Activities and tasks: A case of search in the primary school information use environment

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ABSTRACT

Studies of children (ages 4-11) searching in primary schools have either been of a work task that is a research assignment or of a search task that has been designed by the researcher. There is little understanding of how the environment is influencing the search activity and the full range of search tasks that children conduct in schools.

Research was conducted in two phases. In phase one, using maximal variation sampling ten teachers from a single primary school were asked to describe what children in their class had searched for in the prior academic year. The collected data was analysed using two techniques. Firstly, thematic analysis was used to identify what is shaping children's search. Secondly, a framework initially developed from a review of the literature was used to identify and describe the search tasks. In phase two, using observation data that had previously been collected for other research projects, the phase one analysis was verified and extended.

Findings confirm that the primary school environment influences how children search for information and what they use the information for. It was found that children are conducting a greater range of search tasks than has been currently accounted for. Ten different uses of information were identified. As well as this both children and teachers are doers and originators of search tasks, and therefore search can also be considered a group based activity.

This thesis contributes to a greater understanding of information use environments. In particular, new insights into the range and variety of search activities within primary schools are presented. Furthermore, a novel framework that can be used to describe search tasks within an information use environment is developed.

*"Despite this messiness, the user and his environment are a critical
and necessary ingredient for the understanding of systems and their improvement"*
(Taylor, 1982, p. 202)

"It's just embedded in what we do"
(Y5 Teacher, West Sheffield primary school)

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1   INTRODUCTION

To have a better understanding of why people search as they do it is important to know what is influencing the search, where and how the influence is felt. In this thesis, the setting within which information is used and how different people in the setting influence the search activity (i.e. "the condition in which things are happening or being done" English Oxford Living Dictionaries, 2017) is examined. Then looking more closely at search activities, each search task (operationalised here as the specification of an information requirement) is examined and described according to what is likely to influence the way the search task could be resolved. This description is important as to support people in their use of search technologies it is necessary to have a comprehensive understanding of their search tasks.

This chapter provides the motivation for the study, the research questions, definitions used and scope of the study. The thesis structure is also outlined.

1.1   Motivation

The need to support and educate children in their use of technology is the focus of many recent national and international reports.

> "The skills and knowledge to critically understand the internet, is vital for children to navigate the online world. It is also an essential requirement of the future workforce." (House of Lords, 2017, p. 3)

> "The use of digital technology in education is not optional. Competence with digital technology to find information, to create, to critique and share knowledge, is an essential contemporary skill set. It belongs at the heart of education." (Education Technology Action Group, 2015, p. 7)

> "Students unable to navigate through a complex digital landscape will no longer be able to participate fully in economic, social and cultural life around them." (OECD, 2015, p. 17)

In this thesis, what children are using search technologies for and how they are using them is investigated in the hope that this could lead to a greater understanding of how to support children in their use of technology. As it would not be feasible to study all the uses that children have of search technologies in their daily lives within the timeframe of the PhD, the scope of the thesis was limited to primary schools. Primary schools were selected as the setting because firstly, central to this thesis is the idea that the environment within which information is used is likely to influence how search occurs (Taylor, 1991) and primary schools are an environment within which children (ages 4-11) use information. Secondly, this is a bounded environment making it easier to delineate the study. Thirdly, within this environment, teachers are already supporting children and it is hoped that the findings of this thesis may be used to provide further guidance.

1.2   Why study an information use environment?

Differences between adults' and children's search is often explained in relation to Piaget's theory of cognitive development (see for example Druin & Solomon, 1996; Duarte Torres,

Weber, & Hiemstra, 2014; Gossen, Höbel, & Nürnberger, 2014; Walter, 1994). According to Piaget, children's thinking is qualitatively different to that of adults. Piaget believed that children develop in discrete stages, with each stage fundamentally different from the previous stage. These stages are universal with children at the same age being at approximately the same stage (see Bjorklund, 2012). Those taking a Piagetian perspective therefore consider children of the same age to have a universal search behaviour, and when children are compared to other children, it is age that is the determining factor (Duarte Torres & Weber, 2011; Duarte Torres et al., 2014; Gossen, Hempel, & Nürnberger, 2013; Large, Nesset, & Beheshti, 2008; Marchionini, 1989). However, using Piaget to explain differences in adults' and children's search is problematic. In cognate disciplines such as Psychology and Sociology, these theories have been very influential but they are no longer in vogue (Byrnes & Bernacki, 2015; Ólafsson, Livingstone, & Haddon, 2013). In Psychology the focus has moved to the structural and functional components of cognition (Byrnes & Bernacki, 2015), and in Sociology to recognition that childhood is culturally constructed, and that children are "social actors shaping as well as are shaped by their circumstance" (James, Jenks, & Prout, 1998, p. 6).

So while age and cognitive development may well account for differences between adults and children it is also important to consider whether there are other factors that might lead to differences in the way children search for information. In the more general field, Taylor (1991, p. 218) suggests that there are distinct information use environments. These environments "(a) affect the flow and use of information messages into, within, and out of any definable entity; and (b) determine the criteria by which the value of information messages will be judged". Taylor (1991, p.223) does not consider demographics such as age to be a key factor and instead argues that the search practices of engineers, farmers, lawyers and so on will all be different because of the IUE (1991, p.222). Based on this argument, it is therefore possible that it is the environment within which information is used rather than simply age that is influencing children's search.

To some extent that the environment is influencing children's search is already known. For example it has already been established that differences between home and school environments result in differences between who originates the task, time available, access to technology and motivation (Livingstone & Helsper, 2007). That environment as much as (or more than) age distinguishes children's search is further supported by the work of Lundh (2011) and Limberg (2007) who take a socio-cultural perspective, where "information activities are seen as social activities … situated in specific historical and social contexts" (Lundh, 2011, p. 19). These studies demonstrate that the school environment is fundamental to understanding how information literacies are enacted in the classroom (Lundh, 2011) and how information is used in research assignments (Limberg, 2007). However, both of these studies only consider the research assignment and a more holistic approach that considers all uses of search technologies within schools is required.

1.3   Research questions

A key concern of the field has been whether children are a distinct user group from adults (Druin & Solomon, 1996; Duarte Torres et al., 2014; Gossen et al., 2014; Walter, 1994). This is important because if children are different then a case can be made for bespoke information retrieval systems (Bilal, 2000, 2001, 2002a; Jochmann-mannak, Huibers, Lentz, & Sanders, 2010; PuppyIR, 2014) and search literacy programs (Nesset, 2005, 2014). As discussed above,

in many studies children are considered a distinct user group because of their age and level of cognitive development. This contrasts with Taylor's (1991) view in the more general field (i.e. not limited to children) that it is the information use environment (IUE) that most influences search. Therefore, whether age, IUE or indeed other factors influences search activities (the condition in which search occurs) needs further investigation. The findings of this study are then used to consider whether primary school children (ages 4-11) can be considered a distinct user group.

RQ1: What is shaping primary school children's search activities?

As how people carry out and resolve search varies depending upon the way the task has been constructed (Hackman, 1969, p. 97), it is also important to have a good understanding of the search tasks that children do. However, descriptions of children's search tasks are often poor whereby one, or at best three, elements are given (see Appendix A: Evidence Base A). Furthermore, there is not a good understanding of all the different types of search tasks that children do in primary school, as studies of children searching in school are either for research assignments (see Appendix B: Evidence Base B) or are for search tasks that have been designed by the researcher for the purpose of the study (Evidence Base A). A more thorough and consistent representation of children's search tasks is required, that not only describes the tasks in a meaningful way but also captures the variation. In the more general literature, multi-dimensional schemes have been developed to represent tasks (Kim & Soergel, 2006; Y. Li & Belkin, 2008; Pharo & Järvelin, 2004; Xie, 2009) and these schemes are used as a starting point with which to describe children's search tasks.

RQ2: What are primary school children's real-life search tasks?

To summarise, the overall aim of this thesis is to develop a greater understanding of children's search with a focus on primary school children. It is hoped that this research will lead to a greater understanding of what is influencing children's search activities and the variety of search tasks within primary school. This understanding can then be used to develop support for children in their use of search technologies, both in terms of providing guidance and building more responsive search systems.

1.4 Definitions

Within the field of Library and Information Science a multitude of terms have been used to name similar concepts, and the same term may be applied to different concepts. While there is no single right definition, it is important to be clear on how a term is used. In this section are the definitions of terms that appear frequently in this thesis.

Information use: Kari (2010) identified 7 different conceptions of the term information use (Information practices, Information search, Information processing, Knowledge construction, Information production, Applying information, Effects of information). While acknowledging that information is used throughout the search process, when employing the term information use in this thesis, it is the "effects of information" that is referred to (Kari, 2010, p. n.p.). This is the same interpretation as Taylor (1991, p. 221): "what information does to or for the recipient and for his or her problem or situation". For example, information could be used to find out how to do something, or it could be used to verify other information.

Information seeking / search: In everyday language, the terms information seeking and information search can be used interchangeably. The term search tends to imply the use of a tool whereas information seeking is broader and may or may not include using a tool (Ford, 2015, p. 28). In this thesis, the term search is employed to describe what is investigated in this study and is also used when referring to the work of others where the principle concern has been to investigate the use of a tool. However, also relevant to this thesis are studies that have taken a broader approach. When referring to these studies the term information seeking is used.

Search task: A search task is one of many information tasks (for example, synthesise information, report information) that can occur in a work task. In this thesis, a search task is considered a type of information task where information needs to be acquired from another source. In phases 1 and 2 it is operationalised as the specification of an information requirement. How search tasks have been conceptualised in the research literature is recounted in 2.4.1 Conceptions of task.

Work task: Work tasks are the "separable parts of a person's duties to her/his employer" (Byström & Hansen, 2005, p. 1053). The term is not meant to be restricted to the work context and can be used to describe other non-job related activities such as daily life tasks and learning tasks (Ingwersen & Järvelin, 2005, p. 20; Vakkari, 2003, p. 420). In this thesis, the term work task is considered in the school context to be akin to a unit of work: "a coherent body of teaching / learning material usually focused on one specific topic or subject" (Dictionary of Education, 2016) with the teacher thought of as the "employer". In this thesis term work task is used in place of learning task.

Learning task: The term learning task may also be used to describe a task that motivates search in an educational environment (Limberg, 2007; Tanni & Sormunen, 2008). Limberg (2007) argues that learning tasks share some of the same conceptions as work tasks, in that they have recognisable start and finish points, and may precipitate search but they also differ because they are shaped by the discursive practices of schools. The term work task is preferred in this thesis as task is conceptually differentiated from environment. Nonetheless, there are notable differences in the way tasks are designed and conducted in educational environments. This is discussed further in 2.3 The primary school information use environment.

Search activity: In schools, an activity refers to "a task or exercise undertaken by the learner, and usually set by the teacher, which has an intended learning outcome" (Oxford University Press, 2017). Lessons may be structured around an activity, with the lesson starting with instruction to the class and ending with children reporting the activity back to the class. In this thesis, the term search activity is used to refer to the endeavour that occurs when teachers and children find information for school work. The activity may occur in a lesson or be given to children as homework. During the activity information may be sought for more than one work task. This conception of activity is compatible with Norman's (2005) definition of activity (see 2.4.3 Relationship between activities and tasks).

Search technology: The term search technologies is used in the national curriculum (Department for Education, 2013a) when referring to search engines. A broader approach is taken here and the term is also used to refer any digital search system. For example, site

search (searching within sites such as Wikipedia) and databases (such as those found on rightmove.co.uk) are also considered search technologies.

1.5 Scope

Information seeking is influenced by environment, work task, search task, the situation, the user, the repository and intended outcomes (see Figure 1), and in the context of search these different elements are interwoven (Toms, 2011, p. 49). This thesis is a study of a particular user group searching for information within a single environment. Although the aim of the thesis is to provide an overall understanding of primary school children's search, it is acknowledged that there are limitations to the scope of what can be researched and it is simply not feasible to address all factors within one study. Except at a very cursory level the situations, repositories used and differences between members of a group are not considered.
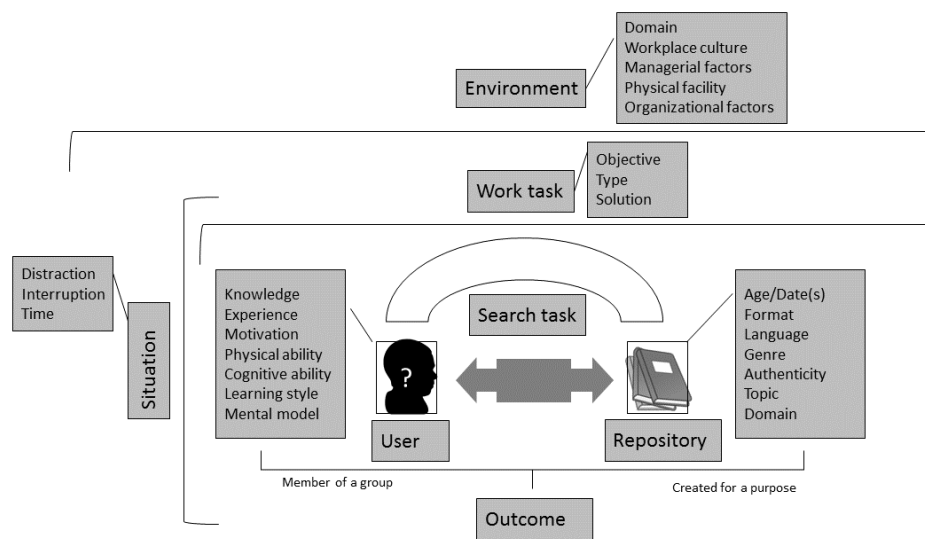
Figure 1: "The information seeking and retrieval process in context" (Toms, 2011, p. 49)

1.6 Thesis structure

Following this introduction, in chapter 2, the literature is reviewed to situate this study in relation to what is already known and to provide theoretical frameworks. In chapter 3, the literature is further reviewed to develop a provisional search task representation scheme. This chapter is supported by two appendices, Evidence Base A and Evidence Base B, that list prior studies of children's search tasks and works tasks where a search activity occurs. The provisional task representation scheme is used as an analytic framework in research phases 1 and 2. In chapter 4, the overall design of research is described. In chapter 5, the elements of primary school search tasks and the aspects of the environment that are influencing the search activity are identified with the phase 1 interview study. The findings are then validated in chapter 6 with the phase 2 observation study. In these two chapters the representation scheme is further developed to describe search tasks in the primary classroom. The findings are discussed in chapter 7. The contributions, limitations and ideas for future work are stated in chapter 8.

