to a summary of findings from the study when it is concluded.

If you have any questions or concerns about the project, either now or in the future, please feel free to contact either:

<p><b>Researcher:</b> Nicholas Vanderschantz Phone: (07) 838 4656 Email: vtwoz@cs.waikato.ac.nz</p>	<p><b>Supervisors:</b> Dr Annika Hinze Phone: (07) 838 4052 Email: hinze@waikato.ac.nz</p>	<p>Dr Sally Jo Cunningham Phone: (07) 838 4402 Email: sallyjo@waikato.ac.nz</p>
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I {first name last name}, Principal of {school name} consent to the conducting of this research project as outlined above.

Signed \_\_\_\_\_ Date \_\_\_\_\_

Figure B.2 Principals Information Sheet

## **Participant Information Sheet (Parents)**



### **Ethics Committee, Faculty of Computing and Mathematical Sciences**

**Invitation to participate in a short interview with a university researcher.**

**Your child's participant ID is: «Student\_ID»**

#### **Project Title**

Teachers Observations of Children's Information Search Tasks

#### **Purpose**

This research is being conducted as part of on-going research into reading materials for children and the design of effective reading materials for learning.

#### **What is this research project about?**

This research sets out to investigate how children access information and read in a digital environment.

#### **What will your child have to do and how long will it take?**

This research activity will be performed as a semi-structured interview with your child conducted by the researcher and will take approximately 20 minutes to complete. This interview will be audio recorded and hand written notes recorded by the researcher. This interview will take place in the classroom, when the teacher is present in the room (but not necessarily sat in on the interview), enabling your child to request advice or guidance from their teacher should the need arise.

#### **What will happen to the information collected?**

The information collected will be used by the researchers to write research papers for submission to conferences or academic journals and will contribute to Nicholas Vanderschantz PhD. The researcher and supervisor will be the only people with access to the data collected from this research activity. The data and audio recordings will be stored on a password protected computer in Nicholas Vanderschantz office at the University of Waikato and paper records will be kept as well. This office and computer are accessible only to the researcher. At completion of the data analysis the data and audio recordings will be housed in the FCMS data archive until completed submission of Nicholas PhD, approximately 2018. After the completion of the project, all documents and audio recordings will be destroyed. No participants will be named, nor will any identifiable information be used in the publications.

The information provided will be treated confidentially.

#### **Declaration to participants**

If your child takes part in the study, they have the right to:

- Refuse to answer any particular question, have withdrawn information pertaining to specific interactions observed or to be withdrawn from the study before analysis has commenced on the data.
- Ask any further questions about the study that occurs to you during your participation.
- Be given access to a summary of findings from the study when it is concluded.

#### **Who's responsible?**

If you have any questions or concerns about the project, either now or in the future, please feel free to contact either:

#### **Researcher's Name:**

Nicholas Vanderschantz  
(07) 838 4652  
vtwoz@waikato.ac.nz

#### **Supervisors:**

Annika Hinze  
(07) 838 4052  
hinze@waikato.ac.nz

Sally Jo Cunningham  
(07) 838 4402  
sallyjo@waikato.ac.nz

**Figure B.3 Parents Information Sheet**

**Participant Information Sheet**  
*(Parents)*



**Ethics Committee, Faculty of Computing and Mathematical Sciences**

Your child's participant ID is: «Student\_ID»

**Project Title**  
Teachers Observations of Children's Information Search Tasks

**Consent Form for Participants**  
I have read the **Participant Information Sheet** for this study and have chosen to contact (or not contact) the researcher or supervisor to have the details of the study I was unclear about explained to me. My questions about the study have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I also understand that I am free to withdraw my child from the study before the study commences or to have my child decline to answer any particular questions in the study. I understand I can withdraw any information I have provided or withdraw from the study up until the researcher has commenced analysis on my child's data. I agree to provide information to the researchers under the conditions of confidentiality set out on the **Participant Information Sheet**.

I agree to my child participating in this interview under the conditions set out in the **Participant Information Sheet**.

Signed: \_\_\_\_\_  
Name: \_\_\_\_\_  
Child's Name: \_\_\_\_\_  
Date: \_\_\_\_\_

I agree to my child's interview being **audio-recorded** under the conditions set out in the **Participant Information Sheet**.

Signed: \_\_\_\_\_  
Date: \_\_\_\_\_

<b>Researcher's Name:</b> Nicholas Vanderschantz (07) 838 4652 vtwoz@waikato.ac.nz	<b>Supervisors:</b> Annika Hinze (07) 838 4052 hinze@waikato.ac.nz	Sally Jo Cunningham (07) 838 4402 sallyjo@waikato.ac.nz
---	---	---

**Figure B.4 Parents Research Consent Form**

**Researchers Interview Notes Sheet  
(students)**



**Project Title**  
Teachers Observations of Children's Information Search Tasks

**Gender** M / F      **Age** ..... years      **Year Level** .....      **School** .....

**Participant ID:**

My questions relate to the most recent task that your teacher set where you searched for information on a topic.

**1) What topic did you investigate?**

.....

**2) Did your teacher set the topic of investigation or did you choose the topic to investigate?**

Teacher set       Student initiated

**3) Where did you investigate this topic:**

in the classroom       in the school library       at home outside of school hours

other outside of school hours .....

**4) Did the teacher or librarian teach you about how to investigate this topic?**

Did they have specific training for this task?

What: .....

**5) What resources did the teacher or librarian tell you to use?**

printed books       printed dictionary       printed encyclopedia

digital books       digital dictionary       digital encyclopedia

specific website       school library cat       school library books

google       Wikipedia      .....

**6) What resources did you use?**

printed books       printed dictionary       printed encyclopedia

digital books       digital dictionary       digital encyclopedia

specific website       school library cat       school library books

google       Wikipedia      .....

**Figure B.5 Researchers Notes (Students) - Page 1**

7a) What was hard when *searching* for digital information?  
.....

7b) What was easy when *searching* for digital information?  
.....

8a) What was hard when *using* digital information?  
.....

8b) What was easy when *using* digital information?  
.....

9a) What was hard when *searching* for printed books?  
.....

9b) What was easy when *searching* for printed books?  
.....

10a) What was hard when *using* printed books?  
.....

10b) What was easy when *using* printed books?  
.....

14) How do you search for books? What is your process for searching for books?

Figure B.6 Researchers Notes (Students) - Page 2

15) How do you search for information on a computer? What do you type into google?

16) Do you prefer printed information or computers?

11) Is there anything else about searching for and using information you would like to tell me?

.....  
.....  
.....  
.....

12) How did you submit a result for this task?

essay    poster    other .....

Figure B.7 Researchers Notes (Students) - Page 3

**13) Did a teacher or librarian teach you about how to investigate topics at any other time?**

Was there training earlier this year?

What: .....

.....

.....

At what year level did other teaching happen?

What: .....

.....

.....

**Figure B.8 Researchers Notes (Students) - Page 4**

**Participant Information Sheet**  
(Teachers)



**Ethics Committee, Faculty of Computing and Mathematical Sciences**

Your participant ID is:

**Project Title**

Teachers Observations of Children's Information Search Tasks

**Purpose**

This research is being conducted as part of on-going research into reading materials for children and the design of effective reading materials for learning.

**What is this research project about?**

This research sets out to investigate how children access information and read in a digital environment.

**What will you have to do and how long will it take?**

This research activity will be performed as a semi-structured interview with the researcher and will take approximately 20 minutes to complete. This interview will be audio recorded and hand written notes recorded by the researcher.

**What will happen to the information collected?**

The information collected will be used by the researchers to write research papers for submission to conferences or academic journals and will contribute to Nicholas Vanderschantz PhD. The researcher and supervisor will be the only people with access to the data collected from this research activity. The data and audio recordings will be stored on a password protected computer in Nicholas Vanderschantz office at the University of Waikato and paper records will be kept as well. This office and computer are accessible only to the researcher. At completion of the data analysis the data and audio recordings will be housed in the FCMS data archive until completed submission of Nicholas PhD, approximately 2018. After the completion of the project, all documents and audio recordings will be destroyed. No participants will be named, nor will any identifiable information be used in the publications.

The information provided will be treated confidentially.

**Declaration to participants**

If you take part in the study, you have the right to:

- Refuse to answer any particular question, withdraw information pertaining to specific interactions observed or to withdraw from the study before analysis has commenced on the data.
- Ask any further questions about the study that occurs to you during your participation.
- Be given access to a summary of findings from the study when it is concluded.

You are not obligated by your employer to participate and choosing not to participate in this study will have no repercussions for you with your employer.

**Who's responsible?**

If you have any questions or concerns about the project, either now or in the future, please feel free to contact either:

**Researcher's Name:**

Nicholas Vanderschantz  
(07) 838 4652  
vtwoz@waikato.ac.nz


**Supervisors:**

Annika Hinze  
(07) 838 4052  
hinze@waikato.ac.nz

Sally Jo Cunningham  
(07) 838 4402  
sallyjo@waikato.ac.nz

**Figure B.9 Teachers Information Sheet**

**Research Consent Form**  
*(Teachers)*



**Ethics Committee, Faculty of Computing and Mathematical Sciences**

**Your participant ID is:**

**Project Title**  
Teachers Observations of Children's Information Search Tasks

**Consent Form for Participants**  
I have read the **Participant Information Sheet** for this study and have had the details of the study explained to me. My questions about the study have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I also understand that I am free to withdraw from the study before the study commences or to decline to answer any particular questions in the study. I understand I can withdraw any information I have provided or withdraw from the study up until the researcher has commenced analysis on my data. I agree to provide information to the researchers under the conditions of confidentiality set out on the **Participant Information Sheet**.

I agree to participate in this interview under the conditions set out in the **Participant Information Sheet**.

Signed: \_\_\_\_\_

Name: \_\_\_\_\_

Date: \_\_\_\_\_

I agree to have this interview **audio-recorded** under the conditions set out in the **Participant Information Sheet**.

Signed: \_\_\_\_\_

Date: \_\_\_\_\_

<b>Researcher's Name:</b> Nicholas Vanderschantz (07) 838 4652 vtwoz@waikato.ac.nz	<b>Supervisors:</b> Annika Hinze (07) 838 4052 hinze@waikato.ac.nz	Sally Jo Cunningham (07) 838 4402 sallyjo@waikato.ac.nz
---	---	---

Figure B.10 Teachers Research Consent Form

**Researchers Interview Notes Sheet  
(teachers)**



**Project Title**  
Teachers Observations of Children's Information Search Tasks

**Gender** M / F      **Year Level** .....      **Years Teaching** .....      **School** .....

**Participant ID:**

My questions relate to the most recent task that you set where students searched for information on a topic.