2 PRIOR RESEARCH ON CHILDREN AND SEARCH

The literature supporting the research is reviewed in this chapter and in chapter 3. In this chapter (chapter 2), the research literature is used to provide background information, identify gaps in understanding, and to situate this study in relation to what is already known about children's search. In chapter 3, the research literature is used to develop a provisional representation scheme to use as an analytic framework in phases 1 and 2. For both chapters, literature relating to children and the more general field were reviewed. As such the methodology described here also applies to the review in chapter 3.

In this chapter, after describing the literature review methodology, the review of prior research on children and search is split across 5 sections. In section 2.2 Taylor's (1991) model of information use environments is described. Then in section 2.3 using the model of an IUE as a framework to situate what is known about search in the primary school environment the literature is further reviewed. How tasks have been conceptualised and ways to describe tasks is reported in section 2.4. Section 2.5 focuses on children's search tasks.

2.1 Literature review methodology

There are two broad types of literature reviews: narrative reviews and systematic reviews. A narrative review is "an examination of theory and research relating to your field of interest that outlines what is already known and that frames and justifies your research question(s). It therefore both acts as a background to what you want to research and provides a platform for establishing what the contribution of your research will be" (Bryman, 2015, p. 91). A narrative approach was taken in much of chapter 2 where key works that are relevant to the research questions are cited to situate the study within other studies of children's information seeking and the wider research literature. In chapter 3 the research literature was used to develop a provisional task representation scheme. However, to develop the representation scheme a purely narrative review is not appropriate because what to include in a narrative review is relatively subjective, and therefore potentially subject to bias. Systematic reviews are "a replicable, scientific and transparent process … that aims to minimize bias through exhaustive literature searches of published and unpublished studies and by providing an audit trail of the reviewer's decisions, procedures and conclusions" (Tranfield, Denyer, & Smart, 2003, p. 209). To reduce bias it has become increasingly common to incorporate elements of systematic reviews in narrative reviews (Bryman, 2015, p. 91). Bryman (2015, p. 99) synthesises different accounts of systematic reviews and suggest that the following steps should be taken when incorporating aspects of systematic reviews into narrative reviews

Step 1: "Define the purpose and scope of the review"
Step 2: "Seek out studies relevant to the scope and purpose of the review"
Step 3: "Assess the relevance of each study for the research question(s)"
Step 4: "Appraise the quality of studies from Step 3"
Step 5: "Extract the results of each study and synthesise the results".

In this thesis literature on children's information seeking and the more general literature were reviewed. The steps taken for each review are described next.

2.1.1 Review of children's information seeking literature

The children's literature was extensively reviewed and documented in Evidence Base A and Evidence Base B. The review was conducted following the steps advocated by Bryman (2015, p. 99). It should be noted that the order of steps was not entirely linear and earlier steps were returned to and revised as the review progressed.

STEP 1: "Define the purpose and scope of the review"

The purpose of reviewing the children's information seeking literature was to

- situate this study in relation to what is already known about children's search, in chapter 2
- identify all the known elements of children's search tasks, and how these elements have been defined, in chapter 3.

The key criteria for considering whether to include a study were that it must be about children and it must include a search activity. These criteria are broad and there were potentially many studies that could be included. The scope was narrowed as follows:

- Location of study: The focus of the review was on school related tasks and included search tasks that researchers set that relate to school work. If a study connected children's leisure related tasks to school related tasks these were also included.
- Information retrieval systems: The focus was on use of internet search engines, but also included studies of digital libraries and older studies of CD-ROM. Studies of the physical library were only included if the focus was on OPAC use. Studies of bookshops and tangibles were not included.
- Age of children in study: The focus was on primary school children but pre- and secondary school studies included. Studies of university students were not included.
- Language of published studies: Only studies published in English were included. Although studies in other languages may be revealing, the author of this thesis can only speak English. This is a limitation of this review.
- Date of published studies: The focus was on studies conducted post 2000. This is because prior to 2000 search technologies were little used in the classroom and in fact it was not until 2008 that most primary schools became connected to the Internet (BESA, 2015). However, some research still took place in classrooms, and if a study conducted before 2000 is still highly cited and therefore likely to be relevant to this study it was included. For example, Bilal's studies of Yahooligans (2000, 2001, 2002a).

STEP 2: "Seek out studies relevant to the scope and purpose of the review"

Techniques recommended by Ford (2012) and Jesson, Matheson & Lacey (2011) were used to find studies. The first technique was to search for articles and books employing tools such as Google Scholar and the library catalogue. Combinations of the following keywords were used: children, students, young people, youth, information seeking, search, search behaviour, search engine, search strategy, task, primary school, elementary school, web, Internet. Then key journals (JASIST, Library Trends, Journal of Documentation and Information Research) and key conferences (IIIX, I[3] and CHIIR) were targeted. A third technique, was to see who else had cited the work and to follow the references of cited works. The fourth technique was to monitor for

new work. Alerts were set up in Google scholar based on the search keywords, and new content alerts for journals.

STEP 3: "Assess the relevance of each study for the research question(s)"

Studies were considered relevant if children's search activities were described.

STEP 4: "Appraise the quality of studies from Step 3"

No quality criteria were applied when selecting studies for the evidence base, as it is how search tasks have been described that is of interest rather than the findings of the individual studies.

STEP 5: "Extract the results of each study and synthesise the results"

The review is documented in Evidence Base A and Evidence Base B. Evidence Base A includes studies where the type of search task is described. For each study, how the search task has been described, the age of the participants, who designed the task, how the task is used in the study are documented. Evidence Base B includes all studies of children's work tasks where a search activity has occurred. For each study, the description of the work task, the age of the participants, the extent to which the search task is considered in the study, and who designed the work task are documented.

Conventions used to document each study:

- Participant demographic: If both age and year group are given then age is selected as this is easier for the reader to follow. When year group / grade is given the location of the study is given as the structure of year groups varies according to each country.
- Search task description: These are based on the descriptions as given in the study:
  - Where possible the descriptions are categorised (in bold) according to this study's representation scheme (e.g. **Origination**, **Goal** and so on). This is to make it easier to read across studies. However, the categorisation may be different in the original study. If this is the case the original categorisation is given in brackets (see for example, Bilal, 2002a).
  - The individual elements are documented verbatim from the original studies.
- Work task description: These are gleaned from descriptions of the study rather than a description of the work tasks as such. To make it easier to read across studies, where possible the descriptions are categorised (in bold) according to this study's representation scheme (e.g. **Location**, **Output** and so on).
- Where a study appears in both Evidence Bases this is indicated by *** in front of the authors' name.

The results of the two evidence bases are extracted and synthesised in chapters 2 and 3. In chapter 2, the evidence bases are used to recount what is already known about children's search. In chapter 3, the evidence bases are used to help build a provisional search task representation scheme.

2.1.2 Review of the general literature

The general literature (literature not confined to children) was reviewed to provide conceptual frameworks and a broader perspective on the issues and gaps identified in the studies of children. As such there were several different reviews in the broad area of information seeking, search, task and environment. A review that is particularly key to this thesis is that of prior task representation schemes. This is described next following the steps advocated by Bryman (2015, p. 99). A similar approach was taken when reviewing other general areas.

Review of task representation literature

STEP 1: "Define the purpose and scope of the review"

The purpose of reviewing the multi-dimensional schemes was to find a framework for describing children's search tasks. The schemes were reviewed so that the representation scheme could be based on what are generally considered by the field as good representations of task. Furthermore, it was hoped that appropriating a framework from the more general literature would aid comparison with other IUE. For these reasons only tried and tested frameworks were reviewed, and the scope of the review was limited to key studies.

STEP 2: "Seek out studies relevant to the scope and purpose of the review"

Key studies were identified as part of a "highly specific detailed search" (Ford, 2012, p.106) and mainly citation searching was employed. Developments in the field were kept up with by monitoring conferences and new journal editions.

STEP 3: "Assess the relevance of each study for the research question(s)"

Studies were considered relevant if they described tasks at multi-dimensions.

STEP 4: "Appraise the quality of studies from Step 3"

Only studies influential in the field were selected. Studies should be in published in journals and be cited by others.

STEP 5: "Extract the results of each study and synthesise the results"

These studies are summarised in chapter 3.

2.2 Information use environments

In this section, Taylor's (1991) concept of an IUE is recounted. Taylor (1991, p. 221) describes an information use environment as having four elements, namely "sets of people, typical structure and thrust of problems of those sets of people, typical settings, and what constitutes resolution of problems". Importantly these four elements together result in a common information behaviour, where information behaviour is considered "the sum of activities through which information becomes useful".

2.2.1 Sets of people

In an IUE search is considered from a group perspective rather than from an individual. In an IUE a set of people is not defined by demographic variables (e.g. boys) or non-demographic

variables (e.g. twitter users) but is a set that has already been defined as a group because of a common professional education (e.g. lawyers), occupation (e.g. farmers), interests (e.g. hobbyists) or socio-economic status (e.g. the elderly). The people in these sets are already "predefined categories of people"(Taylor, 1991, p. 223). While recognising that demographic variables (for example, age) and non-demographic variables (for example, attitudes towards technology) may influence individual information behaviour, Taylor (1991, p.223) argues that they do not change the IUE as these variables are either linked to the set of people anyway (for example, media use) or the influence is not significant (for example, marital status).

2.2.2   Problems

Taylor (1991, p.224) suggests there are three areas to contemplate when considering information problems. The first is that problems change over time and so problems within an IUE are not fixed. The second is that within an IUE there are typical problems that stem from the setting and the demands made on the set of people. As such each IUE will have its own class of problems. The third is there can be different responses to problems depending on their characteristics, such as well-structured / ill-structured, complex / simple, and so on.

2.2.3   Setting

The setting is the physical context within which people work. Taylor (1991, p. 226) does not consider the size of an organisation or the local setting to be a substantial factor. According to Taylor (1991, p. 226) there are four key components of a setting that affect information behaviour. Firstly, there is "importance of organisation". This is the extent to which an organisation imposes on the set of people. Some types of organisations will impose more than others. For example, corporations may impose more than cooperatives. Secondly, there is the "domain of interest". What information is available and where, may depend on the central concern of the setting. Thirdly, there is "access to information". How information is accessed and the preferred route to access (for example, people, books, TV and so on) will differ according to the setting. Fourthly, there is "history and experience". Whether a setting experiences continuity or change is important. For example, what could be considered difficult tasks may become routine in an organisation that experiences continuity.

2.2.4   Resolution of problems

How information problems are resolved is dependent upon the IUE and in different IUE there will be different resolutions. As Taylor (1991, p. 219) suggests all members of professional groups may need to keep up with latest developments in their field but how they keep up with developments will depend on their group. Taylor (1991) considers two aspects to problem resolution: information traits ("identifiable traits inherent in information" for example, whether there is a single solution or a field of possibilities) and information use. That in different environments there will be particular uses of information is of specific interest to this thesis and so is explained at greater length here.

Taylor (1991, p. 221) defines information use as "what information does to or for the recipient and his or her problem or situation". Heavily influenced by Dervin (Dervin, 1983; Dervin & Nilan, 1986), Taylor (1991, p. 229) identifies 8 general classes:

- Enlightenment – information is used to grasp context and understand a situation
- Problem understanding – similar to enlightenment but more specific, where information is used to comprehend a particular problem
- Instrumental – information is used to find out how to do things
- Factual – information is used as precise data
- Confirmational – information is used to verify other information
- Projective – information is used to forecast outcomes
- Motivational – information is used to stimulate personal involvement
- Personal or political – information is used to understand relationships and develop networks.

Taylor (1991, p. 229) offers these as 8 general classes not limited to any particular user group or information system. These classes should not be thought of as mutually exclusive as people may use information in more than one way or one type of information use may preclude another.

2.2.5   How the concept of an IUE is used in this thesis

Taylor (1991, p.219) uses the concept of an IUE to "isolate similarities and differences among varying populations in specific contexts". By comparing the information practices of engineers, legislators and doctors as recorded in the research literature, Taylor (1991) demonstrates that what makes information valid depends on the IUE. A different approach is taken in this thesis. Rather than directly compare primary schools with other IUE, Taylor's (1991) model is used as a guide when exploring how the primary school environment may influence search.

2.3   The primary school information use environment

In this section, using Taylor's (1991) concept of an IUE as a framework, how the primary school environment might influence search is considered in more detail. Other models from the more general field are also cited if they are thought to be particularly relevant.