**1) Did you set the topic of investigation or did the students choose the topic to investigate?**

Teacher set       Student initiated

**2) What topic did the students investigate?**

OR

**What types of topics did the students choose to investigate?**

.....

**3) Where did the students investigate this topic:**

in the classroom       in the school library       at home outside of school hours

other location outside of school hours .....

**4) What instruction or training did the students receive on how to investigate this topic?**

Did they have specific training for this task?

What: .....

**5) What resources did you expect the students to use to investigate this topic?**

printed books       printed dictionary       printed encyclopedia

digital books       digital dictionary       digital encyclopedia

specific website       school library books       school library catalogue

google       Wikipedia      .....

**Figure B.11 Researchers Notes (Teachers) - Page 1**

**6) What percentage of students used the following resources?**

printed books       printed dictionary       printed encyclopedia

digital books       digital dictionary       digital encyclopedia

specific website       school library books       school library catalogue

google       Wikipedia      .....

**6a) Do you know this through**

observation       cited references       handed in copies of references

individual discussion       written evidence       other .....

**7) What issues did you notice children having when *searching* for digital information?**

.....

.....

**8) What issues did you notice children having when *using* digital information?**

.....

.....

**9) What issues did you notice children having when *searching* for printed books?**

.....

.....

**10) What issues did you notice children having when *using* printed books?**

.....

.....

**11) Do you have further observations regarding children's search for and use of information?**

.....

.....

.....

.....

Figure B.12 Researchers Notes (Teachers) - Page 2

16) Can you describe the process when searching using printed material or books etc?

17) Can you describe the process when searching using printed computers or iPads etc?

**Figure B.13 Researchers Notes (Teachers) - Page 3**

**12) How did the student submit a result of this?**  
[ ] essay [ ] poster [ ] other .....

**13) What previous instruction or training did the students receive on how to investigate a task?**  
[ ] Was there training previously this year?  
What: .....  
[ ] At what year level did previous training happen?  
What: .....  
.....  
.....

**14) Do you have plans for further instruction or training on how to investigate a task?**  
[ ] This year?  
What: .....  
[ ] At what year level will further training happen?  
What: .....  
.....  
.....

**15) What future topics will you set this year for investigation?**  
.....

Figure B.14 Researchers Notes (Teachers) - Page 4



## **Appendix C.**

### **Material for Visual Analysis Study (Chapter 7)**

This appendix contains larger visuals for selected figures presented in Chapter 7. These images allow clearer review of the complex visual nature of internet search engine results pages at the time of this study.

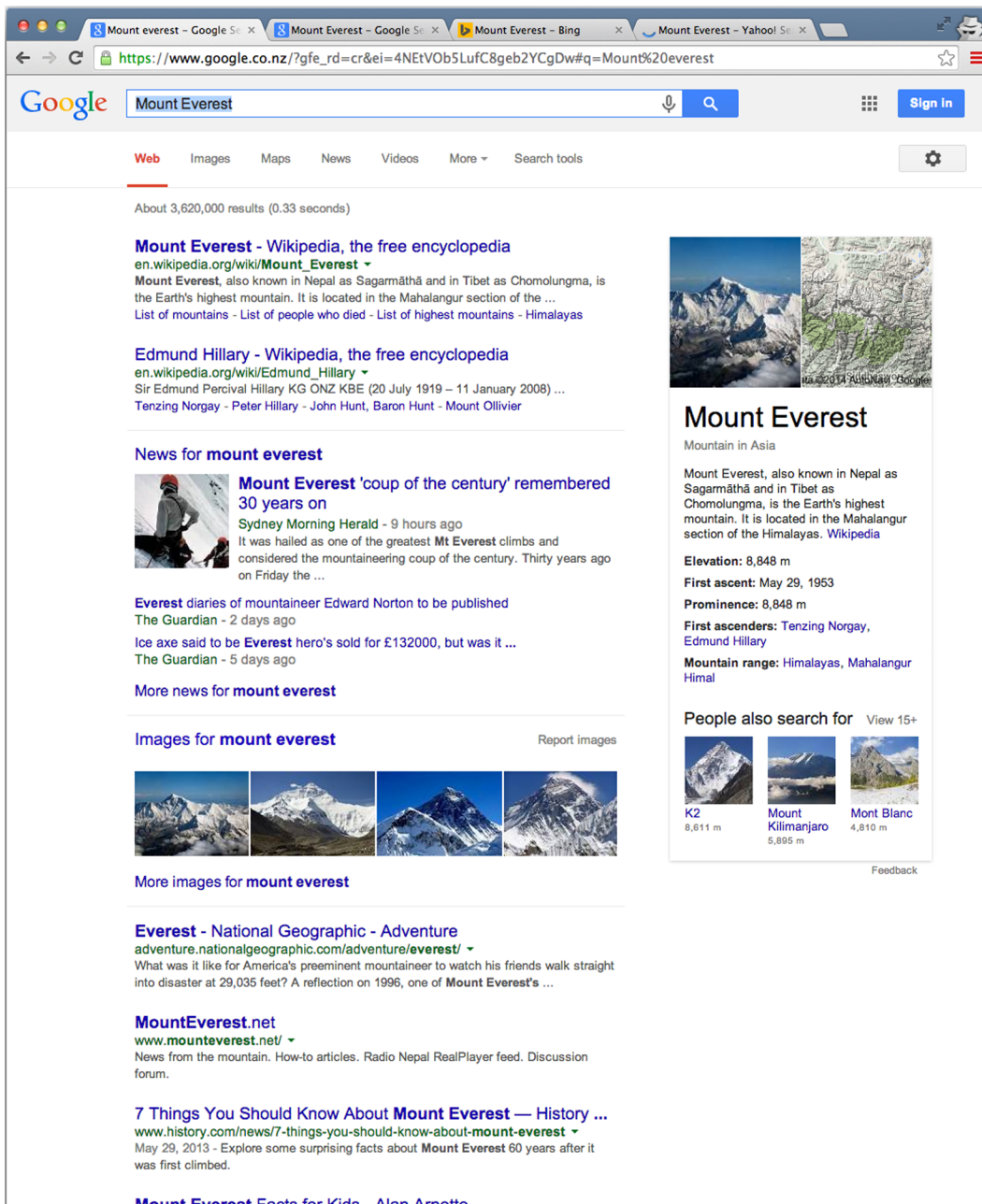


Figure C.1 Google SERP refer Figure 7.1. Google and the Google logo are registered trademarks of Google Inc., used with permission.

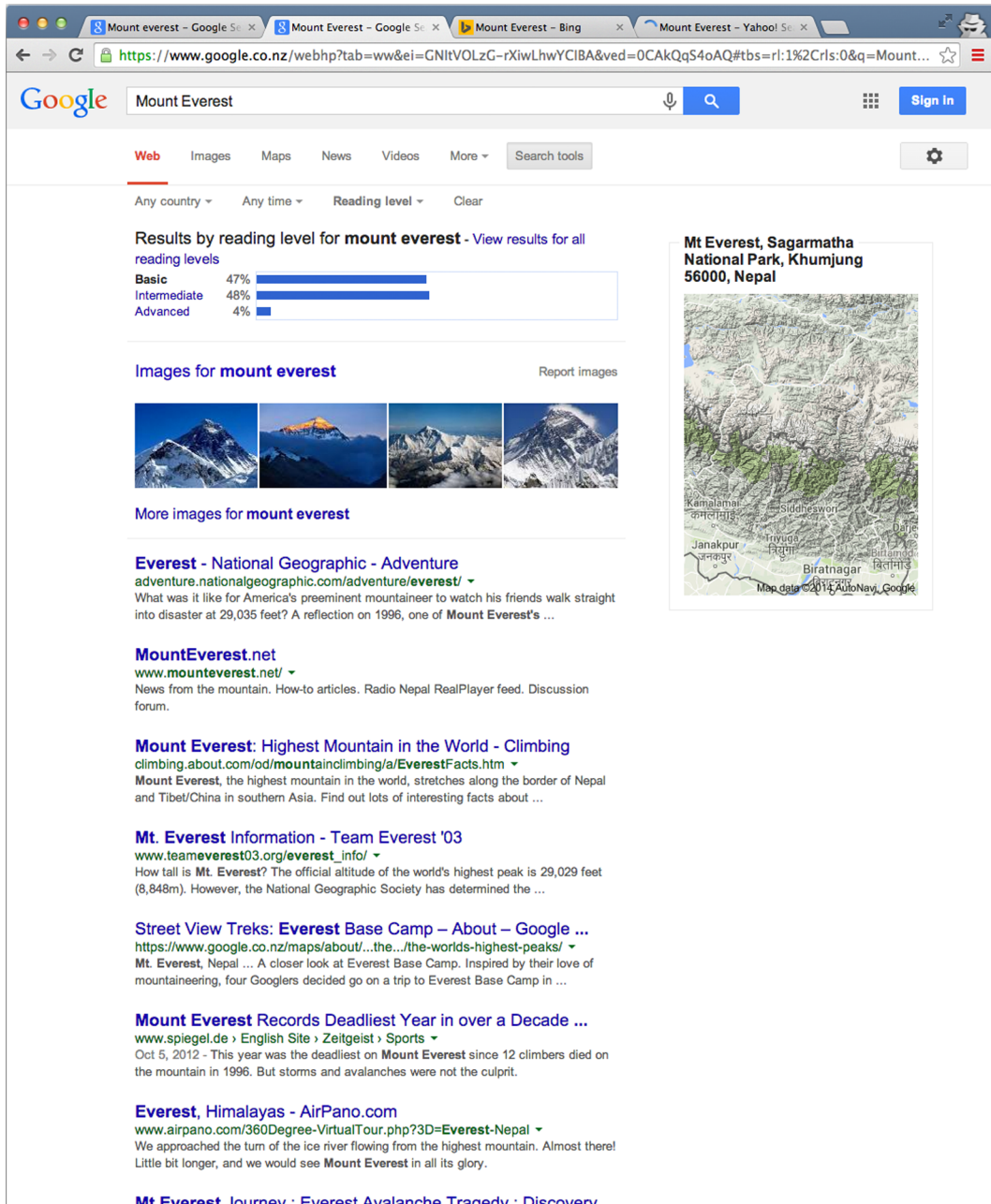


Figure C.2 Google-BRLF SERP refer Figure 7.1. Google and the Google logo are registered trademarks of Google Inc., used with permission.