2.3.1   Sets of people

Based on Taylor's (1991) model, primary school children can be considered a set of people as they are a group as defined by society. However, whether primary children can be considered a single set is debatable as so many studies of children have found age to be an important factor (Duarte Torres & Weber, 2011; Duarte Torres et al., 2014; Gossen et al., 2013; Large et al., 2008; Marchionini, 1989). It should also be noted that Taylor's (1991, p.219) conceptualisation is based on analysis of "the professions" and as such children could be an exception when considering the importance of demographic variables.

Again according to Taylor's (1991) model, while teachers are also located in primary schools, they should be considered a separate set as they are another group defined by society. While they may share the same setting they likely have different problems and resolution of problems. However, it could be role rather than set that distinguishes teachers from children,

and Leckie, Pettigrew & Sylvain (1996, pp. 180–181) argue that information seeking is strongly related to role (Figure 2).
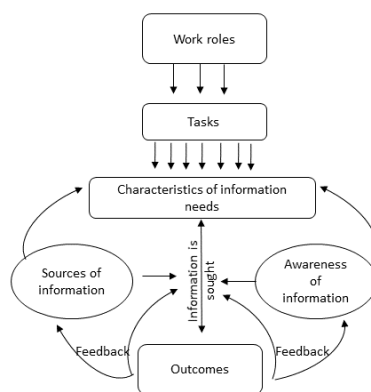
Figure 2: "A model of the information seeking of professionals" (Leckie et al., 1996, p. 180)

Though to complicate this further, while teachers and children may play different roles in class they also work together. When studying information literacies in primary school Lundh (2011, p. 58) found that they are "enacted in information activities which are carried out together with other people, such as librarians and teachers; thus, the information activities in primary school are constructed jointly by children and adults." As such it can be anticipated that it might be difficult to distinguish the search tasks of children and teachers.

2.3.2   Problems

Whether primary school children have problems in common, whether there is continuity or change in the primary school environment and problem dimensions are considered next.

2.3.2.1   Typical problems

IUE have classes of problems that stem from the setting and the demands made on the set of people. It is likely that children's information problems are shared across primary schools. Most English state schools follow a national curriculum (Department for Education, 2017), the purpose of which is "so children learn the same things" (Department for Education, 2016b). The curriculum covers the subjects that should be taught and the standards that should be reached. The Department for Education provides a framework that includes a program of study and the targets that should be met. Teachers are expected to continually monitor children's progress and there are three national tests that all children must undertake (Standards and Testing Agency, 2016). As such it is possible that there are typical information problems that children need to resolve in primary schools.

More generally, a number of studies have considered what children need information for and the topics they are searching on (Agosto & Hughes-Hassell, 2005; Duarte Torres, Hiemstra, & Serdyukov, 2010a; Duarte Torres et al., 2014; Eynon, 2009; Shenton & Dixon, 2003, 2004b; Silverstein, 2005; Vanderschantz, Hinze, & Cunningham, 2014). Of particular interest to this thesis are the studies by Shenton & Dixon (2003, 2004b) and Duarte Torres et al. (2010a, 2014) who demonstrate that what children need information for changes with age. This could be an indication that children's problems also change with age. These studies are described next.

Shenton & Dixon (2003) find that there are 13 main types of information need (for the full list see Evidence Base A) and that these needs occur in response to both home and school environments. The types of need vary according to age. For example, young children need information on the local environment (categorised as personal information) whereas older children are more likely to need information to assist them in making purchases (categorised as consumer information). Most of the information needs occurred in response to school work. In a follow-up study Shenton & Dixon (2004b) consider what information needs children have during their time at school. They find that when children start school they need information that relates to their personal experiences. As they get older they need information on curriculum topics and when they are close to finishing school they need information to help them determine their future.

In a study of the AOL transaction log Duarte Torres, Hiemstra & Serdyukov (2010a) find that the topics searched on cluster according to age. For example, teens are much more likely to search on social topics such as "boyfriend" than younger children. In a follow up study, this time of the Yahoo transaction log, Duarte Torres, Weber & Hiemstra (2014) again find that there is a link between topic distribution and age, and that children search on a narrower range of topics than adults. The main topics that children under 12 search on are games and recreation, computers and internet, entertainment and products, and sport. Over the age of 12, games and recreation topic searches decrease.

2.3.2.2 Continuity or change

The adoption of new technologies and the changing curriculum means that it is likely that information problems will have changed overtime and will continue to change.

The increasing adoption of new technologies in schools means that there has been considerable change in the information environment (Buckingham, 2007). Coinciding with increasing access to the Internet, there has been a move away from rote learning where the teacher provides the class with all the required information towards children finding information for themselves (Kuhlthau, Maniotes, & Caspari, 2007; Walraven, Brand-Gruwel, & Boshuizen, 2008b). This has had a knock on effect on how information is sought and used in the classroom. In turn this has led to the development of different types of research activities (Robins, 2001), most notably problem-based learning (finding a solution to a real-world problem), inquiry-based learning (find answers to own questions), project based learning (working as a group but submitting individually).

In 2014, a new national curriculum was introduced in England that among other things, overhauled what was previously the Information Communication Technology (ICT) subject area to what is now Computing. In this new Computing curriculum children on leaving primary school are expected to know how to "use search technologies effectively, appreciate how results are selected and ranked, and be discerning in evaluating digital content" (Department for Education, 2013a). Significantly, this now means that primary school children in England will be expected to use search technologies while at school.

2.3.2.3 Problem dimensions

Taylor (1991) suggests that the most important problem dimensions are well-structured / ill-structured, complex / simple, assumptions agreed upon / not agreed upon, and familiar / new

patterns. What is known about problem dimensions and primary-age children is discussed next.

Well-structured / Ill-structured

There has been considerable investigation of children searching for information for well-structured and ill-structured problems (see for example Bilal, 2002b; Schacter, Chung, & Dorr, 1998). However, it is not clear from the literature what the structure of children's real-life tasks is as in many of the studies of task structure the problem has been designed by the researcher.

Furthermore, what impact task structure has is unclear as there is a lack of consistency between studies both in terms of search behaviour and search success. While in many studies the structure of problems (often operationalised through the specificity of the search goal) does account for differences in query formulation, results examination, time spent searching and navigation style within a study (Bilal, 2002b; Bilal, Sarangthem, & Bachir, 2008; Borlund, 2016; Gwizdka & Bilal, 2017; Marchionini, 1989; Schacter et al., 1998) there is a lack of consistency across studies. Equally when considering success, a lack of consistency across studies is also apparent (Bilal, 2000; Marchionini, 1989; Schacter, Chung, & Dorr, 1998).

Complex / simple

As with the structure of tasks, although there is considerable interest in task complexity, this interest is in whether children can complete complex tasks rather than whether their tasks are simple or complex.

In keeping with the more general literature complexity is usually a combination of one or more elements (Wildemuth & Freund, 2009, p. 118). What these elements are varies between studies as different researchers have different conceptions of what makes a task complex for children. For example, the following have all been considered: abstract as opposed to concrete topics (Solomon, 1993, 1994); number of steps needed (Druin et al., 2009); goal specificity (Bilal, 2002a); directory structure and type of system (Cooper, 2002; Walraven, Brand-Gruwel, & Boshuizen, 2008a); prior knowledge (de Vries, van der Meij, & Lazonder, 2008). As such it is difficult to determine how this problem dimension impacts on children's search.

Assumptions agreed upon / not agreed upon

That the primary school environment is one where there are agreed upon assumptions with regard to resolving information problems has been widely discussed.

It is thought that in primary schools, children are assigned tasks by teachers to which teachers already know the answer(s) to. Children's outputs are then assessed against the teachers known answers (Gross, 2006). This can mean that children search for facts to find the "right" answer rather than critically evaluate the full range of information on a topic (Limberg, 1999). Limberg (2007) finds that children "define their task according to the school's discursive practice, that is, that the school is a non-research environment, not based on genuine research questions but on the understandings that there are right answers to find, compile and represent". Lundh (2012, p. n.p.) also found that pictures are predominantly used as decoration in research assignments because schools are "text-dominated".

Familiar / new patterns

Whether primary school children's tasks are familiar is not clear from the research literature. However, it is thought that given the extent to which tasks stem from a recommended programme (in the form of a national curriculum) they will likely follow familiar patterns.

2.3.3   Setting

Using Taylor's (1991) framework the importance of organisation, the domain of interest, access to information, and history and experience of the primary school environment is reviewed. In addition to this the local setting and differentiating between home and school is included as these are also thought to be important when considering primary schools.

2.3.3.1   Importance of organisation

Taylor (1991) argues that the extent to which an organisation imposes on the set of people will determine the degree of influence over information behaviour. Primary schools are a highly regulated space and the imposition on people within the setting is likely high. As discussed under problems (2.3.2), there are likely typical problems that stem from the national curriculum and there are likely agreed upon assumptions of problems. Within this environment not only do teachers impose on children but teachers too are imposed on.

Teachers are the assigners of children's tasks. As such search tasks are imposed on children. Although there may be a degree of choice in what children search for (see 2.3.3.6), Gross (2005, 2006) and Limberg (2007) argue that school tasks should always be viewed as externally-assigned because they are always assessed, have intended learning outcomes and it is the teacher who decides whether the search task has been successfully completed (Gross, 2005, 2006; Limberg, 2007).

However, this imposition is complex. Gross (1999, 2001, 2006; 2004) found that teachers may not see themselves as imposers and children may not conceive of these tasks as being imposed but that the imposed nature of the tasks is overlooked by both teachers and children because it is easier this way to achieve the ultimate goal of school which is to socialise children into society. Furthermore, teachers are likely to assign the task from within the curriculum that has been imposed on them, they do not need this information for themselves, and likely already know the answers.

2.3.3.2   Domain of interest

The central concern of primary schools is to educate children aged between four and eleven. As such primary schools are a learning environment. To make learning meaningful, school work tasks are often designed to relate to the real world (Gordon, 1999, p. 5). School tasks are neither true real life tasks nor are they simulated. Tasks are part of school life, making them real, but they are also simulated in that they deal with problems that occur outside of school. Another idiosyncrasy of work tasks in an educational context is that the same task is multiply assigned, in that a single work task is not given to just one child but the whole class. Not only will teachers and children have different conceptions of the task, the task can also be experienced very differently depending on the task doer (Limberg, 2007).

2.3.3.3   Access to information

What access children have to information will depend on the setting. It is likely that access will be similar across primary schools. Schools, particularly in the UK, have invested heavily in technology (BESA, 2013) ensuring that all pupils have access to computers in schools. Access is likely to be different at home where in terms of time it is widely recognised that children have greater access to technology (Rideout, Foehr, & Roberts, 2010). However, there is an inequality of access and some children may have little or no access to technology at home. That there is a digital divide has been much researched (see for example Livingstone & Helsper, 2007).

2.3.3.4   History and experience

Taylor (1991, p.228) suggests that within a setting complex tasks may become routine over time. Whether this could be the case in primary schools is not clear from the research literature.

2.3.3.5   The local setting

Although Taylor thinks the local setting is unimportant, Nardi and O'Day (1999) have demonstrated how individual schools can differ. Nardi and O'Day (1999, p. 49) describe an information ecology as "a system of people, practices, values and technologies in a particular local environment". They use this analogy of an information ecology to explain how making a change in one part of a system will also have knock on effect on another. In each ecology these effects will be felt differently. In their examples of information ecologies (including schools) they demonstrate how practices in the local setting change how technology is adopted and used.

2.3.3.6   Differentiating between home and school settings

For Taylor (1991) the environment within which information is used has the most influence on search. However, a number of studies have shown that for children there is a merging of the home and school environments. This is seen in the topic of children's search and the search location.

Search topics

A number of studies have found that when it comes to the topic of the search task there is a merging of school and home interests. From a constructivist perspective, the degree to which a school task is assigned is important, as new information only becomes knowledge when it is incorporated into prior knowledge structures. To learn, children need to activate existing knowledge and if children are given a choice of what to look for they are more likely to develop a sense of ownership, and motivation will be increased (de Vries et al., 2008; Kuhlthau, 2004). Before starting a search activity in the classroom teachers discuss the task topic so as to activate children's prior knowledge (Cooper, 2002, p. 910; de Vries et al., 2008; Hoffman, Wu, Krajcik, & Soloway, 2003; Kuiper, 2007; Oliver & Perzylo, 1994). The search task is not simply imposed on the class but is discussed and stems in part from what children already know. This prior knowledge can be from previous school work or from children's out of school experiences (de Vries et al., 2008, p. 650). The merging of school and home interests has been observed in a number of studies, and is discussed next.

In Chung & Neuman's (2007) study of secondary-age children, when allowed to select their own topic these children chose socially controversial and popular topics rather than anything relating to school curriculum. Silverstein (2005) found that primary-age children are researching school topics in their own time for their own interests (although this curiousity in school-related topics drops as the children get older). Shenton & Dixon (2004a) found that not only did children willingly research school topics beyond any school requirement but that children's long standing interests also get covered in school, and that that personal interests can coincide with school topics. In a follow-up study, Beautyman & Shenton (2009) find that the two most common reasons for children wanting to study topics beyond school were that children identified with a particular situation or person, or the information they were presented with did not fit with their conceptions of the topic.

Search location

Children are also given search tasks to complete at home. So although primary schools are the environment within which information for school work is used it is not the only environment within which information is searched for. Not only is the home environment also likely to influence the search, children will also be influenced by their previous search experience, wherever this may have taken place, and children will be using information retrieval systems that have been designed in another context possibly for another context. This is best exemplified in Ingwersen & Jarvelin (2005, p. 31) cognitive framework of IS&R model. This model (Figure 3) depicts how people interact with information retrieval systems within organisational contexts, cultural contexts and social contexts. Here, it is the information seekers' perception of their task that has the key influence on the search process. This perception is based not only on the current situation but also on past experience and prior knowledge. In this way a person can be seen to be operating in more than one context. The model also indicates that the user of an information system is only one of many cognitive actors engaged in the information retrieval process. Information retrieval systems have system designers, authors of documents, interface designers and so on. All of these individuals are operating in different contexts and at different times. Therefore, the user of an information retrieval system is doing so within one context(s) but the system has been designed in other contexts and possibly for other contexts too. For Ingwersen & Järvelin (2005, p. 30) "the perception, interpretation and cognition of the individual actor is *determined* by its / his / her prevailing cognitive structures – and *influenced* but not directed or dictated by the environment or domain" (italics in original).
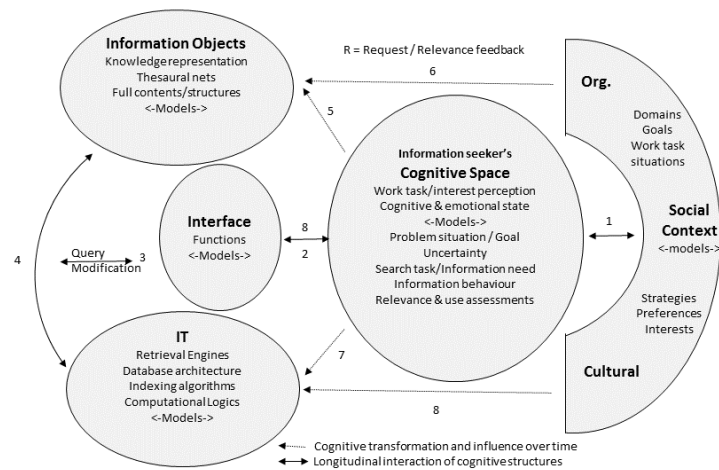
Figure 3: "Cognitive framework of (longitudinal) IS&R" (Ingwersen & Järvelin, 2005, p. 274)

2.3.4 Resolution of problems

Primary school information use and information traits are reviewed next.

2.3.4.1 Information use

There has been little research on how information is used by children (Large et al., 2008, p. 131). Where research has examined information use, unsurprisingly a link is found between work task requirements, information types and format. For example, Chung & Neuman (2007) found that even when set research assignments children search for facts because they have been instructed to find reliable information. In other studies of school assignments, children are observed searching for text and images because it is difficult to make use of multi-media in paper-based writing projects (Large & Beheshti, 2000, p. 1074; Nesset, 2007, p. 8).

In terms of the different uses of information both Limberg (1999) and Lundh & Limberg (2012) have investigated the different ways individuals use information in schools. Limberg (1999) examined how different members of a class perceive research assignments. It was found that for the same assignment there were three conceptions of the task and this lead to three different uses of information. For some the task was a fact-finding exercise, and they looked for factual information to answer the assignment. For others the task was to find the right information in order to support an opinion. For the third conception, students searched for information in order to strengthen their understanding of the assignment topic. Each of these different conceptions of the assignment led to different uses of information. Lundh & Limberg (2012) investigated how primary school children used pictures to support text in research assignments. It was found that there are four ways pictures can be used to support text (decorating, illustrating, explaining and narrating). What is not clear from this study though is to what extent images are used to explain the actual phenomenon beyond supporting the text.

In Table 1 these different uses are mapped onto Taylor's (1991, p. 229) classes of information use. As Bartlett & Toms (2013) suggest that there is evidence of a common set of information uses across different environments, studies in the more general field are also documented in this table.

Table 1: Classes of information use in the research literature

General (Taylor, 1991, p. 230)	By students on the same task (Limberg, 1999)	On the web (Morrison, Pirolli, & Card, 2001, p. 164)	By engineers (Freund, 2008, p. 86)	By groups (Toze, 2014, p. 330)	Pictures in research assignments (Lundh & Limberg, 2012)
Enlightenment	Scrutinising and analysing		Learn about		
Problem understanding		Understand	Find a solution		
Instrumental			How to	How to	
Factual	Fact finding	Find	Find facts	Fact-finding	
Confirmational				Confirm	
Projective					
Motivational					
Personal or political					
	Balancing information	Compare / choose	Make a decision	Decision support	
				Re-find	
				Keep track	
				Entertainment	
				Make sense	
					Decorating
					Illustrating
					Explaining
					Narrating

2.3.4.2   Information traits

There is some indication that there are particular information traits that primary school children look for, particularly in relation to the focus and solution continuum. In much research children are observed looking for factual information (focus continuum) and single solutions (solution continuum), and this relates to the setting and information use (see 2.3.3 and 2.3.4.1).

2.3.5   Summary of the primary school information use environment

Taylor (1991, p. 221) describes an information use environment as having four elements, namely "sets of people, typical structure and thrust of problems of those sets of people, typical settings, and what constitutes resolution of problems". Each of these were examined in turn for primary schools and summarised below. There is some indication that primary schools are an IUE and that it is the IUE that is influencing search. However, for each of the elements there is enough ambiguity that it would be foolish to assert that primary schools are a type of IUE.

Sets of people

Primary school children (ages 4 to 11) could be considered a set of people in that they are a group defined by society but research suggests that children of different ages will be searching for different information. Furthermore, it might be that children and teacher's both partake in search activities.

Problems

It seems likely that because schools follow a national curriculum there will be typical problems in the IUE but the problems might vary according to age. In relation to search there has been considerable change in the IUE but this change is likely to be common to all U.K. primary schools. The problem dimensions that Taylor (1991) describes are likely to be significant to primary schools. However, the only problem to have been investigated in real-life terms is the agreed upon assumptions to problem resolution.

Setting

Attributes of primary schools that Taylor (1991) considers important to an IUE (importance of the setting, the domain of interest, access to information, and history and experience) suggest that primary schools could be IUE. However, it is likely that differences in the local setting will impact on search. Furthermore, in terms of search there appears to be some fluidity between school and home settings.

Resolution of problem

There has been little work that directly relates to information use and information traits. However, based on the research that has been done in this area it seems very likely that the setting is influential here.

2.4   Conceptualising and describing tasks

How tasks have been conceptualised and different ways to describe tasks are outlined next. The relationship between activities and tasks is also explained.

2.4.1   Conceptions of task

A task is a focus "on a particular item of work" (Byström & Hansen, 2005, p. 1051). Tasks are purposeful, goal-based, and have start and end points (Byström & Hansen, 2005; Hackos & Redish, 1998). A task may consist of sequences of sub-tasks that need to be performed to achieve an outcome for a work function (Toms, 2011, p. 45). There are both work tasks and information tasks. Within a work task there may be many information tasks such as, search for information, synthesise information or write a report. The focus of this thesis is the search task that is the information task that occurs when new information is required to complete a work task. For example, a work task of "choose and purchase a yacht" could have an information task of "which models of yacht are available" and this information may need to be searched for (Toms et al., 2008).

Search is rarely carried out for its own sake and is a dynamic process that is part of a larger process of decision making and problem solving (Rouse & Rouse, 1984). Increasingly work

tasks, the "separable parts of a person's duties to her/his employer" (Byström & Hansen, 2005, p. 1053) are considered an important motivator of search because it is from here that the "value and cost structure" (Pirolli & Card, 1995) of the search task is derived and it is the work task in which a "person's search behaviours are situated" (Wildemuth & Freund, 2009). Work tasks are "always to some degree outlined by the work organisation"(Byström & Hansen, 2005, p. 1053) and the work task may be interpreted differently depending on the context within which it is operating (Byström & Hansen, 2005, p. 1052). Hence, what work tasks are and how work tasks motivate search may also vary depending on the work task domain (Taylor, 1991).

For any given work task there may be multiple information tasks that lead to a search for information. The interconnections between these tasks may be hierarchical and / or serial (Toms, 2011, p. 48). In much of the research literature the hierarchy of the task that is the search for information is explicated into three named levels: information seeking task, search task and retrieval task. These levels are differentiated by number of consultations, the specificity of the information goal and type of search system used (see for example Byström & Hansen, 2005; Y. Li & Belkin, 2008, p. 1823). Although there is some disagreement about the definitions of the different levels, there is consensus over their place in the hierarchy (Byström & Hansen, 2005, p. 1055).

There are, however, some problems with conceptualising these levels. Although the hierarchy between the levels is generally accepted, it is also recognised that there are situations in which the hierarchy collapses (Byström & Hansen, 2005; Y. Li, 2009, p. 275; Y. Li & Belkin, 2008, p. 1823; Pharo & Järvelin, 2004). For example, when a librarian searches for information for others the task could be categorised as a search task, an information seeking task or work task (Y. Li, 2009, p. 275; Pharo & Järvelin, 2004). Furthermore, empirically the differences, particularly between information seeking tasks and search tasks are not always observed. Freund (2008) suggests that this may be because information seekers themselves do not distinguish between these two levels of task.

2.4.2   Descriptions of tasks

Hackman (1969, p. 103) suggests that tasks can be described in four different ways. Firstly, the properties of the task can be described. This is the "task qua task" approach. Secondly, the description can focus on what the task doer should do. This is the "task as behaviour requirement" approach. Thirdly, what the task doer actually does can be described. This is the "task as behaviour description" approach. Finally, the description can be what abilities the task doer needs to have to successfully complete the task. This is the "task as ability requirement" approach.

Tasks can also be thought of as both independent of the task performer (objective) and how they are perceived by the task performer (subjective). For example, an assigned task given to a classroom of children is an objective task, but how individual children understand the task is subjective (Byström & Hansen, 2005; Hackman, 1969). So although children's search tasks can be described objectively and a class of children may be given the "same" task, how each child experiences these tasks will differ (Hackman, 1969; Limberg, 1999).

This thesis is primarily concerned with "task qua task" with only objective elements of task considered. The term element is used here to mean "a component part of a complex whole"

(OED, 2017) whereby a description of a task may be broken down into different components. The subjective classification of task is considered a characteristic of the user rather than the task or activity per se. However, when validating the representation scheme in phase 2 "task as behaviour description" is also considered. This is important because as Hackman (1969, p. 102) suggests "ignoring this (probably sizable) portion of the behavioural variance in dealing with tasks would seem indefensible".

A further problem though with the "task qua task" approach to describing tasks is that what to describe is potentially unlimited (Hackman, 1969). For this reason, when considering what to include it is necessary to give thought to the purpose of describing tasks. The purpose here is to describe children's search tasks to better understand the variation. Therefore, it is the elements of tasks that most influence search that should be described. In the more general literature, there are four key schemes that can be used to describe tasks that focus on elements most likely to influence search (Kim & Soergel, 2006; Li & Belkin, 2008; Pharo & Järvelin, 2004; Xie, 2009). These are reviewed in Chapter 3.

2.4.3   Relationship between activities and tasks

The concept of activity is also needed to explain search in schools. Within LIS the term activity has been used as a synonym for task (see for example Y. Li & Belkin, 2008). However, in cognate fields an activity is considered a distinct concept. Norman (2005) explains that activities are composed of multiple work tasks which in turn may be composed of multiple information tasks some of which will be search tasks. So for example the activity "get caught up on the day's correspondence" has several tasks such as "reading email, responding, looking up information, sometimes to copy and paste into emails, checking calendars" and could be for more than one work task (Norman, n.d., p. n.p.). This conception of an activity is in keeping with how search is enacted in primary schools (Figure 4). In primary schools, lessons may be structured around an activity, with the lesson starting with instruction to the class and ending with children reporting the activity back to the class. During a search activity, information may be sought for more than one work task.
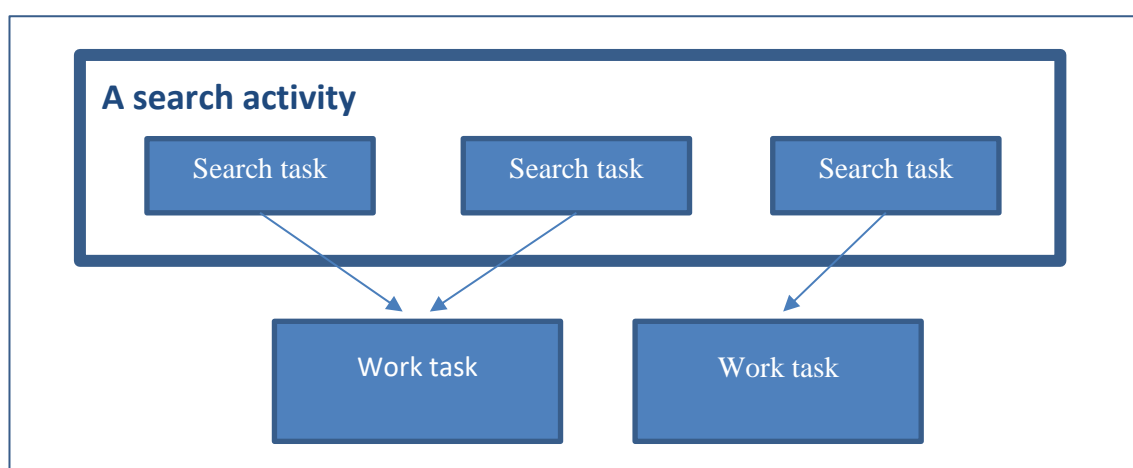
Figure 4: Relationship between activities and tasks

In this thesis, what is influencing the search activity is investigated in RQ1 and the individual search tasks described in RQ2. The reason why the individual search tasks are described rather than the overall activity is that although many of the properties of the search task will likely be

the same for all search tasks within an activity, not all properties will be shared (for example, information use). It is therefore thought more appropriate to describe the individual search tasks.