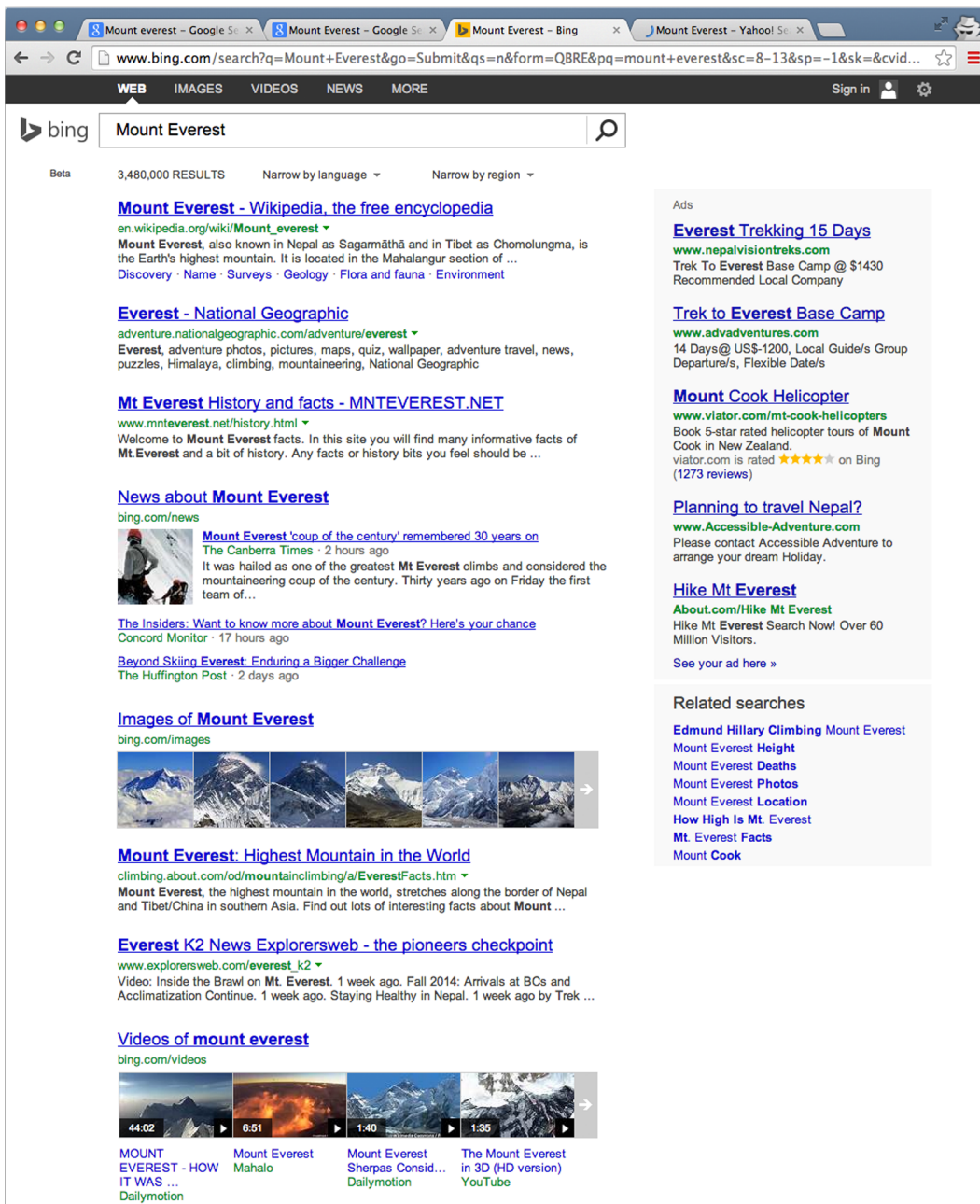


Figure C.3 Bing SERP refer Figure 7.1. Bing, used with permission from Microsoft.

The screenshot shows a Yahoo! search engine results page for the query "Mount Everest". The browser's address bar displays a URL from nz.search.yahoo.com. The page layout includes a search bar at the top with the query "Mount Everest" and a "Search" button. Below the search bar, there are navigation links for "Web", "Images", "News", "Sport", "Finance", and "More". The main content area is divided into several sections:

- Ads related to: Mount Everest:** This section contains several sponsored links for Everest base camp tours and treks, including "Everest Base Camp Tours - tibetravel.org", "Everest Base Camp Trek - ametreks.com", and "Everest Base Camp, Nepal - AdventureAlternative.com".
- Yahoo featured content:** This section features a link to "Mount Everest Images - Flickr" with a grid of eight small images showing various views of the mountain, including snow-capped peaks and rocky terrain.
- Web results:** This section lists organic search results, including:
  - Mount Everest - Wikipedia, the free encyclopedia:** A link to the Wikipedia page for Mount Everest, with a "Cached" label.
  - Edmund Hillary - Wikipedia, the free encyclopedia:** A link to the Wikipedia page for Edmund Hillary, with a "Cached" label.
  - Everest - National Geographic - Adventure:** A link to a National Geographic article about Everest, with a "Cached" label.
  - MountEverest.net:** A link to the website MountEverest.net, with a "Cached" label.
- Ads:** A vertical column of sponsored links on the right side of the page, including "Tanzania Wildlife Safari", "2014 Mt Everest Avalanche", "Where Is Mount Everest", "Climbing Everest?", "Mt Everest History And Facts", "Blades, Mounts, Eyelets", "Mt Everest Pictures", and "Mt Everest Hike".

Figure C.4 Yahoo! SERP refer Figure 7.1. Yahoo! used with permission from Yahoo!



## **Appendix D.**

### **Material for Observation Study (Chapter 8)**

This appendix contains all related material for the observation user study reported in Chapter 8:

- Ethical Approval Letter from the Human Research Ethics Committee of the Faculty of Computing and Mathematical Sciences at the University of Waikato, dated 22 July 2014;
- Principals Information Sheet, which each principal received and signed before participant recruitment begun;
- Parents Information Sheet, which outlines the study goals and procedure as well as the participant's rights;
- Research Consent Form, which each participant's parent signed before a participant met the researcher;
- Researchers Notes, which contains instructions, the study tasks and the script used for each observation.

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22 July 2014

Nic Vanderschantz  
C/- Department of Computer Science  
THE UNIVERSITY OF WAIKATO

Dear Nic

**Request for approval to conduct a research evaluation involving human participants**

I have considered your request to carry out a research study *Children's Information Search Practices* to be conducted in nominated primary and intermediate schools in the Hamilton, by teachers in classrooms and also with children selected by their teacher.

The primary purpose of the research is to investigate how children access information and read in a digital environment.

The procedure described in your request is acceptable.

I note that interviews with children will be conducted in the school library with a teacher or librarian present and will be audio recorded.

Publications and reports will not contain any personal data of the participants and their identities will be kept anonymous. At completion of the data analysis the data and audio recordings will be housed in FCMS data archive and destroyed after the submission of your PhD thesis.

The research participants' information sheets, consent forms and questionnaires meet the requirements of the University's human research ethics policies and procedures.

I therefore approve your application to perform the evaluation.

Yours sincerely,

**Masood Masoodian**  
Human Research Ethics Committee  
School of Computing and Mathematical Sciences

**Figure D.1 Study Ethics Approval**



THE UNIVERSITY OF  
**WAIKATO**  
*Te Whare Wānanga o Waikato*

**Principal's Information Sheet**

(date)

We would like to invite {first name last name} and {school name} to take part in a research project investigating children's on-screen knowledge acquisition. This research is being conducted as part of on-going research into reading materials for children and the design of effective reading materials for learning.

**Project Title**  
Children's Information Search Practices

**Benefits**  
By being a contributing partner in this research, your school may benefit from innovations that occur in the design of on-screen reading material for young readers. Teaching staff at the school may also benefit from early insight into the results of this investigation through access to reports and papers generated. Please request access to reports, papers and summaries via email to Nicholas Vanderschantz should you wish to receive these once they become available.

**Research Relevance**  
This research sets out to investigate how children access information and read in a digital environment.

To date, there has been limited research and investigation about how children read and find information on-screen, and the visual design of children's on-screen reading media for effective learning. An increasing amount of children's reading material is on a small screen. With the increase of personal hand-held devices, a greater amount of reading material is available at all times. Through development of a greater understanding of how children find information, it is envisaged that this research may encourage better practices in the design of reading material for children.

**Research Method**  
I would ask that you invite 4 male and 4 female students at both year 5 & 6 or both year 7 & 8 to take home a document that invites the parent to give permission for their child to participate in a 30 minute observation study with the researcher (attached for your benefit). This observation will be audio recorded and hand written notes recorded by the researcher. The computer screen will also be video recorded, but the child will not be identifiable by the video camera. This observation will take place in the school library, when the child's teacher or the school librarian is present in the room (but not necessarily sat in on the observation), enabling the child to request advice or guidance from their teacher or the librarian should the need arise. The child will be asked to perform an information search using a school computer or the schools library facilities and books.

The Faculty of Computing and Mathematical Sciences Ethics Committee, University of Waikato, has approved this project. This research will uphold and abide by the research regulations of the University of Waikato.

**What will happen to the information collected?**  
The information collected will be used by the researchers to write research papers for submission to conferences or academic journals and will contribute to Nicholas Vanderschantz PhD. The researcher and supervisor will be the only people with access to the data collected from this research activity. The data and audio recordings will be stored on a password protected computer in Nicholas Vanderschantz office at the University of Waikato and paper records will be kept as well. This office and computer are accessible only to the researcher. At completion of the data analysis the data and audio recordings will be housed in the FCMS data archive until completed submission of Nicholas PhD, approximately 2018. After the completion of the project, all documents and audio recordings will be destroyed. No participants will be named, nor will any identifiable information be used in the publications.

**Declaration to participants**  
If parents agree for their child to take part in the study, you and your staff and the parents of pupils have the right to:

- Refuse to answer any particular question, withdraw information pertaining to specific interactions observed or to be withdrawn from the study before analysis has commenced on the data.
- Ask any further questions about the study that occurs to you or your child during their participation.
- Be given access to a summary of findings from the study when it is concluded.