2.5   Children's search tasks

How children's search tasks have been studied and the descriptions of search tasks are reviewed in this section.

2.5.1   Studies of children's search tasks

In past studies children's search tasks may be part of a real-life work task or designed by the researcher. There are a number of studies of children's real-life work tasks where an information seeking activity occurs. However, these studies are predominantly focused on only one type of work task, the research assignment (see Evidence Base B). Furthermore, although there are some notable exceptions (for example, Cooper, 2002; Francke, Sundin & Limberg, 2011; Solomon, 1993) mostly studies do not consider the search task (Evidence Base B). The search tasks are what Toms (2011) refers to as the "vehicle" for conducting the study rather than the "object" of study. It is usually in experimental studies that the search task becomes the "object" of study. But here the search task is usually divorced from the work task, and often the search task is designed by the researcher.

When researchers have designed search tasks they do so to investigate particular characteristics or to stimulate activity but the actual search tasks are rarely derived from real-life (see Evidence Base A). There is a danger that because the scope of the field has been so narrow and so few of the search tasks are derived empirically, a large part of what children are actually doing in real-life when searching for information has not been studied.

2.5.2   Descriptions of children's search tasks

The different elements of children's search tasks may be selected in advance as part of the study design for researcher designed tasks or can be identified during the course of the study for real-life search tasks. How search tasks are described for these two approaches is described next.

2.5.2.1   Description of researcher designed search tasks

When researchers have designed search tasks few elements are described and the description of elements is not standardised across studies.

Number of elements described

In experimental research children's search tasks are usually described at a single element and sometimes they are not described at all (see Evidence Base A). Where children's search tasks are described for more than one element, it is usually Bilal's (2002a) taxonomy of tasks that is used. Bilal (2002a) categorises children's search tasks for goal, complexity and origination. However, goal and complexity are not distinct categories as Bilal (2002a) considers tasks with general search goals as complex tasks for children, and tasks with specific search goals as simple tasks. Crow (2011, p. 19) has since extended Bilal's (2002a) taxonomy and added in

another category "task relationship", that is whether the search is "experienced with a group (more than one) or as an individual" (see Figure 5).

That so few elements are described is problematic. Search tasks are multi-faceted and are a combination of multiple elements (such as origination, goal, and so on). It is important to describe multiple elements as more than one element could be responsible for a study finding What impact other elements are playing on the observed search behaviour is not known (Freund & Wildemuth, 2014). By describing tasks in this restricted way, it is not possible to get a complete picture of what is taking place in any study. This situation is not peculiar to studies of children's search and Li & Belkin (2008, p. 1833) find in a review of the more general field that most studies describe search tasks using only one or two elements.
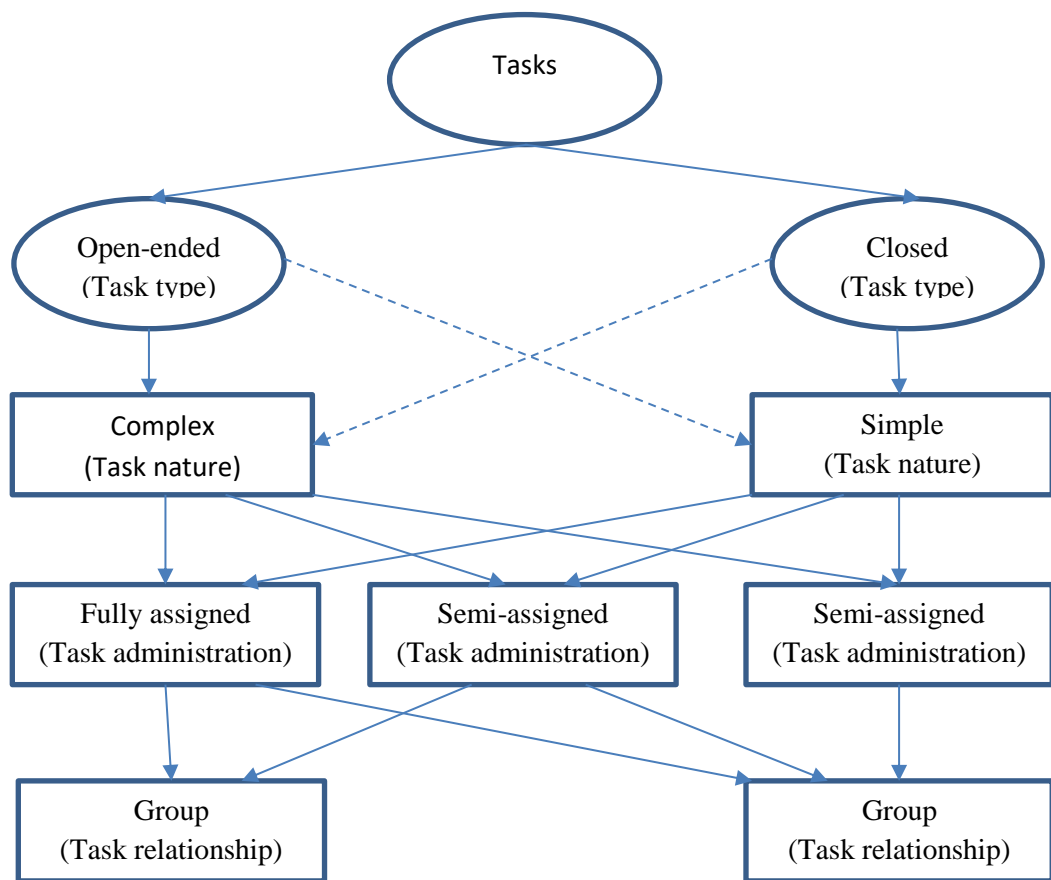
Figure 5: "Adapted taxonomy of tasks" (Crow, 2011, p. 38)

Standardisation of description

It is also preferable to use standardised operationalisations of elements otherwise it is not possible to compare findings across different studies (Kim & Soergel, 2006). As can be seen in Evidence Base A, there is no standardised description of elements. For example, different terms may be used for what is essentially the same goal even by the same author (see Appendix C). This is also true of the general field where while there is some agreement as to which elements are important to search, there are as yet no agreed upon definitions and operationalisations of the different elements (Wildemuth & Freund, 2009, p. 19). This lack of

standardisation is problematic because it makes it difficult to compare findings across studies, and so understanding of search is fragmented.

2.5.2.2   Researchers' descriptions of real-life tasks

Descriptions of search tasks can also be gleaned from studies of children's real-life work tasks (see Evidence Base B). Often the descriptions are much broader than those given in studies of search tasks (compare Evidence Base A with Evidence Base B). Even though the descriptions are often only based on one type of work task, the research assignment, the variation in the elements is notable.

In some studies of children's real-life information seeking, elements of search tasks are identified through observation or by analysing search transaction logs. While these studies help provide some light on the different elements of children's search tasks it is still not possible to obtain a complete picture of children's search tasks from either of these approaches.

Firstly, observations are concentrated on search tasks stemming from research assignments. A similar complaint about the range of tasks investigated is made in the more general literature too (He & Yilmaz, 2017, p.67). This is limiting because search technologies are not just used for research assignments. Interestingly when Asselin & Moayeri (2008, p. 4) wanted to study how children were conducting research assignments at home they found that children were using the Internet for homework but during the study period (5 months) no "substantive research projects" were assigned.

Secondly, where a potentially broader range of work tasks are investigated the search tasks are usually inferred by working back from queries and search interactions (Duarte Torres et al., 2010a) and from library usage patterns (Gross, 2001) rather than directly investigated.

Thirdly, the purpose of these studies is often to investigate particular elements rather than describe the actual search tasks, and so only a few elements are described albeit in depth (see for example, Agosto & Hughes-Hassel, 2005). When tasks are described more broadly, elements are described individually and are separated from the search tasks in which they occur (see for example, Vanderschantz, Hine & Cunningham, 2014). Therefore, how the elements co-occur in children's search tasks is not clear. This is also a concern in the more general field where there are only a few studies that investigate relationships among task elements (He & Yilmaz, 2017; Li & Belkin, 2010).

Although from Evidence Base B we can see that when it comes to completing research assignments aspects of children's search activities vary (timeframe, system use, location, and so on) when it comes to studying search tasks (Evidence Base A) few elements are studied. What is striking is that some elements have received much attention (for example, goal, origination and complexity) but others have received considerably less attention (for example, timeframe and output). While it is possible that origination and goal are the key elements to understanding children's search, it is important to identify other elements and to consider how they too impact.

2.5.3 Summary of children's search tasks

In studies of children's search the tasks have mostly been designed by researchers. Furthermore, what is known about children's search is based on what are arguably barely adequate descriptions of what children are doing. A more thorough and consistent representation of children's search tasks is required. In the more general literature, multi-dimensional schemes have been developed to represent tasks (Kim & Soergel, 2006; Y. Li & Belkin, 2008; Pharo & Järvelin, 2004; Xie, 2009) but whether these schemes can be used to describe children's search tasks needs further consideration.

2.6 Summary

Whether children are a distinct user group is an important question because if they are then support should be tailored to this group. This question is central to much of the work examining children's search and it is usually children's age and cognitive development that leads researchers to consider children distinct. However, this is based on theory that while still considered seminal is somewhat outdated in cognate disciplines. In the more general field, Taylor (1991) puts forward a compelling argument for information use environments, whereby it is the environment within which information is used that has the most influence. Using this model as a framework, studies of children's search have been reviewed in relation to primary schools. In this review there are indications that the IUE as defined by Taylor (1991) does influence children's search. However, it is difficult to draw a definitive conclusion and what is shaping primary school children's search requires further examination and is investigated in RQ1 (what is shaping primary school children's search).

Furthermore, although much research is conducted in primary schools our understanding of what children are using search technologies for in primary schools is restricted. Naturalistic studies of children are mostly limited to one type of work task, the research assignment. As well as this, descriptions of the actual search tasks are poor. A much more holistic picture is required whereby the full range of children's search tasks is captured. These search tasks should be described in such a way that elements that are thought to affect information behaviour are included in the description. To support people in their use of search technologies, both in terms of providing guidance and building more responsive search systems, it is important to have a good understanding of the tasks that lead to use. This leads to RQ2 (what are primary school children's real-life search tasks). To answer this question, it is necessary to have a systematic way to describe these tasks. In the following chapter, the literature is further reviewed to develop a provisional scheme for representing primary school children's search tasks.

3 DEVELOPING A PROVISIONAL SEARCH TASK REPRESENTATION SCHEME

3.1 Introduction

In this chapter, a provisional search task representation scheme, grounded in the research literature is drawn. This scheme is used to provide an analytic framework with which to analyse the data collected in phases 1 and 2. The scheme is then further refined during these two phases and when finalised is used to describe primary school children's search tasks.

The provisional scheme is built by combining two different literature reviews. A review of key works from the more general literature (literature not confined to children) is used to determine what aspects should be considered when describing search tasks. Then the different elements of what is already known about these aspects are taken from a review of the children's literature (Evidence Base A and Evidence Base B).

3.2 Review of the general literature on task representation

In the more general research literature there are three key schemes that categorise tasks at multi-dimensions, namely Li & Belkin's (2008) faceted classification, Kim & Soergel's (2006) task characteristics and Xie's (2009) dimensions of tasks. While not strictly a classification of task, Pharo & Järvelin's (2004) search situation and transition model is also considered here as the model lists factors, including those belonging to work tasks and search tasks, that influence the search process. To aid the reader, these schemes are reproduced in full in Appendix D.

Next the four multi-dimensional schemes used in the general field are described and differences between them considered. Then the suitability of using these schemes to describe primary school children's search tasks is deliberated.

Li & Belkin (2008) incorporate work tasks, information seeking tasks and search tasks into one scheme and classify them using the same set of facets and, where possible, values. The scheme is developed from a review of the literature. They find that there are both generic facets of task (source, doer, time, process, product, goal) and common attributes of task (characteristics, user's perception). Although they consider topic an important element of task, because there are limitless topics and it is impractical to allocate values, topic is not included in this scheme. Using this classification scheme, Li (2009) examines both inter-relationships and intra-relationships of search task and work task, concluding that work task influences search task, and that the facets of search task most affected are length of time, and both objective and subjective task complexity. Similarly, He and Yilmaz (2017) use this scheme to identify the co-occurrence of elements in real-life tasks, finding that the elements of seemingly similar tasks can vary considerably. Li & Belkin (2010) also use the scheme to investigate the relationship between work tasks and search behaviour. They find that there are different search tasks for different work tasks, and that both work task and search task influence search behaviour.

Also deriving their scheme from a review of the research literature, Kim & Soergel (2006) identify all the different characteristics and corresponding variables used to study task. Building on the framework developed by Hackman (1969) they arrange task characteristics

under four categories: intrinsic task characteristics, extrinsic task characteristics, task performer and relationship between task and performer. They do not distiguish between work and search task. From the literature reviewed they identify that stage, complexity, analysability and determinancy, interdependence and scope of task are the characteristics most associated with changes of information behaviour.