If you have any questions or concerns about the project, either now or in the future, please feel free to contact either:

<b>Researcher:</b> Nicholas Vanderschantz Phone: (07) 838 4656 Email: vtwoz@cs.waikato.ac.nz	<b>Supervisors:</b> Dr Annika Hinze Phone: (07) 838 4052 Email: hinze@waikato.ac.nz	 Dr Sally Jo Cunningham Phone: (07) 838 4402 Email: sallyjo@waikato.ac.nz
---	--	--

---

I {first name last name}, Principal of {school name} consent to the conducting of this research project as outlined above.

Signed \_\_\_\_\_ Date \_\_\_\_\_

Figure D.2 Principals Information Sheet

**Participant Information Sheet**  
(Parents)



**Ethics Committee, Faculty of Computing and Mathematical Sciences**

**Invitation to participate in a short user study with a university researcher.**

**Your child's participant ID is: «Student\_ID»**

**Project Title**

Children's Information Search Practices

**Purpose**

This research is being conducted as part of on-going research into reading materials for children and the design of effective reading materials for learning.

**What is this research project about?**

This research sets out to investigate how children access information and read in a digital environment.

**What will your child have to do and how long will it take?**

This research activity will be performed as an observation study with your child conducted by the researcher and will take approximately 30 minutes to complete. This observation will be audio recorded and hand written notes recorded by the researcher. The computer screen will also be video recorded, but the child will not be identifiable by the video camera. This observation will take place in the school library, when the child's teacher or the school librarian is present in the room (but not necessarily sat in on the observation), enabling your child to request advice or guidance from their teacher or the librarian should the need arise. The child will be asked to perform an information search using a school computer or the school's library.

**What will happen to the information collected?**

The information collected will be used by the researchers to write research papers for submission to conferences or academic journals and will contribute to Nicholas Vanderschantz PhD. The researcher and supervisor will be the only people with access to the data collected from this research activity. The data and audio recordings will be stored on a password protected computer in Nicholas Vanderschantz's office at the University of Waikato and paper records will be kept as well. This office and computer are accessible only to the researcher. At completion of the data analysis the data and audio recordings will be housed in the FCMS data archive until completed submission of Nicholas PhD, approximately 2018. After the completion of the project, all documents and audio recordings will be destroyed. No participants will be named, nor will any identifiable information be used in the publications.

The information provided will be treated confidentially.

**Declaration to participants**

If your child takes part in the study, they have the right to:

- Refuse to answer any particular question, withdraw information pertaining to specific interactions observed or to be withdrawn from the study before analysis has commenced on the data.
- Ask any further questions about the study that occurs to you or your child during their participation.
- Be given access to a summary of findings from the study when it is concluded.

**Who's responsible?**

If you have any questions or concerns about the project, either now or in the future, please feel free to contact either:


**Researcher's Name:**  
Nicholas Vanderschantz  
(07) 838 4652  
vtwoz@waikato.ac.nz

**Supervisors:**  
Annika Hinze  
(07) 838 4052  
hinze@waikato.ac.nz

Sally Jo Cunningham  
(07) 838 4402  
sallyjo@waikato.ac.nz

**Figure D.3 Parents Information Sheet**

**Participant Information Sheet**  
(Parents)



THE UNIVERSITY OF  
**WAIKATO**  
*Te Whare Wānanga o Waikato*

**Ethics Committee, Faculty of Computing and Mathematical Sciences**

**Your child's participant ID is: «Student\_ID»**

**Project Title**  
Children's Information Search Practices

**Consent Form for Participants**  
I have read the **Participant Information Sheet** for this study and have chosen to contact (or not contact) the researcher or supervisor to have the details of the study I was unclear about explained to me. My questions about the study have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I also understand that I am free to withdraw my child from the study before the study commences or to have my child decline to answer any particular questions in the study. I understand I can withdraw any information I have provided or withdraw from the study up until the researcher has commenced analysis on my child's data. I agree to provide information to the researchers under the conditions of confidentiality set out on the **Participant Information Sheet**.

I agree to my child participating in this observation study under the conditions set out in the **Participant Information Sheet**.

Signed: \_\_\_\_\_

Name: \_\_\_\_\_

Child's Name: \_\_\_\_\_

Date: \_\_\_\_\_

I agree to my child's observation study being **audio-recorded** under the conditions set out in the **Participant Information Sheet**.

Signed: \_\_\_\_\_

I agree to my child's computer screen being **video-recorded** under the conditions set out in the **Participant Information Sheet**.

Signed: \_\_\_\_\_

<p><b>Researcher's Name:</b> Nicholas Vanderschantz (07) 838 4652 vtwoz@waikato.ac.nz</p>	<p><b>Supervisors:</b> Annika Hinze (07) 838 4052 hinze@waikato.ac.nz</p>	<p>Sally Jo Cunningham (07) 838 4402 sallyjo@waikato.ac.nz</p>
---	---	--

**Figure D.4 Parents Research Consent Form**

**Researchers Interview Notes Sheet  
(students)**



**Project Title**  
Children's Information Search Practices

**Gender** M / F      **Age** ..... years      **Year Level** .....      **School** .....

**Participant ID:**

Today you are going to help me search for information.  
We can use this computer here in any way to search for this information.  
I am interested in how you find information, and there really are no wrong answers today.

Lets start by searching for information about something you enjoy.

1. Do you have a favorite book or sport or musician?
  
2. What could we search the internet to find out about ..... (from above favorite)?
  
3. Right, can you please search for information about ..... (from 2. above)?

**3.1. How would you like to do that?**

**a. Student said:**

**b. Student did:**

**3.2. I noticed you did ..... Why did you do that?**

**Keyboard**

**Screen**

**Suggestion**

**Enter**

**Retype**

**Figure D.5 Researchers Notes – Page 1**

4. Now lets find out,  
*Where do possums live and are they a pest in New Zealand?*

**4.1. How would you like to do that?**

**a. Student said:**

**b. Student did:**

**4.2. I noticed you did ..... Why did you do that?**

**Keyboard**  
**Screen**  
**Suggestion**  
**Enter**  
**Retype**

Figure D.6 Researchers Notes – Page 2

5. Now,

*Mount Cook is a mountain in the South Island of New Zealand, lets find facts about Mount Cook.*

**5.1. How would you like to do that?**

**a. Student said:**

**b. Student did:**

**5.2. I noticed you did ..... Why did you do that?**

**Keyboard**

**Screen**

**Suggestion**

**Enter**

**Retype**

**Figure D.7 Researchers Notes – Page 3**

**\*\* Give printed question \*\***

6. Now, what would you do if I gave you this as a question to investigate?  
(How many rings does Uranus have, and what are they made of?)

6.1. How would you like to do that?

a. Student said:

b. Student did:

6.2. I noticed you did ..... Why did you do that?

Keyboard

Screen

Suggestion

Enter

Retype

Figure D.8 Researchers Notes – Page 4

**\*\* Give printed topic \*\***

7. Now, what would you do if I gave you this as a question to investigate?  
(*The Cricket World Cup will be held in New Zealand in 2015, find facts about the Cricket World Cup*)

7.1. How would you like to do that?

a. Student said:

b. Student did:

7.2. I noticed you did ..... Why did you do that?

Keyboard

Screen

Suggestion

Enter

Retype

**Figure D.9 Researchers Notes – Page 5**

**8) What was hard when searching today?**  
.....

**9) What was easy when searching today?**  
.....

**10) What can be hard when searching on a computer?**  
.....

**11) What can be easy when searching on a computer?**  
.....

Figure D.10 Researchers Notes – Page 6

**12a) How did you decide what to type into the search box today?**

**12b) When a teacher sets an inquiry, what your process?**

**13) Is there anything else about searching for and using information you would like to tell me?**

.....

.....

.....

.....

**Figure D.11 Researchers Notes – Page 7**

**\*\* Refer to Pictures \*\***

**14) Did they click on one of the example queries?** [ ] Yes [ ] No

**15) Did you see an example search while you were typing today?** [ ] Yes [ ] No

**16) Do you use these example queries?** [ ] Yes [ ] No

When? Why?

Remember it is OK to say no OR yes, please be truthful.  
Scroll down to the bottom of the search result list for me.

**17) Did they click a related search?** [ ] Yes [ ] No

**18) Have you ever seen a list like this one in the red box before?** [ ] Yes [ ] No

**19) Do you use these related queries?** [ ] Yes [ ] No

When? Why?

**20) The image above is what a search result list might look like.**  
Please look at the blue text, the green text and the grey text for each website you could visit.  
Please put a tick in the box proved next to the colour text that you used today to make decisions about which website to visit.  
You can tick more than one colour text if you read more than one to make a decision.

[ ] Blue [ ] Green [ ] Grey

Why?

Figure D.12 Researchers Notes – Page 8

Question 6.

*How many rings does Uranus have, and what are they made of?*

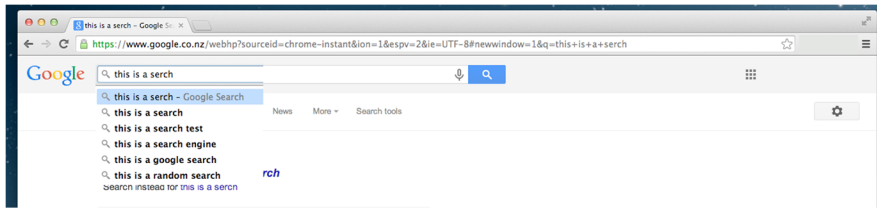
**Figure D.13 Researchers Notes – Question 6 for Student to Read**

Question 7.

*The Cricket World Cup will be held in New Zealand in 2015,  
find facts about the Cricket World Cup.*

**Figure D.14 Researchers Notes – Question 7 for Student to Read**

14) & 15) & 16)



17) & 18) & 19)

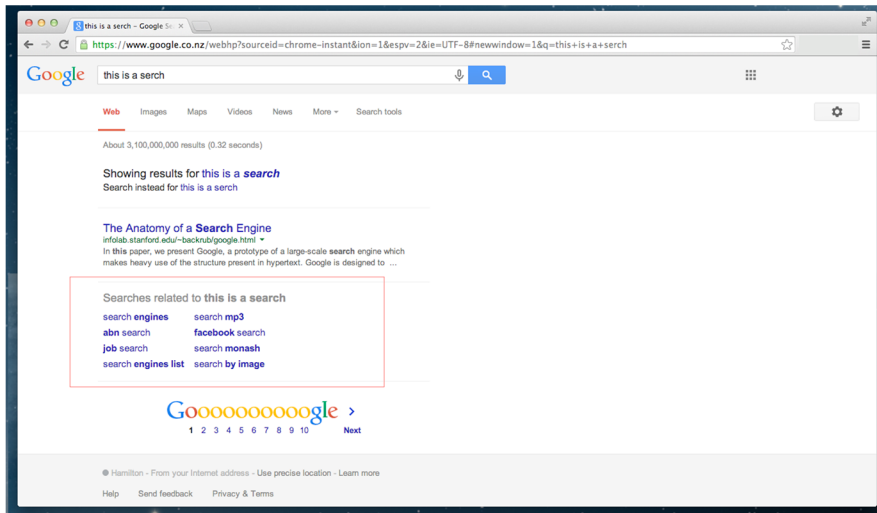


Figure D.15 Researchers Notes – Visuals for Questions 14 – 19. Google and the Google logo are registered trademarks of Google Inc., used with permission.