Xie (2009) empirically investigated in two settings (corporate and academic) dimensions of tasks that are important in the search process. Xie (2009) found that the key dimensions for work task are nature, stage and timeframe, and the key dimensions for search task are origination, types and flexibility. During the search process planning, use of strategies and changes in goal are influenced by different combinations of these dimensions.

In a scheme based initially on a review of the literature, then refined through an empirical study, Pharo (2002) identifies 5 categories and corresponding attributes that are important in understanding search behaviour: work task, search task, searcher, social / organisational environment and search process. Pharo & Järvelin (2004) investigate the relationship between these categories and suggest that work task and environment influence search tasks, and the search process is influenced by work task, search task and searcher.

Suitability of multi-dimensional schemes as a basis for describing children's search tasks

The four schemes offer a promising basis on which to build a scheme to represent children's search tasks. However, it is unlikely that any scheme could be adopted wholesale for the following reasons.

These schemes are designed to represent the tasks of individuals, and include both subjective and objective categorisations of task. This purpose of the scheme in this thesis is to represent the tasks of an information use environment, and therefore only objective elements can be described.

Li & Belkin (2008) and Kim & Soergel (2006) offer comprehensive schemes that cover many aspects. However, as these schemes are derived from a review of the literature, they are based on what those in the field consider important to study. While they do consider which characteristics are most important to understand search, to a large extent the schemes are a catch-all. These schemes are useful for considering all potential characteristics but they do not help elucidate which characteristics could be important for understanding search within a particular environment. Xie's (2009) dimensions go some way towards this, in that the scheme is derived empirically and is based on analysis of two different environments (corporate and academic) but this is also the simplest classification scheme.

A further concern is that to compare children's search tasks with other user groups it is important to employ terminology used in other schemes (Toms, 2011, p.58). However, even if one scheme were appropriated the problem remains that there is a lack of standardisation in terminology and operationalisation across the different schemes.

Although the multi-dimensional schemes can be used as a basis for representing children's search tasks, none can be directly employed. When developing their scheme Li & Belkin (2008, p.1833) suggest that a description of a task should include answers to the following questions:

- "Where is this task from?
- Who carries it out?
- How long does this task last?
- What is it about (topic or content)?
- How should this task be completed?
- What is (are) its products?"

It is thought that these questions are comprehensive and broad enough to describe children's search tasks, and offer a more promising framework on which to build a representation scheme. These questions are now used in section 3.3 to elucidate from Evidence Bases A and B what is already known about the elements of children's search tasks. The multi-dimensional schemes and the more general research literature are also referred to, to help define and operationalise elements.

3.3 Provisional representation of children's search tasks

Using Li & Belkin's (2008, p.1833) suggestion of questions that can be used to describe a task, how these questions could be answered for primary school search tasks is considered. This is done by using the evidence bases to identify appropriate studies and the variation of approaches. The multi-dimensional schemes and where appropriate the more general literature are also used to help define and operationalise elements.

3.3.1 "Where is this task from?"

A task "may originate from another person, result from the demands of the job function, or be triggered by another task" (Toms, 2011, p. 45). Therefore, what the work task is that motivates the search task and who originates the search task should be considered.

Work task

In studies of children's search, it is the research assignment that is usually the work task that motivates search tasks. Other types of work task have rarely been considered (Evidence Base B), yet it is likely that other types of work task motivate search. In schools, children are taught in units of work and as units are "a coherent body of teaching / learning material usually focused on one specific topic or subject" (Dictionary of Education, 2016) they could be considered conceptually equivalent to work tasks. However, there are many units of work and to date there has been no attempt to differentiate children's work units in relation to search tasks. In the more general literature, there have been different approaches to categorising work tasks (for reviews see Kim & Soergel, 2006; Y. Li & Belkin, 2008; Toms, 2011). Recently Saastamoinen & Järvelin (2017) examined work tasks in three different domains (city administration, higher education and commercial companies) and found that there are three types: communication, support, editing and intellectual tasks. However, as operationalised in this thesis these are three types of activities rather than work task types.

As yet it appears that there is no categorisation that can be used across different domains (Toms, 2011, p.56). So although it may be possible to identify the different work tasks that children do, it is anticipated that it may be difficult to find a way to succinctly represent these different tasks.

Three of the multi-dimensional schemes (Kim & Soergel, 2006; Y. Li & Belkin, 2008; Xie, 2009) also consider how familiar the work task is that motivates the search task (whether it has never been done before, done occasionally or is a matter of routine). There is little or no discussion in the research literature with regards to how familiar children are with the work tasks where search takes place. However, most studies are on research assignments and it is reasonable to assume that children are familiar with this type of work task but there could be differences for other types of work task.

Origination

How origination influences search has been a big concern in research on children. Two broad approaches have been taken to conceptualising origination. In one conceptualisation origination is considered as either internally-generated or externally-assigned (Agosto, 2002; Gross, 2006; Limberg, 2007). In the other conception, origination is something that emerges in collaboration (Lundh, 2010; Shenton & Dixon, 2004a). The conceptions differ depending on whether origination is considered purely upon task initiation or at the different stages of the task. Both these conceptions have been represented in the multi-dimensional categorisation schemes but only one approach is taken in each scheme. Li & Belkin (2008) consider origination in relation to who motivated the task with collaboration included as an option. Xie (2009) across two categories (origination and flexibility) considers the degree of choice in topic selection i.e. the extent to which a search task can be changed by the performer. It is conjectured that both these approaches will be needed to describe children's search tasks. It should be noted, though, that Shenton & Dixon's (2004a) open / closed continuum (see Table 2) is more sophisticated than Xie's (2009) categorisation and is therefore preferable.

Shenton & Dixon (2004a) studied the different ways teachers give children choice in what to research in homework assignments (see Table 2). They examine two aspects of the assignments. Firstly, the degree to which the topic can be selected. For this they find there are four possibilities: specified topic, own topic drawn from a category, own topic pertaining to appropriate curriculum area, and own topic. Secondly, they consider the focus of the search and whether there are any areas that must be addressed in the assignment. They combine these two aspects and plot them on a continuum of closed to open.

Table 2: Shenton & Dixon's (2004a) closed / open continuum for homework assignments

Requirement		Continuum
Topic selection	**Focus**	Closed
Topic specified	Specified areas	
Topic specified	No specified areas	
Own topic drawn from a category	Specified areas	
Own topic pertaining to appropriate curriculum area	Specified areas	
Own topic	No specified areas	Open

3.3.2 "Who carries it out?"

In most studies, the doer of search tasks is usually described by age and occasionally gender (see Evidence Base A). As this is based on demographics rather than a description of the task, it is not considered in the provisional representation scheme. However, as can be seen in Evidence Base B when conducting research children commonly work individually, in pairs and in groups. Crow (2011) also categorises search tasks on whether they are completed by individuals or in a group. In the multi-dimensional schemes, a similar approach is taken by Li & Belkin (2008) and Kim & Soergel (2006).

3.3.3 "How long does this task last?"

Children's search tasks are not usually categorised for time (see Evidence Base A). When conducting experimental research there is concern that children's tasks are not too long but these tend to be "single instance, single study" (Shenton, 2004, p. 246) and beyond a concern for children losing concentration time is not a factor. However, most real-life research is on research assignments that take place over a period of time (see Evidence Base B). Despite the lack of research, time is considered important in studies of children's search and it is widely recognised that children have more time to complete tasks at home than they do at school (Rideout et al., 2010).

The length of a task (the time period within which a task needs to be completed) is considered in three of the multi-dimensional schemes (Y. Li & Belkin, 2008; Pharo & Järvelin, 2004; Xie, 2009) and this operationalisation could be used to describe children's search tasks.

3.3.4 "What is it about (topic or content)?"

What children are searching for has been categorised for topics (Agosto & Hughes-Hassell, 2005; Duarte Torres, Hiemstra, & Serdyukov, 2010b; Duarte Torres et al., 2014; Eynon, 2009; Silverstein, 2005; Slone, 2003; Vanderschantz et al., 2014; Walter, 1994). However, given that the number of topics is large it is questionable how useful this categorisation is for describing search tasks within an information use environment. Multi-dimensional schemes do not categorise tasks for topic as what is being searched for is potentially unlimited (Li & Belkin, 2008, p.1833). However, what subject area children are searching for is often used when describing children's search activities (see Evidence Base B). Subject areas are defined by the national curriculum. They are few in number and common to all schools. As such subject area may be apposite for representing what content children are searching for.

3.3.5 "How should this task be completed?"

In the multi-dimensional schemes how search tasks are completed has mostly been considered in relation to what stage they occur in work tasks (Xie, 2009; Li & Belkin, 2008). Pharo & Järvelin (2004) also consider what resources may be used, and in this study information use is considered in addition.

Stage

Most studies of children's search tasks are "single instance, single study" (Shenton, 2004, p. 246) and are not connected to work tasks. Therefore, at what stage a search task occurs in a work task is rarely considered. However, that information seeking occurs in stages for

children's work tasks has long been recognised (Cole, Behesthi, Large, Lamoureux, & Abuhimed, 2013; Kuhlthau, 2004). In two of the multi-dimensional schemes, search tasks are categorised for stage depending on whether a task appears at the start, middle or end of a work task (Xie, 2009; Li & Belkin, 2008). The concepts are operationalised differently. Xie (2009) considers stage from the task performer's point of view and determines stage based on how focused the task performer is. This is a subjective categorisation so cannot be used here. By contrast Li & Belkin (2008) are more pragmatic and stage is based on when the search task occurs in the work task.

Resources

What resources children make use of has been of interest, particularly with regard to how useful children find different resources (Madden, Ford, & Miller, 2007) and whether search differs when using print or digital resources (for a review see Large et al., 2008). As part of their study Madden, Ford & Miller (2007) asked secondary-age children what resources (books, info from computer, Internet, library, newspapers & magazines, TV & radio, friends, relatives, teachers) they used for homework assignments. It is thought likely that a similar set of resources would be used by primary school children.

Information use

How children are using information should also be considered. Taylor (1991, p.249) suggests eight general classes (enlightenment, problem understanding, instrumental, factual, conformational, projective, motivational, personal and political) not limited to any particular user group or information system. These classes could be used as a basis to describe children's information use.

3.3.6 "What are its products?"

In two of the multi-dimensional schemes, search tasks are categorised for product. In these schemes, product is conceived of as a combination of intellectual, physical, decision/solution, factual information, and image (Kim & Soergel, 2006; Y. Li & Belkin, 2008). As such these categorisations include both the products of the search and the search goal. In this thesis, product and goal are considered distinct categories, and are discussed individually next.

Product

Grouping together the products of search as intellectual, physical, decision/solution is at odds with conceptualisations of product in the children's research literature where tasks are thought to have both outcomes (what has been learnt) and outputs (the physical product) (Tanni & Sormunen, 2008). The distinction is important because it is wrong to think that a task has either an intellectual product or a physical product. A work task will always have an outcome and that may be accompanied by an output. For example, a research assignment is likely to have an outcome that leads to a greater understanding of the topic (an intellectual product) and an output of an essay (physical product). Therefore, a description of task should distinguish between outcomes and outputs. There is a considerable range of outputs for children's work tasks (see Evidence Base B) but little is known about how these outputs influence search, and output is not categorised in representations of children's search tasks (Evidence Base A). There is some interest in children's cognitive outcomes (Kuhlthau, 2004;

Tanni & Sormunen, 2008) but again these outcomes have not been categorised in representations of children's search. It is also anticipated that it could be difficult to determine cognitive outcomes and that as cognition is individual and therefore subjective, it cannot be used to describe tasks in this study.

Search goal

It is common to categorise the goal of children's search tasks (see Evidence Base A). In the research literature there is considerable duplication of goal types. Based on a review of the general literature, Toms (2011) concludes that when considering goal there are two types of search task: specific item and general topical. Toms (2011, pp. 56–57) likens the difference to whether tasks are constraints-based or instruction-based (Vicente, 1999, p. 77). Specific item tasks are instruction-based tasks in that there is only one way to tackle this task and whether the task can be completed is dependent on the system being able to supply the information. By contrast a general topical task is constraints-based in that the task doer can choose how to perform the task and the success of the task is dependent both on the user and the system. Although the search tasks in the different studies go under different labels, essentially they fall under one of the two types (see Appendix C).

3.4   Summary

By combining two different literature reviews (children's search and multi-dimensional schemes) a provisional task representation scheme has been developed in this chapter. Table 3 summarises the questions considered important to ask and what are likely answers.

This scheme is used in phases 1 and 2 as a framework to describe primary school children's search tasks. However, the scheme is also adjusted in these two phases. This is necessary because while this scheme draws upon the children's literature, the underlying structure is based on studies of adults. Whether what is important to consider in describing children's search tasks is the same as it is for adults should be considered. Furthermore, very few of the studies of children's search are drawn from real-life so it is possible that many elements have not been considered or will not be seen in real-life studies. In phase 1, the scheme is adjusted according to how primary school teachers describe the search environment. To try and capture all the different occurrences of search a range of search tasks are documented. In phase 2, whether the scheme can be used to describe the search tasks as they occur in the classroom is tested.