20)

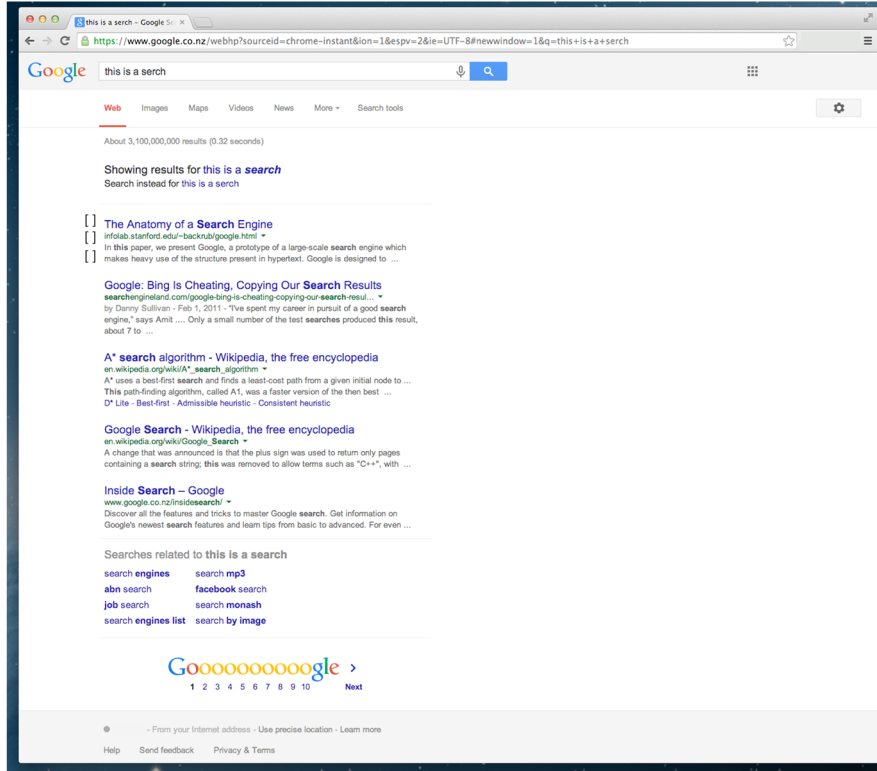


Figure D.16 Researchers Notes – Visuals for Question 20. Google and the Google logo are registered trademarks of Google Inc., used with permission.



## **Appendix E.**

### **Material for KidsQuestions Usability Study (Chapter 10)**

This appendix contains all related material for the observation user study reported in Chapter 10:

- Ethical Approval Letter from the Human Research Ethics Committee of the Faculty of Computing and Mathematical Sciences at the University of Waikato, dated 14 April 2015;
- Principals Information Sheet, which each principal received and signed before participant recruitment begun;
- Parents Information Sheet, which outlines the study goals and procedure as well as the participant's rights;
- Research Consent Form, which each participant's parent signed before a participant met the researcher;
- Researchers Notes, which contains instructions, the study tasks and the script used for each observation.

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Mathematical Sciences  
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THE UNIVERSITY OF  
**WAIKATO**  
*Te Whare Wānanga o Waikato*

14 April 2015

Nic Vanderschantz  
C/- Department of Computer Science  
**THE UNIVERSITY OF WAIKATO**

Dear Nic

**Application for approval under the Ethical Conduct in Human Research and Related Activities Regulations**

I have considered your application for a research project involving human participants entitled "Children's Information Search Practices 2", this being a follow on from your previously approved study.

I have considered your request to carry out an observation study with pupils at a range of Waikato primary and intermediate schools. The primary purpose of the research is to investigate how children access information and read in a digital environment.

The procedure described in your request is acceptable.

I note that interviews with children will be conducted within the classrooms or adjoining space and will be audio recorded, and the computer screen only will be video recorded.

Publications and reports will not contain any personal data of the participants and their identities will be kept anonymous. At completion of the data analysis the data and audio recordings will be housed in FCMS data archive and destroyed on completion of the project.

The research participants' information sheets, consent forms and questionnaires meet the requirements of the University's human research ethics policies and procedures.

I therefore approve your application to perform the evaluation.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Mark Apperley'.

**Mark Apperley**  
Human Research Ethics Committee  
Faculty of Computing and Mathematical Sciences

Figure E.1 Study Ethics Approval

## Principal's Information Sheet



THE UNIVERSITY OF  
**WAIKATO**  
*Te Whare Wānanga o Waikato*

(date)

We would like to invite {first name last name} and {school name} to take part in a research project investigating children's on-screen knowledge acquisition. This research is being conducted as part of on-going research into reading materials for children and the design of effective reading materials for learning.

**Project Title**  
Children's Information Search Practices 2

**Benefits**  
By being a contributing partner in this research, your school may benefit from innovations that occur in the design of on-screen reading material for young readers. Teaching staff at the school may also benefit from early insight into the results of this investigation through access to reports and papers generated. Please request access to reports, papers and summaries via email to Nicholas Vanderschantz should you wish to receive these once they become available.

**Research Relevance**  
This research sets out to investigate how children access information and read in a digital environment.

To date, there has been limited research and investigation about how children read and find information on-screen, and the visual design of children's on-screen reading media for effective learning. An increasing amount of children's reading material is on a small screen. With the increase of personal hand-held devices, a greater amount of reading material is available at all times. Through development of a greater understanding of how children find information, it is envisaged that this research may encourage better practices in the design of reading material for children.

**Research Method**  
I would ask that you invite 4 male and 4 female students at both year 5 & 6 or both year 7 & 8 to take home a document that invites the parent to give permission for their child to participate in a 30 minute observation study with the researcher (attached for your benefit). This observation will be audio recorded and hand written notes recorded by the researcher. The computer screen will also be video recorded, but the child will not be identifiable by the video camera. This observation will take place in the school library, classroom or adjoining space, when the child's teacher or the school librarian is present (but not necessarily sat in on the observation), enabling the child to request advice or guidance from their teacher or the librarian should the need arise. The child will be asked to perform an information search using a school computer or the schools library facilities and books.

The Faculty of Computing and Mathematical Sciences Ethics Committee, University of Waikato, has approved this project. This research will uphold and abide by the research regulations of the University of Waikato.

**What will happen to the information collected?**  
The information collected will be used by the researchers to write research papers for submission to conferences or academic journals and will contribute to Nicholas Vanderschantz PhD. The researcher and supervisor will be the only people with access to the data collected from this research activity. The data and audio recordings will be stored on a password protected computer in Nicholas Vanderschantz office at the University of Waikato and paper records will be kept as well. This office and computer are accessible only to the researcher. At completion of the data analysis the data and audio recordings will be housed in the FCMS data archive until completed submission of Nicholas PhD, approximately 2018. After the completion of the project, all documents and audio recordings will be destroyed. No participants will be named, nor will any identifiable information be used in the publications.

**Declaration to participants**  
If parents agree for their child to take part in the study, you and your staff and the parents of pupils have the right to:

- Refuse to answer any particular question, withdraw information pertaining to specific interactions observed or to be withdrawn from the study before analysis has commenced on the data.
- Ask any further questions about the study that occurs to you or your child during their participation.
- Be given access to a summary of findings from the study when it is concluded.

If you have any questions or concerns about the project, either now or in the future, please feel free to contact either:

<b>Researcher:</b> Nicholas Vanderschantz Phone: (07) 838 4656 Email: vtvozz@cs.waikato.ac.nz	<b>Supervisors:</b> Dr Annika Hinze Phone: (07) 838 4052 Email: hinze@waikato.ac.nz	Dr Sally Jo Cunningham Phone: (07) 838 4402 Email: sallyjo@waikato.ac.nz
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I {first name last name}, Principal of {school name} consent to the conducting of this research project as outlined above.

Signed \_\_\_\_\_ Date \_\_\_\_\_

Figure E.2 Principals Information Sheet

## **Participant Information Sheet (Parents)**



### **Ethics Committee, Faculty of Computing and Mathematical Sciences**

**Invitation to participate in a short user study with a university researcher.**

**Your child's participant ID is: «Student\_ID»**

#### **Project Title**

Children's Information Search Practices 2

#### **Purpose**

This research is being conducted as part of on-going research into reading materials for children and the design of effective reading materials for learning.

#### **What is this research project about?**

This research sets out to investigate how children access information and read in a digital environment.

#### **What will your child have to do and how long will it take?**

This research activity will be performed as an observation study with your child conducted by the researcher and will take approximately 30 minutes to complete. This observation will be audio recorded and hand written notes recorded by the researcher. The computer screen will also be video recorded, but the child will not be identifiable by the video camera. This observation will take place in the school library, classroom or adjoining space, when the child's teacher or the school librarian is present (but not necessarily sat in on the observation), enabling your child to request advice or guidance from their teacher or the librarian should the need arise. The child will be asked to perform an information search using a school computer or the school library.

#### **What will happen to the information collected?**

The information collected will be used by the researchers to write research papers for submission to conferences or academic journals and will contribute to Nicholas Vanderschantz PhD. The researcher and supervisor will be the only people with access to the data collected from this research activity. The data and audio recordings will be stored on a password protected computer in Nicholas Vanderschantz office at the University of Waikato and paper records will be kept as well. This office and computer are accessible only to the researcher. At completion of the data analysis the data and audio recordings will be housed in the FCMS data archive until completed submission of Nicholas PhD, approximately 2018. After the completion of the project, all documents and audio recordings will be destroyed. No participants will be named, nor will any identifiable information be used in the publications.

The information provided will be treated confidentially.

#### **Declaration to participants**

If your child takes part in the study, they have the right to:

- Refuse to answer any particular question, withdraw information pertaining to specific interactions observed or to be withdrawn from the study before analysis has commenced on the data.
- Ask any further questions about the study that occurs to you or your child during their participation.
- Be given access to a summary of findings from the study when it is concluded.