Table 3: Provisional search task representation scheme

Questions to ask	Likely answers
What are the work tasks that motivate the search task?	This can be answered by considering units of work as equivalent to work tasks. However, it may not be possible to succinctly represent units of work.
What is the nature of the motivating work task?	Work tasks may be routine, typical or unusual (based on Xie, 2009).
How does the search task originate?	Origination can be internally-generated, externally-assigned, and generated in collaboration (based on Y. Li & Belkin, 2008).
If the search task originates from a teacher, how flexible is it?	Teachers design tasks where children may be given some choice of what aspect to research but openness of topics can be restricted by frameworks (based on Shenton & Dixon, 2004a).
Who does the search task?	Tasks are done by individuals, pairs or groups (based on Crow, 2011).
How much time is spent searching?	The time period within which a task needs to be completed could be short term or long term (based on Y. Li & Belkin, 2008).
What content is searched for?	Potentially unlimited but categorising by subject area may be a possibility (Department for Education, 2013c).
What is information used for?	Information may be used for enlightenment, problem understanding, instrumental, factual, confirmational, projective, motivational, personal or political (based on Taylor, 1991).
At what stage in the work task is the search task?	Search tasks may occur at the beginning, middle or end of work tasks (based on Y. Li & Belkin, 2008).
What resources are used?	Books, information from a computer, Internet, library, newspapers & magazines, TV & radio, friends, relatives and teachers may be used as resources (based on Madden et al., 2007).
What is the product?	No pre-existing categorisation of output to base answers on. Outcomes may be difficult to determine and are likely subjective.
What is the search goal?	Goals can be categorised as either general topical or specific item (based on Toms, 2011).

4   RESEARCH DESIGN

In this chapter, the overall research design is reported. The research philosophy and approach are described in the first two sections. An overview of the different research phases is given in section 4.3, and how research instruments and data sources were selected explained in sections 4.4 and 4.5. An overview of how the data was analysed is given in section 4.6. Precisely how the data were analysed is documented separately in chapters 5 and 6 for each of the phases. Research quality and ethics are considered in sections 4.7 and 4.8.

4.1   Research philosophy

The aim of this thesis is to develop a greater understanding of primary school children's search tasks, and so it is important that the data collected is an accurate representation of children's real-life search tasks. Therefore, naturalistic inquiry offers an appropriate philosophy around which to base the research. In its purest form naturalistic inquiry has a particular epistemology, ontology and axiology that guide how research should be conducted (Owen, 2012). These are stated in 5 axioms: (1) "realities are multiple, constructed, and holistic", (2) "knower and known are interactive and inseparable", (3) "only time- and context-bound working hypothesis (idiographic statements) are possible", (4) "all entities are in a state of mutual simultaneous shaping, so that it impossible to distinguish causes from effects", and (5) "inquiry is value bound" (Lincoln & Guba, 1985, p. 37).

While broadly concurring with the naturalistic philosophy, this study has some differences of application and does not conform to all the characteristics of a naturalistic inquiry (Lincoln & Guba, 1985, pp. 39–43). Firstly, although the researcher was present for all the data collection, non-human research instruments such as screen-recording software were employed (human research instruments are desirable in naturalistic inquiry). But this is a matter of practicality if nothing else. Secondly, not all the analysis is inductive. In naturalistic inquiry inductive data analysis is preferable as multiple realities are more likely to be identified this way (Lincoln & Guba, 1985, p. 40). In this study, a framework derived from the research literature is used to analyse some of the data. It should be noted though that this framework is not imposed and was adapted in light of the collected data. Thirdly, and perhaps the most notable difference, is that the results are not considered totally idiographic and are thought to be transferable to other settings. This is at odds with naturalistic inquiry because "the particular "mix" of mutually shaping influences may vary markedly from setting to setting" (Lincoln & Guba, 1985, p. 42). In this study, although context is considered key to understanding children's search activities, it is thought that the schools studied belong to a particular IUE (Taylor, 1991) and similar enactment of search could be observed in other primary schools.

Other characteristics of this research, though, do conform to naturalistic inquiry. For example, the data was collected in a naturalistic setting, the research approach is qualitative, the sampling is purposive and criteria for trustworthiness are used to ensure the quality of the research. So although this research does not conform to all the characteristics of naturalistic inquiry, the philosophy is still used to guide many aspects of the study. In fact many studies claiming to be naturalistic take a light approach where the aim is to conduct studies as best as possible in "natural, uncontrived conditions" rather than conform to all the tenets of naturalistic inquiry (Crystal & Wildemuth, 2009, p. 62). It is within this lighter approach that this study falls.

4.2 Research approach

Although it is debatable as to whether it is possible to pigeon hole research as either qualitative or quantitative, these distinctions are used in the methodology literature as a useful means with which to distinguish different types of research approaches (Bryman, 2015, p. 31). Put simply, the differences between the approaches is that in quantitative research data is analysed numerically whereas qualitative analysis is usually text-based where the focus is on meaning. A qualitative approach is taken in this thesis.

Qualitative research is an umbrella term, that groups together work founded on many different theoretical bases (Bryman, 2015, p. 375; Flick, 2014, p. 17; Mason, 2002, p. 2) and the approach is in keeping with a naturalistic philosophy. Furthermore, qualitative research has "an unrivalled capacity to constitute compelling arguments about how things work in particular contexts" (Mason, 2002, p. 1) and this makes it a particularly appropriate approach for this thesis where the aim is to understand how the information use environment of a primary school setting shapes search, and how search occurs within that environment.

There is no one way to conduct qualitative research but qualitative researchers do share some common ground. Bryman (2015, pp. 392–397) suggests that qualitative researchers

- try to view events as they are seen by the people in their study
- are interested in the context within which the event is taking place
- investigate how events occur over time
- take a flexible approach to data collection
- ground analysis in the data.

A similar approach is taken here. The aim of this thesis is to understand search as it occurs in the classroom and as best as possible from the perspective of teachers and children. However, it should be noted that phase 1 is from the perspective of teachers rather than children. Understanding the context within which search is taking place is central to the aim of this thesis. How search occurs over time is of interest and to a small extent how the different search tasks fit together was investigated. However, this study cannot be thought of as longitudinal. The research is exploratory and the data collection process fluid, particularly the teacher interviews which were semi-structured. The thematic analysis of the information environment was entirely inductive and grounded in the interview data. The search task analysis was informed by an analytic framework but ultimately the analysis was grounded in the data.

4.3 Research phases

The overall aim of this thesis is to develop a greater understanding of children's search with a focus on primary school children. The research questions are

RQ1: What is shaping primary school children's search activities?
RQ2: What are primary school children's real-life search tasks?

To answer these research questions, research was conducted in two phases and a review of the literature was used to support the analysis in these phases. Figure 6 depicts the relationship between the different research phases and literature. It should be noted though

that the research process itself was not linear and the literature was reviewed throughout both phases of research.

An overview of the different phases is described next. In phase 1, the prime objective was to identify different occurrences of search in primary schools. Maximal variation sampling and semi-structured interviews were employed to gather data as this method is appropriate for uncovering variation. Two different types of analysis were employed. First, the interviews were analysed inductively using thematic analysis to find out what aspects of the environment are influencing the way search happens (RQ1). Then the interviews were analysed deductively using the research literature to identify the different elements of primary school children's search tasks (RQ2). Initially it had been hoped that one of the pre-existing multi-dimensional task schemes could be employed with little revision but this proved difficult, and so a provisional representation scheme was developed (see chapter 3). This provisional scheme was then used as an analytic framework with which to analyse the interview data. During phase 1, the scheme was further developed with the results of the thematic analysis.

In phase 2, the prime objective was to validate phase 1 findings. Multiple methods is a technique that can be used to triangulate findings and so comparing observation data with interview data is an appropriate technique to verify and extend phase 1. Here three previous observations of classes (two from the same school and one from an additional school) using search technologies to find information for school work were analysed against the findings of phase 1. Descriptions of the classes were compared with the findings of the thematic analysis to verify how the primary school IUE is influencing search (RQ1). Whether the revised representation scheme could be used to describe the class search tasks was also tested (RQ2). The representation scheme was finalised in this phase.

	Data source & collection	Data analysis	Phase objectives
Review of the literature: To build a provisional search task representation scheme and analytic framework for Phase 1 (to answer RQ 2)			

⬇

	Data source & collection	Data analysis	Phase objectives
Phase 1: Identification of search in the primary school IUE	A priori maximal variation sampling (1 school, 10 teachers) Semi-structured interviews	Thematic analysis Use of analytic framework developed from literature review (provisional search task representation scheme, chapter 3)	To identify factors in the environment that shape search (RQ1) To establish the variety of search tasks in the primary school classroom (RQ2) To further develop the provisional search task representation scheme and analytic framework for Phase 2 (RQ 2)

⬇

	Data source & collection	Data analysis	Phase objectives
Phase 2: Validation of primary school search	Re-use of existing datasets (2 schools, 3 classes) Classroom observations	Descriptive analysis compared against phase 1 thematic analysis Use of revised analytic framework derived in Phase 1	To verify and extend findings from Phase 1 (RQ1 & RQ2) To finalise representation scheme

Figure 6: Relationship between the different research phases and the research literature

4.4   Choice of research instruments

Interviews, observation and documents are the usual choice of research instruments in naturalistic studies and qualitative research (Mellon, 1990, p. 39; Patton, 2015, p. 14). Each of these instruments has advantages and disadvantages. Why and how research instruments are selected for this thesis is discussed next.

In qualitative studies interviews are usually flexible. Semi-structured interviews are commonly used and an interview guide may be prepared that specifies the topics for consideration but the ordering and wording of questions is left open. This allows for a more natural conversation between interviewer and interviewee. Interviewees are not constrained into answering prepared questions and this has several advantages. Firstly, this allows the researcher to gain insights based on what participants consider important, rather than what have been the concerns in related work. This can lead to unanticipated insights (Gorman & Clayton, 2005, p. 125) and is particularly useful when little is known about the phenomenon in question. Given

that most research has concentrated on how children search for information for research assignments, allowing the teachers to talk freely about search may be more fruitful than a list of prepared questions. It is thought that the different elements of search and the complexities of how search is enacted are more likely to be revealed (RQ2). A second advantage of interviews is that interviewees can be asked why they act as they do (Gorman & Clayton, 2005, p. 125). This will be particularly helpful for answering the first research question concerning how the environment influences search (RQ1).

There are also some disadvantages to semi-structured interviews. Firstly, although the interview guide acts as a checklist to ensure that all participants are asked the same basic questions (Patton, 2015, p. 439), the kinds of response may vary making it difficult to compare participant responses (Gorman & Clayton, 2005, p. 127). In this regard surveys are usually preferable as the responses will be standardised. However, given that this thesis is exploratory in nature it will be difficult to build a survey. Therefore, overall interviews are preferable, as through the interviews the range of factors that are important to understanding search in primary school can be identified. But a limitation will be that the identified factors may not be captured in every interview.

A second disadvantage is that interviews are open to bias (Gorman & Clayton, 2005, p. 125; Patton, 2015, p. 333). Consciously or unconsciously often interview participants only share what they want to show. Participants may also inadvertently overlook details particularly those that are routine and that for the participant are obvious. Furthermore, events may be misremembered. Combining interviews with observation can alleviate this problem.

Observations are "naturally occurring" in that the situation observed will occur regardless of the research whereas interviews are "researcher provoked data" (Silverman, 2006, p. 200). However, it should be noted that being observed may alter the situation (Patton, 2015, p. 390) and care needs to be taken to minimise this. Observations have a "present orientation" in that activities are observed at the time in which they take place. So unlike interviews they are not biased by memory. They are also "reality-verifying" and can be used to confirm or question the accuracy of the interviews (Gorman & Clayton, 2005, p. 104). However, not all events can be observed, and this is particularly the case for spontaneous events (Patton, 2015, p. 390). Together with the fact that observations are time-consuming, it would be difficult to observe a full range of search activities.

Documents can be an alternative source of information. They can shed light on activities that cannot be easily observed and may provide a "behind-the-scenes" perspective (Patton, 2015, p. 390). Documents such as homework information sheets and lesson plans could provide a valuable source of information about children's search. In the event, due to data collection difficulties documents were not used in this study (see section 4.5). However, it is thought that documents could have been a good information source for this thesis.

As well as considering the general advantages and disadvantages of research instruments, the suitability of using these instruments when researching children also needs consideration. In theory, any data collection method used with adults can also be used with children (Olafsson, Livingstone & Haddon, 2013). In practice, there are some limitations relating to power relations, language and context. It is also widely recognised that context impacts on children's behaviour so it is important to collect data in as naturalistic context as possible (Greene &

Hogan, 2005). Observation is an appropriate research method to use with children and can be particularly fruitful if children find it difficult to communicate (Greig, Taylor & Mackay, 2007, p.150). Therefore, observing children in the classroom is appropriate. Interviews are also an appropriate research instrument to use with children. Care does need to be taken to ensure the reliability and validity of children's responses to interview questions. However, any interview is subject to response bias whether the respondent is an adult or child, and it would be wrong to think that children's responses are inherently unreliable (Olafsson, Livingstone & Haddon, 2013, p.70). In the event, children were not interviewed for this thesis but this was a sampling decision (see 4.5.1) rather than a concern that children's responses would not be reliable or valid.

In summary, to compensate for disadvantages of each research instrument, it is often advisable to use more than one instrument in any project (Patton, 2015, p. 316). It was therefore decided that both interviews and observation would be employed. Interviews would be used in phase 1 to find out what is influencing search activities within a single school and the range of search tasks. Then in phase 2 observations would be used to confirm the presence / absence of what is influencing the activities and the different elements of search tasks. It had been hoped that documents could be used as a further source but this data proved difficult to collect so this approach was abandoned. Surveys were not employed in this thesis, but could be used in further research.