#### **Who's responsible?**

If you have any questions or concerns about the project, either now or in the future, please feel free to contact either:

#### **Researcher's Name:**

Nicholas Vanderschantz  
(07) 838 4652  
vtwoz@waikato.ac.nz


#### **Supervisors:**

Annika Hinze  
(07) 838 4052  
hinze@waikato.ac.nz

Sally Jo Cunningham  
(07) 838 4402  
sallyjo@waikato.ac.nz

**Figure E.3 Parents Information Sheet**

**Participant Information Sheet**  
*(Parents)*



**Ethics Committee, Faculty of Computing and Mathematical Sciences**

Your child's participant ID is: «Student\_ID»

**Project Title**  
Children's Information Search Practices

**Consent Form for Participants**  
I have read the **Participant Information Sheet** for this study and have chosen to contact (or not contact) the researcher or supervisor to have the details of the study I was unclear about explained to me. My questions about the study have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I also understand that I am free to withdraw my child from the study before the study commences or to have my child decline to answer any particular questions in the study. I understand I can withdraw any information I have provided or withdraw from the study up until the researcher has commenced analysis on my child's data. I agree to provide information to the researchers under the conditions of confidentiality set out on the **Participant Information Sheet**.

I agree to my child participating in this observation study under the conditions set out in the **Participant Information Sheet**.

Signed: \_\_\_\_\_

Name: \_\_\_\_\_

Child's Name: \_\_\_\_\_

Date: \_\_\_\_\_

I agree to my child's observation study being **audio-recorded** under the conditions set out in the **Participant Information Sheet**.

Signed: \_\_\_\_\_

I agree to my child's computer screen being **video-recorded** under the conditions set out in the **Participant Information Sheet**.

Signed: \_\_\_\_\_

<b>Researcher's Name:</b> Nicholas Vanderschantz (07) 838 4652 vtwoz@waikato.ac.nz	<b>Supervisors:</b> Annika Hinze (07) 838 4052 hinze@waikato.ac.nz	Sally Jo Cunningham (07) 838 4402 sallyjo@waikato.ac.nz
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Figure E.4 Parents Research Consent Form

**Researchers Interview Notes Sheet  
(students)**



**Project Title**  
Children's Information Search Practices 2

**Gender** M / F      **Age** ..... years      **Year Level** .....      **School** .....

**Participant ID:**

Today you are going to help me search for information.  
We can use this computer here to search for this information.  
I am interested in how you find information, and there really are no wrong answers today.

I know that you have been using Google right?  
Today we are going to use an enhanced version of Google – we call it the Questions Search Engine.

Lets start by searching for information about something you enjoy.

1. Do you have a favorite book or sport or musician?
  
2. What could we search the internet to find out about ..... (from above favorite)?

3. Right, can you please search for information about ..... (from 2. above)?

**3.1. How would you like to do that?**

**a. Student said:**

**b. Student did:**

**3.2. I noticed you did ..... Why did you do that?**

**Keyboard**

**Screen**

**Suggestion**

**Enter**

**Retype**

- Clicked a starter
- Clicked a recent Q
- Clicked a related search
- Clicked yellow toggle
- Clicked remember toggle

**Figure E.5 Researchers Notes – Page 1**

4. Now lets find out,  
*Where do possums live and are they a pest in New Zealand?*

**4.1. How would you like to do that?**  
a. **Student said:**

b. **Student did:**

**4.2. I noticed you did ..... Why did you do that?**

Keyboard  
Screen  
Suggestion  
Enter  
Retype

Clicked a starter  
 Clicked a recent Q  
 Clicked a related search  
 Clicked yellow toggle  
 Clicked remember toggle

Figure E.6 Researchers Notes – Page 2

5. Now,

*Mount Cook is a mountain in the South Island of New Zealand, lets find out about Mount Cook.*

**5.1. How would you like to do that?**

**a. Student said:**

**b. Student did:**

**5.2. I noticed you did ..... Why did you do that?**

**Keyboard**

**Screen**

**Suggestion**

**Enter**

**Retype**

- Clicked a starter
- Clicked a recent Q
- Clicked a related search
- Clicked yellow toggle
- Clicked remember toggle

**Figure E.7 Researchers Notes – Page 3**

**\*\* SHOW AND TELL \*\***

Saw?  Yes  No

Where info from?  Wiki  Sidebar

**\*\* Give printed question \*\***

6. Now, what would you do if I gave you this as a question to investigate?  
(How many rings does Uranus have, and what are they made of?)

6.1. How would you like to do that?

a. Student said:

b. Student did:

6.2. I noticed you did ..... Why did you do that?

Keyboard  Clicked a starter  
Screen  Clicked a recent Q  
Suggestion  Clicked a related search  
Enter  Clicked yellow toggle  
Retype  Clicked remember toggle

Figure E.8 Researchers Notes – Page 4

**\*\* Give printed topic \*\***

7. Now, what would you do if I gave you this as a question to investigate?  
(*The Cricket World Cup was held in New Zealand in 2015, find out about the Cricket World Cup*)

7.1. How would you like to do that?

a. Student said:

b. Student did:

7.2. I noticed you did ..... Why did you do that?

Keyboard

Screen

Suggestion

Enter

Retype

- Clicked a starter
- Clicked a recent Q
- Clicked a related search
- Clicked yellow toggle
- Clicked remember toggle

**Figure E.9 Researchers Notes – Page 5**

Question 6.

*How many rings does Uranus have, and what are they made of?*

**Figure E.10 Researchers Notes – Question 6 for Student to Read**

Question 7.

*The Cricket World Cup was held in New Zealand in 2015,  
find out about the Cricket World Cup.*

**Figure E.11 Researchers Notes – Question 7 for Student to Read**

## Switch to Test Account

### \*\* on the index page \*\*

Great. Thank you. You are doing a really great job.

I want to show you some things about the Questions Search Engine which are a little bit different to what you might have used in another search engine.

Both of these suggestions here are clickable.

You can click a question starter, and it automatically gets added to the search box.  
Like this.

Or, you can click a recent question, and it too is automatically added to the search box.  
Like this.

### \*\* on the SERP \*\*

Now when we create a search, the Search Engine gives us some extra hints on this page.  
These question starter ideas are clickable too, just like on the previous page.

These related ideas that you could search are also clickable.  
If one of these suggestions is helpful, you can click it, and it too gets added to the search box.

Did you see these bars here when you were doing the previous tasks today?  
They are to help you with your planning and remembering.

When you are looking at the list you might like to identify which websites might contain useful information.  
You can do this by changing the colour of the bar.

I can scan this list and see that this one, this one and this one look useful to me.  
Actually this one doesn't look useful, maybe I clicked this one by mistake.

Lets see what happens when we click into the website and come back after we have read the information.  
Look now it has changed colour.  
This helps me know we have visited this website today.

If it had some really great information, I can click it to remind me it was useful and that I might want to come back to it later.

Now, one last thing.  
Where do you think the information in this sidebar comes from?

.....

Do you have any questions about what I have shown you?

Shall we conduct another couple of searches?

## Switch to User Account

Figure E.12 Researchers Notes – Script for \*Show & Tell\*

19)

The screenshot shows a search engine results page for the query "mt cook". The browser address bar displays "file:///localhost/Users/vtwoz/PhD/study\_final/Question\_root/serp.html#". The search bar contains "mt cook". Below the search bar, there is a section titled "What do you want to know about 'mt cook'?" with options to refine the search by "Who ...", "What ...", "Where ...", "When ...", "Why ...", and "How ...". A section titled "You could ask a question about:" lists several related queries: "mt cook weather", "mt cook activities", "mt cook web cam", "mt cook height", "who was the first person to climb mt cook", and "what is the average snow fall of mt cook". The main results area displays a list of Wikipedia entries for "Aoraki / Mount Cook - Wikipedia, the free encyclopedia". Each entry includes the URL "https://en.wikipedia.org/wiki/Aoraki/\_Mount\_Cook" and a snippet of text: "Aoraki / Mount Cook is the highest mountain in New Zealand. Until 2014, its height was officially listed as 3,754 metres, but new measurements have given a ...". To the right of the search results, there is a summary box for "Aoraki / Mount Cook Mountain in New Zealand". This box includes a photograph of the mountain and a list of key facts: "Elevation: 3,724 m", "First ascent: December 25, 1894", "Prominence: 3,724 m", "Mountain range: Southern Alps", and "First ascenders: George Graham, Jack Clarke, Tom Fyfe".

Figure E.13 Researchers Notes – Visuals for Question 19

## Appendix F. Raw Data Selected Questions Survey Study (Chapter 4)

This appendix contains raw data for selected questions from the survey study reported in Chapter 4 to provide context and further review:

1) What technology does your child have access to at home?

Gender	Year Level	Tablet	Smartphone	PDA	Computer
unspecified	unspecified	0	1	0	1
unspecified	unspecified	1	0	0	1
unspecified	unspecified	1	0	0	1
male	unspecified	0	0	0	1
male	1	0	0	0	1
female	1	0	1	0	1
male	1	1	0	0	1
female	1	0	0	1	1
female	1	0	0	0	1
male	1	0	0	0	1
female	1	0	0	0	1
male	1	0	1	0	1
male	1	0	0	1	1
female	1	0	1	0	1
unspecified	1	1	0	0	1
female	1	0	1	1	1
male	1	1	1	0	1
female	1	0	0	1	1
female	1	1	1	1	1
female	2	0	0	1	1
male	2	0	0	0	1
female	2	1	0	0	1
unspecified	2	0	0	0	0

unspecified	2	0	0	0	0
unspecified	2	0	0	0	0
male	2	0	0	1	1
female	2	0	0	1	0
female	2	0	0	0	0
male	2	1	1	0	1
female	2	0	0	0	1
male	2	0	0	0	1
female	2	0	0	0	0
male	2	1	0	0	1
male	2	0	1	0	1
female	2	0	1	0	1
male	2	0	1	1	1
male	2	1	1	1	1
male	2	0	0	0	1
female	3	0	0	0	1
male	3	1	0	0	1
male	3	0	0	1	1
female	3	1	0	0	1
male	4	0	0	0	1
female	4	1	0	1	1
female	4	1	0	1	1
male	4	0	0	0	1
male	4	0	0	1	1
male	4	0	0	0	0
female	4	0	0	0	0
male	4	0	0	1	1
unspecified	4	0	0	0	1
male	4	0	0	1	1
female	4	1	0	0	1
female	4	0	0	1	1
female	4	0	1	0	1
female	4	0	0	0	1
female	4	0	0	0	1
male	4	0	0	1	1
male	4	1	0	0	1
female	4	1	0	1	1
female	4	1	0	1	1
male	4	0	0	1	0
male	5	0	0	0	1
female	5	0	0	1	1
female	5	0	1	1	1
female	5	0	0	0	1
female	5	1	0	0	1
male	5	0	0	1	1
female	5	0	0	1	1
male	5	0	1	0	1

Appendix E. Material for KidsQuestions Usability Study (Chapter 10)

male	5	0	0	1	1
male	5	0	1	0	1
female	5	1	1	0	1
female	5	0	0	1	1
female	5	1	0	1	1
male	5	0	0	0	1
male	5	1	1	0	1
female	5	0	0	1	1
female	5	0	0	0	1
female	5	0	1	1	1
male	5	1	0	0	1
male	6	1	1	0	1
male	6	0	0	0	1
unspecified	6	0	1	0	1
female	6	1	0	0	1
female	6	1	1	0	1
female	6	0	0	1	1
male	6	1	0	0	1
male	6	0	1	0	1
female	6	0	1	0	1
male	6	1	0	1	1
male	6	0	0	0	1
male	6	0	0	1	1
female	6	0	0	0	1
male	6	0	1	1	1
male	6	1	0	1	1
male	6	0	0	1	1
male	6	1	0	0	1
female	7	0	0	0	1
female	7	1	1	0	1
female	7	1	1	1	1
male	7	1	1	0	1
female	7	1	1	1	1
unspecified	7	0	0	0	1
unspecified	7	0	1	1	1
female	7	0	0	1	1
female	7	1	0	1	1
male	7	0	0	0	1
female	7	0	0	0	1
female	7	1	0	1	1
male	7	1	0	1	1
female	7	0	0	0	1
female	7	1	0	1	1
female	7	0	0	1	1
male	7	1	0	1	1
female	7	1	1	0	1
male	7	1	0	0	1

male	7	1	1	1	1
male	7	0	0	1	1
female	7	0	1	0	1
female	7	1	0	1	1
female	7	0	0	1	1
male	7	0	1	0	1
female	7	0	0	0	1
male	7	1	0	0	1
male	7	0	0	1	1
male	7	0	0	1	1
female	7	0	1	0	1
female	7	1	0	0	1
male	7	0	1	0	1
female	7	0	1	0	1
male	8	1	0	0	1
female	8	0	0	0	1
male	8	0	0	1	1
female	8	0	1	0	1
male	8	0	0	1	1
female	8	0	1	0	1
female	8	1	1	1	1
female	8	0	1	1	1
female	8	0	0	1	1
female	8	0	0	1	1
female	8	1	1	0	1
female	8	1	0	1	1
female	8	1	0	1	1
female	8	0	1	0	1
female	8	1	0	0	1
female	8	0	0	1	1
male	8	0	0	1	1
male	8	0	0	0	1
female	8	1	0	1	1
female	8	0	1	1	1
female	8	1	0	1	1
female	8	0	0	0	1
female	8	0	0	0	1
unspecified	8	0	0	1	1
female	8	0	1	1	1
<b>TOTAL</b>		<b>53</b>	<b>45</b>	<b>67</b>	<b>147</b>

**Table F.1 Raw Data Parents Survey Question 1. n=156**

2) What technology does your child use to complete school work?

Gender	Year Level	Tablet	Smartphone	PDA	Computer
unspecified	unspecified	0	0	0	1
unspecified	unspecified	0	0	0	0
unspecified	unspecified	0	0	0	1
male	unspecified	0	0	0	1
male	1	0	0	0	0
female	1	0	0	0	0
male	1	0	0	0	1
female	1	0	0	0	0
female	1	0	0	0	0
male	1	0	0	0	0
female	1	0	0	0	1
male	1	0	0	0	0
male	1	0	0	0	1
female	1	1	0	0	1
unspecified	1	1	0	0	1
female	1	0	1	0	1
male	1	1	0	0	1
female	1	0	0	0	0
female	1	1	0	0	1
female	2	0	0	0	0
male	2	0	0	0	1
female	2	0	0	0	1
unspecified	2	0	0	0	0
unspecified	2	0	0	0	0
unspecified	2	0	0	0	0
male	2	0	0	0	1
female	2	0	0	0	0
female	2	0	0	0	0
male	2	0	0	0	1
female	2	0	0	0	1
male	2	0	0	0	0
female	2	0	0	0	0
male	2	0	0	0	0
male	2	0	0	0	0
female	2	1	0	0	1
male	2	1	0	0	1
male	2	0	0	0	1
male	2	0	0	0	0
female	3	0	0	0	1
male	3	1	0	0	0
male	3	0	0	0	1
female	3	1	0	0	1
male	4	0	0	0	0

female	4	1	0	1	1
female	4	1	0	0	1
male	4	1	0	0	1
male	4	0	0	1	1
male	4	0	0	0	0
female	4	0	0	0	0
male	4	0	0	0	0
unspecified	4	0	0	0	0
male	4	0	0	0	1
female	4	1	0	0	1
female	4	0	0	0	1
female	4	0	0	0	1
female	4	0	0	0	1
female	4	0	0	0	1
male	4	0	0	0	1
male	4	1	0	0	1
female	4	0	0	0	1
female	4	0	0	0	1
male	4	0	0	0	1
male	5	0	0	0	1
female	5	0	0	0	1
female	5	1	0	0	1
female	5	0	0	0	1
female	5	0	0	0	1
male	5	0	0	0	1
female	5	0	0	0	0
male	5	0	0	0	1
male	5	0	0	0	1
male	5	0	0	0	1
female	5	0	0	0	0
female	5	0	0	1	1
female	5	0	0	0	1
male	5	0	0	0	1
male	5	1	0	0	1
female	5	0	0	0	1
female	5	0	0	0	1
female	5	0	0	0	1
male	5	0	0	0	0
male	6	1	1	0	1
male	6	0	0	0	1
unspecified	6	0	0	0	0
female	6	0	0	0	1
female	6	0	0	0	1
female	6	0	0	0	1
male	6	1	0	0	1
male	6	0	1	0	1
female	6	0	0	0	1

Appendix E. Material for KidsQuestions Usability Study (Chapter 10)

male	6	1	0	1	0
male	6	0	0	0	1
male	6	0	0	0	1
female	6	1	0	1	1
male	6	0	0	1	1
male	6	0	0	0	1
male	6	0	0	0	1
male	6	1	0	0	1
female	7	0	0	0	1
female	7	0	0	0	0
female	7	0	0	1	1
male	7	0	0	0	1
female	7	1	1	1	1
unspecified	7	0	0	0	1
unspecified	7	0	0	1	1
female	7	0	0	1	1
female	7	1	0	1	1
male	7	0	0	0	1
female	7	0	0	0	1
female	7	1	0	1	1
male	7	0	0	0	1
female	7	0	0	0	1
female	7	0	0	1	1
male	7	1	0	0	1
female	7	0	0	0	1
male	7	1	0	0	1
male	7	0	0	0	1
male	7	0	0	1	1
female	7	0	0	0	1
female	7	0	0	0	1
female	7	0	0	0	1
male	7	0	0	0	1
female	7	0	0	0	1
male	7	0	0	0	1
male	7	0	0	0	1
male	7	0	0	1	1
female	7	0	0	0	1
female	7	0	0	0	1
male	7	0	0	0	1
female	7	0	1	0	1
male	8	1	0	0	1
female	8	0	0	0	1
male	8	0	0	0	1
female	8	0	0	0	1
male	8	0	0	0	1
female	8	0	0	0	1

female	8	1	1	1	1
female	8	0	0	1	0
female	8	0	0	0	1
female	8	0	0	1	1
female	8	1	1	0	1
female	8	0	0	0	1
female	8	0	0	1	1
female	8	0	0	0	1
female	8	1	0	0	1
female	8	0	0	1	1
male	8	0	0	0	1
male	8	0	0	0	1
female	8	0	0	0	1
female	8	0	0	1	1
female	8	0	0	0	1
female	8	0	0	0	1
female	8	0	0	0	1
unspecified	8	0	0	0	1
female	8	0	0	0	1
<b>TOTAL</b>		<b>29</b>	<b>7</b>	<b>21</b>	<b>124</b>

**Table F.2 Raw Data Parents Survey Question 2. n=156**

## 5) What does your child use to read for pleasure at home? (as many as appropriate)

Gender	Year Level	Tablet	PDA	Smartphone	Computer	eReader	Print
unspecified	unspecified	0	0	0	0	0	1
unspecified	unspecified	0	1	0	1	0	0
unspecified	unspecified	0	0	0	0	0	1
male	unspecified	0	0	0	0	0	1
male	1	0	0	0	0	0	1
female	1	0	0	1	1	0	1
male	1	1	0	0	1	0	1
female	1	0	0	0	0	0	1
female	1	0	0	0	0	0	0
male	1	0	0	0	0	0	1
female	1	0	0	0	0	0	1
male	1	0	0	1	1	0	1
male	1	0	0	0	0	0	1
female	1	0	0	0	0	0	1
unspecified	1	0	0	0	0	0	1
female	1	0	0	0	0	0	1
male	1	1	0	0	1	0	1
female	1	0	0	0	0	0	1
female	1	1	0	0	0	0	1
female	2	0	0	0	1	0	1
male	2	0	0	1	1	0	1
female	2	0	0	0	0	0	1
unspecified	2	0	0	0	0	0	1
unspecified	2	0	0	0	0	0	0
unspecified	2	0	0	0	1	0	0
male	2	0	0	0	0	0	1
female	2	0	0	0	0	0	1
female	2	0	0	1	0	0	1
male	2	0	0	1	1	0	1
female	2	0	0	0	1	1	1
male	2	0	0	0	1	0	1
female	2	0	0	0	0	0	1
male	2	1	0	0	0	0	1
male	2	0	0	0	0	0	1
female	2	0	0	0	1	0	1
male	2	1	0	1	1	1	0
male	2	0	0	0	0	0	1
male	2	0	0	0	0	0	1
female	3	0	0	0	1	0	1
male	3	0	0	0	0	0	1
male	3	0	0	0	1	0	1
female	3	0	0	0	0	0	1
male	4	0	0	0	0	0	1

female	4	1	1	0	0	0	1
female	4	1	0	0	1	0	1
male	4	0	0	0	1	0	1
male	4	0	1	0	1	0	1
male	4	0	0	1	0	0	1
female	4	0	0	0	0	0	1
male	4	0	0	0	0	0	1
unspecified	4	0	0	0	0	0	1
male	4	0	0	0	1	0	1
female	4	1	0	0	1	0	1
female	4	0	0	0	0	1	1
female	4	0	0	0	1	0	1
female	4	0	0	0	0	0	1
female	4	0	0	0	1	0	1
male	4	0	0	0	0	0	0
male	4	0	0	0	0	0	1
female	4	0	0	0	0	1	1
female	4	0	0	0	0	0	1
male	4	0	0	0	0	0	1
male	5	0	0	0	0	0	1
female	5	0	1	0	1	0	1
female	5	0	0	0	0	0	1
female	5	0	0	0	0	0	1
female	5	0	0	0	1	0	1
male	5	0	1	0	1	0	1
female	5	0	0	0	1	0	1
male	5	0	0	0	0	0	1
male	5	0	0	0	0	0	1
male	5	0	0	1	1	1	1
female	5	0	0	0	0	1	1
female	5	0	0	0	0	0	1
female	5	0	0	0	1	0	1
male	5	0	0	0	0	0	1
male	5	0	0	0	0	0	1
female	5	0	0	0	0	0	1
female	5	0	0	0	0	0	1
female	5	0	0	0	0	0	1
male	5	0	0	0	0	1	0
male	6	1	0	1	1	0	1
male	6	0	0	0	1	0	1
unspecified	6	0	0	1	1	0	1
female	6	0	0	0	1	0	1
female	6	1	0	0	1	0	1
female	6	0	0	0	1	0	1
male	6	1	0	0	1	0	0
male	6	0	0	0	0	0	1
female	6	0	0	0	1	0	1

Appendix E. Material for KidsQuestions Usability Study (Chapter 10)

male	6	0	1	0	1	0	0
male	6	0	0	0	1	0	1
male	6	0	1	1	1	0	1
female	6	0	1	1	1	0	1
male	6	0	1	1	1	0	1
male	6	0	0	0	0	0	1
male	6	0	0	1	0	0	1
male	6	1	0	0	1	0	1
female	7	0	0	0	1	0	1
female	7	0	0	0	0	1	1
female	7	0	1	0	0	0	1
male	7	0	0	0	0	0	1
female	7	1	0	0	0	0	1
unspecified	7	0	0	0	1	0	1
unspecified	7	0	1	1	1	0	1
female	7	0	0	0	1	0	1
female	7	1	0	0	1	1	1
male	7	0	0	0	0	0	1
female	7	0	0	0	0	0	1
female	7	1	0	0	0	0	1
male	7	0	0	0	1	0	1
female	7	0	0	0	0	0	1
female	7	0	0	0	0	0	1
female	7	0	0	0	0	0	1
male	7	0	0	0	0	0	1
female	7	1	0	1	1	0	1
male	7	1	0	0	0	0	1
male	7	0	0	0	1	0	1
male	7	0	0	0	1	0	1
female	7	0	0	0	1	0	1
female	7	0	0	0	0	0	1
female	7	0	0	0	0	0	1
male	7	0	0	0	1	0	1
female	7	0	0	0	0	0	1
male	7	0	0	0	1	0	1
male	7	0	0	0	1	0	1
female	7	0	0	0	1	0	1
female	7	0	0	0	0	0	1
male	7	0	0	0	1	0	1
female	7	0	0	1	1	0	1
male	8	1	0	0	1	0	0
female	8	0	0	0	1	0	1
male	8	0	0	0	0	0	1
female	8	0	0	0	0	0	1
male	8	0	0	0	1	1	1
female	8	0	0	0	1	0	1

female	8	1	0	0	0	0	1
female	8	0	1	0	0	0	1
female	8	0	1	0	1	1	1
female	8	0	0	0	0	0	1
female	8	1	0	0	1	0	1
female	8	1	0	0	1	0	1
female	8	0	0	0	0	0	1
female	8	0	0	1	1	0	1
female	8	1	0	0	0	1	1
female	8	0	0	0	0	0	1
male	8	0	1	0	1	0	1
male	8	0	0	0	1	0	1
female	8	0	0	0	0	0	1
female	8	0	0	0	0	0	1
female	8	1	0	0	1	0	1
female	8	0	0	0	1	0	1
female	8	0	0	0	0	0	1
unspecified	8	0	0	0	1	0	1
female	8	0	0	0	0	0	1
<b>TOTAL</b>		<b>23</b>	<b>14</b>	<b>18</b>	<b>72</b>	<b>12</b>	<b>146</b>

**Table F.3 Raw Data Parents Survey Question 5. n=156**

## 6) What does your child use to find information at home? (as many as appropriate)

Gender	Year Level	tablet	PDA	Smartphone	Computer	Print
unspecified	unspecified	0	0	0	1	1
unspecified	unspecified	0	1	0	1	1
unspecified	unspecified	0	0	0	1	1
male	unspecified	0	0	0	1	1
male	1	0	0	0	1	0
female	1	0	0	1	1	1
male	1	0	0	0	1	1
female	1	0	0	0	1	0
female	1	0	0	0	0	0
male	1	0	0	0	0	1
female	1	0	0	0	0	1
male	1	0	0	0	1	1
male	1	0	0	0	1	1
female	1	0	0	0	1	1
unspecified	1	0	0	0	1	1
female	1	0	0	0	1	1
male	1	1	0	0	1	1
female	1	0	0	0	0	0
female	1	1	1	1	1	1
female	2	0	1	0	1	1
male	2	0	0	0	1	1
female	2	0	0	0	1	1
unspecified	2	0	0	0	1	1
unspecified	2	0	0	0	0	0
unspecified	2	0	0	0	1	0
male	2	0	0	0	1	1
female	2	0	0	0	0	1
female	2	0	0	0	0	1
male	2	0	0	0	1	1
female	2	0	0	0	1	1
male	2	0	0	0	1	1
female	2	0	0	0	0	1
male	2	0	0	1	1	0
male	2	0	0	1	0	0
female	2	0	0	0	1	1
male	2	1	1	0	1	0
male	2	0	0	0	1	1
male	2	0	0	0	1	0
female	3	0	0	0	1	1
male	3	1	0	1	1	1
male	3	0	0	0	1	1
female	3	1	0	0	1	1
male	4	0	0	0	0	1

female	4	1	1	0	0	1
female	4	1	0	0	1	1
male	4	0	0	0	1	0
male	4	0	1	0	1	1
male	4	0	0	0	1	1
female	4	0	0	0	0	0
male	4	0	0	0	1	0
unspecified	4	0	0	0	1	1
male	4	0	0	0	1	1
female	4	1	0	0	1	1
female	4	0	0	0	1	1
female	4	0	0	0	1	1
female	4	0	0	0	1	1
female	4	0	0	0	1	1
male	4	0	0	0	1	1
male	4	0	0	0	1	0
female	4	1	0	0	1	1
female	4	0	0	0	1	1
male	4	0	0	0	1	1
male	5	0	0	0	1	1
female	5	0	0	0	1	1
female	5	0	0	1	1	1
female	5	0	0	0	1	0
female	5	1	0	0	1	1
male	5	0	0	0	1	1
female	5	0	0	0	1	1
male	5	0	0	1	1	1
male	5	0	0	0	1	1
male	5	0	0	1	1	1
female	5	0	0	1	1	1
female	5	0	0	0	1	1
female	5	0	0	0	1	1
male	5	0	0	0	1	0
male	5	1	0	0	1	0
female	5	0	0	0	1	0
female	5	1	0	0	1	0
female	5	0	0	0	1	1
male	5	0	0	0	1	0
male	6	1	0	1	1	1
male	6	0	0	0	1	1
unspecified	6	1	0	1	1	1
female	6	0	0	0	1	1
female	6	1	0	0	1	1
female	6	0	0	0	1	1
male	6	1	0	0	1	0
male	6	0	0	1	1	1
female	6	0	0	1	1	1

Appendix E. Material for KidsQuestions Usability Study (Chapter 10)

male	6	0	1	0	0	1
male	6	0	0	0	1	1
male	6	0	0	0	1	0
female	6	0	0	0	1	1
male	6	0	1	1	1	1
male	6	0	0	0	1	1
male	6	0	0	1	1	1
male	6	1	0	0	1	1
female	7	0	0	0	1	1
female	7	1	0	1	1	1
female	7	0	0	0	1	1
male	7	0	0	0	1	1
female	7	1	1	0	1	1
unspecified	7	0	0	0	1	1
unspecified	7	0	1	1	1	1
female	7	0	0	0	1	1
female	7	1	0	0	1	1
male	7	0	0	0	1	1
female	7	0	0	0	1	1
female	7	1	1	0	1	1
male	7	1	0	0	1	1
female	7	0	0	0	1	1
female	7	0	0	0	1	1
female	7	0	1	0	1	1
male	7	1	0	0	1	1
female	7	1	0	1	1	1
male	7	1	0	0	1	1
male	7	0	0	0	1	1
male	7	0	0	0	1	1
female	7	0	0	0	1	0
female	7	0	0	0	1	1
female	7	0	0	0	1	1
male	7	0	0	1	1	0
female	7	0	0	0	1	1
male	7	0	0	0	1	1
male	7	0	0	0	1	1
female	7	0	0	0	1	1
female	7	0	0	0	0	0
male	7	0	0	0	1	1
female	7	0	0	1	1	1
male	8	0	0	0	0	0
female	8	0	0	0	1	1
male	8	0	0	0	1	1
female	8	0	0	0	1	1
male	8	0	0	0	1	0
female	8	0	0	0	1	0

female	8	1	0	0	1	1
female	8	0	0	0	1	0
female	8	0	1	0	1	1
female	8	0	0	1	1	1
female	8	1	0	1	1	1
female	8	1	0	0	1	0
female	8	0	1	0	1	1
female	8	0	0	0	1	0
female	8	1	0	0	1	1
female	8	0	0	0	1	1
male	8	0	1	1	1	1
male	8	0	0	0	1	1
female	8	1	1	0	1	0
female	8	0	1	1	1	1
female	8	0	0	0	1	0
female	8	0	0	0	1	1
female	8	1	0	0	1	0
unspecified	8	0	0	0	1	1
female	8	0	0	0	1	1
<b>TOTAL</b>		<b>31</b>	<b>17</b>	<b>24</b>	<b>141</b>	<b>122</b>

**Table F.4 Raw Parents Survey Data Question 6. n=156**