4.5 Data sources

4.5.1 Sampling

Data was collected in two phases, and each phase has different objectives. The intention in phase 1 is to uncover the variation in children's search, whereas phase 2 is used to confirm the findings of phase 1. As such different sampling procedures were required for each phase.

Phase 1

To be able to describe what is influencing search and all the different search tasks it is necessary to capture as wide a range of search activities as possible. Therefore, the intention in this phase is to uncover variation, a concern shared with phenomenography. As with phenomenography, and in keeping with naturalistic inquiry, purposeful sampling was used to select participants and determine sample size (Yates, Partridge, & Bruce, 2012). With purposeful sampling, participants are chosen because they provide "information-rich cases whose study will illuminate the questions under study" (Patton, 2015, p. 264). Important in purposive sampling is the selection of appropriate cases rather than the number of cases.

There are different ways to sample purposefully (see Patton, 2015). Maximum variation (heterogeneity) sampling was chosen for this study where participants are chosen so as to gain as much variation in the sample as possible (Patton, 2015, p. 267). To achieve this several decisions needed to be taken.

The first decision was how to sample for heterogeneity, and capture the widest possible range of search activities and tasks. The two options were to either select a range of schools or to select a range of people within schools. In terms of selecting a range of schools, as there has

been no prior research into how school differences affect search, what factors would lead one school to have different types of search from another is not known. However, in terms of what might affect search within a school, research in the field suggests that children of different ages have different search practices and this could be indicative of different search activities and tasks. So although it is possible that search may differ between schools, it is difficult to sample for this because there are no known criteria on which to base the selection. For the above reason, it was thought that it would be more fruitful for the sample to include representations from all year groups, and that this could be achieved from a sample of a single school. The disadvantage is that makes it harder to determine the transferability of the results to other schools (see 4.7.2 for more on this) but an advantage of this approach is that by studying a single school it would be easier to determine if age (rather than differing environments) is responsible for any differences in findings across interviews.

The second decision was who should be included in the sample: teachers, children or both. For three reasons it was decided that teachers should be interviewed. Firstly, although some search may be "under the desk" (Maybin, 2007) by and large what children are doing in school will be known by teachers. As an objective of the research is to identify children's search tasks in school, it was felt that teachers would be in a good position to inform on this. The second reason for collecting data from teachers was that it was hoped that the wording of the search tasks as given to children could be analysed. (However, this data proved difficult to collect.) The third reason was a concern that collecting data from children across such a large age range (4-11) would mean that different research instruments would need to be used depending upon the age of the child, and this could lead to a fragmented data collection. However, it is recognised that adults can, and do, misrepresent children (Lobe, Livingstone, & Haddon, 2007). Furthermore, there is a danger that when using adults to inform on children, this makes children the object of the research rather than "social actors who are subjects" (Christensen & James, 2008, p. 1).

Having decided on how and who to sample, a decision was needed on which school and which teachers should be selected. The school was selected partly because of convenience (previous research had been conducted in this school and a relationship had already been established) and partly because it was considered likely to be a typical case or at the least not an extreme or deviant case. The teachers were selected to ensure as much variation as possible, and also to include teachers who may offer particular insights on children's use of search. Therefore, it was decided that the sample should consist of a teacher from every year group plus any teachers who specialise in Computing. Primary schools are structured into 7 year groups, and in the selected school there were two teachers who specialised in computing. It was also decided that only one teacher per year group need be recruited as teachers within a year group work together to plan lessons, and the same lesson is given to each class in a year group. To be certain that no new insights would be obtained from other year group teachers, those interviewed were asked if what they did was typical for their year group.

This resulted in a sample size of 9 but it was increased to 10 when one teacher asked if another teacher could join the interview. As this is a small sample, further consideration was given to whether the sample size is appropriate. Bryman (2012, pp. 19–20) recommends five factors to consider when deciding the size of a sample. The first factor is "saturation" whereby cases are sampled until there are no new insights (Glaser & Strauss, 1967). This can be challenging as sampling must continue alongside analysis, and so how many cases are needed

cannot be known at the outset. The plan for the interviews was to collect the data at the end of the academic year with teachers asked to reflect back over that year. This requires the data to be collected in a relatively short timeframe. Furthermore, whether saturation has been reached is not always clear. The second factor is that some methodologists advocate "minimum requirements". However, these requirements vary considerably. While some suggest that a single case is enough as it can provide a "rich and deep understanding of the subject and breakthrough insights" (Patton, 2015, p.266), others suggest 30 (Adler & Adler, 2012) or 50 (Ragin, 2012). Another consideration is what Galvin (2015, p. 5) calls the "wisdom of the elders" approach whereby the sample size is based on those in previous studies. Li (2009) validated the faceted categorisation scheme using 12 participants in an interview study. The third factor is "the style or theoretical underpinnings of the study". For studies employing a fine grained analysis (as is the case here) a large sample is not necessary. The fourth factor is the "heterogeneity of the population". It is often important to capture differences within a population and therefore the size of the sample will depend upon the variation in the community studied; the more variation there is likely to be the greater the sample size required. At the time of data collection, the school had 20 teachers spread across 17 classes (6 teachers worked part-time), a head and a deputy. So while 30 (Adler & Adler, 2012) or 50 (Ragin, 2012) interviews are suggested for a PhD this was clearly not feasible if the research was to be conducted in one primary school. The fifth factor is the "breadth and scope of the research question". A more focused question is likely (but not certain) to need fewer cases. It was decided that the sample size was appropriate for the study and the research question but the findings of the study would need to be evaluated in phase 2.

In summary, this sampling approach is suitable for capturing the range of children's search at one school but the school may not be representative of other primary schools. However, firstly the school was not selected as an extreme or pivotal case, and when selecting the school there was no reason to suppose that results would be different elsewhere. Secondly, whether the teachers selected were representative was further considered by asking each of the interviewed teachers whether they viewed their teaching as representative for the year group they taught, both within their school and across other schools. Thirdly, the findings were verified with another school in phase 2; discussed next.

Phase 2

The purpose of this phase is to verify and extend the findings of phase 1. To do this observation data was used to triangulate the methods. Furthermore, a second school in addition to the phase 1 school was observed.

Although it was tempting to collect new data, three previous observations were available for use in this thesis. Given that any data collection exercise, no matter how thoughtfully conceived, will to some extent inconvenience participants, it was decided that it would be preferable to re-use observation data collected in prior research. Re-using data also has the added advantage that the design of the observation studies could not have been influenced by the interview findings. A potential disadvantage is that search could have changed in schools in the time gap between the observations and the interview study. Furthermore, the data has not been collected for the purpose of the study and the research instruments have not been designed to directly respond to the study research questions.

On balance it was thought that the advantages outweighed the disadvantages, and that the previously collected observation data could be used to validate and extend the findings from phase 1.

As such this study uses observation data previously collected for two other research projects. The West Sheffield observation study data was originally collected for a master's dissertation (Rutter, 2013). This was at the same school as the interview study but the teacher (and the children) had already left the school at the time of the interview study. The observations had been previously analysed but the data is reanalysed here in light of the findings of the interview study. The new analysis is distinct but complementary to the previous analysis. The East Sheffield observation study was originally collected as a pilot study for an earlier research idea for this thesis. This idea was dropped in favour of this thesis. The data had only been cursorily analysed.

4.5.2 Study settings

The study settings are described next using Ofsted inspection reports (Ofsted, 2017). The precise reports are not cited as this would reveal the identity of the two schools.

Both schools that participated in this study are rated as good by Ofsted. Ofsted also describes both schools as large primaries where the majority of pupils are of White British heritage. Both schools also have higher than average number of pupils who are disabled and higher than average number of children who have special educational needs.

The schools differ, however, in their catchment areas. The West Sheffield school is situated in an affluent area, whereas the East Sheffield school is in a deprived area. This is reflected in the number of pupils who claim free school meals. In the West Sheffield school, the number of free meals claimed is well below average but in East Sheffield the number is well above average. Therefore, the children who participated in these two studies likely have different socio-economic backgrounds.

Linked to the number of free meals claimed, the schools also differ in what funding they can access, as in general schools in poorer areas tend to get allocated more funding (Department for Education, 2016a; The Independent, 2016). One difference this makes that is pertinent to this study is that the East Sheffield school had considerably more technology than the West Sheffield. While in West Sheffield children had to share computers, in East Sheffield the children could have one each.

4.6   Data analysis

Two approaches were taken to analysing data in this thesis. Data analysis is the "process of bringing order, structure and meaning to the mass of collected data" (Gorman & Clayton, 2005, p. 206). There are no hard and fast rules for analysing qualitative data, and many different approaches can be taken (Bryman, 2015, p. 570). In this thesis, thematic analysis and analytic frameworks were used. Central to both of these approaches is the use of codes to both understand and manage all of the data (Gorman & Clayton, 2005, p. 207). Codes also allow for a consistent and systematic analysis across data sources (Mason, 2002, p. 150). How the coding schemes were developed differs in the two approaches, and an overview of the

different approaches is given next. Precisely how the data collected in this study were analysed using these approaches is described in chapters 5 and 6 for each phase of the study.

4.6.1 Thematic analysis

Thematic analysis is commonly employed in qualitative research (Bryman, 2015, p. 584) and is used to code data into different themes. A theme usually "captures something important about the data in relation to the research question" (Braun & Clarke, 2006, p. 82) and represent "a pattern found in the information that at the minimum describes and organises possible observations, and at the maximum interprets aspects of the phenomenon" (Boyatzis, 1998, p. vii). In this thesis, thematic analysis was used to answer the first research question: what is shaping primary school search activities? To do this thematic analysis was applied to the interview data collected in phase 1, and different aspects of the environment were identified. Although Taylor's (1991) concept of an IUE was used as a framework throughout this thesis (notably to structure the literature review and discussion chapters) it was not used to analyse the interview data as whether primary schools are an IUE could not be established in the literature review. Instead it was thought more apt to an analyse the data inductively.

Either a semantic (identifying the "surface meaning") or latent (identifying the "underlying ideas, assumptions and conceptualisations") approach to coding can be taken with thematic analysis, but not usually both (Braun & Clarke, 2006, p. 84). Latent thematic analysis is associated with discourse analysis. A semantic approach was considered preferable in this thesis as the overall intention is to describe search within the primary school environment rather than theorise the ideologies of participants.

Thematic analysis is not linked to any theoretical framework, and so it can be accommodated within different research philosophies and approaches (Braun & Clarke, 2006, p. 82) including naturalistic inquiry. There are different ways of applying thematic analysis. In this thesis, the approach advocated by Braun & Clarke (2006) was employed. Precisely how this was applied is described in section 5.2.4.3.

4.6.2 Analytic frameworks

At the start of this thesis a decision had to be made on whether to take a deductive approach and decide in advance how to analyse elements of the search tasks or to take an inductive approach and ground the analysis in the data. Both these approaches have been used to develop multi-dimension schemes in the more general literature. For example, Li (2009, p. 281) uses the research literature to design a classification scheme that is then used to design interview questions. By contrast, although Xie (2009, p.348-349) uses the research literature to inform the design of a diary study and interviews, the actual dimensions "emerged from the data" and are based upon how people describe their searches. Both approaches have their advantages and disadvantages. Li's (2009) participants' answers directly correspond to the scheme. Not only is the data easier to analyse but the findings are directly relatable to other studies. However, Li's (2009) participants may have been constrained by the questions and important aspects of their search may have been missed. In Xie's (2009) approach what is important to participants will surface but other aspects of search that participants may not consider important could remain undiscovered.

A combination of both approaches was used in this thesis. The initial plan for phase 1 had been to use Li & Belkin's (2008) faceted classification of task as a basis to identify elements of tasks in the interview data. But as it was thought that search tasks could occur differently in primary schools and so to not constrain participant's answers, Li & Belkin's more general questions on what it is important to ask about a task were used as a basis for the interview questions. After an initial attempt to analyse the data it became apparent that pre-existing multi-dimensional schemes could not be easily applied (see 7.2.1), and so a provisional search task representation scheme was developed from Li & Belkin's general questions (see chapter 3). This provisional scheme was then used to analyse the interview data but needed to be adapted in light of the findings of the thematic analysis. This revised scheme was then used to analyse the phase 2 observation data. Again, some revisions to the scheme occurred as the data was analysed.

The scheme when finalised was used to explain how the different aspects of the IUE influences search (RQ1) and to identify all the different elements of search tasks (RQ2).

4.7   Research quality

Whether findings are "worth paying attention to" depends upon the quality of the research and the trustworthiness of the study (Lincoln & Guba, 1985, p. 290). Determining the trustworthiness of a study depends upon the research approach. Several researchers have proposed schemes to judge qualitative research (see Bryman, 2015, pp. 387–391 for a good overview). In this thesis, the criteria proposed by Lincoln and Guba (1985) for those undertaking naturalistic inquiry are used to discuss the research quality. Where appropriate techniques suggested by other researchers are incorporated into the discussion.

Lincoln and Guba (1985) suggest that qualitative research should be judged using four criteria: credibility, transferability, dependability, and confirmability. These will be discussed next.

4.7.1   Credibility

For research to be credible it must be trusted. Lincoln & Guba (1985, p. 301) suggest the following techniques to make research more credible: prolonged engagement, persistent observation, triangulation, peer debriefing, negative case analysis, referential adequacy and member checking. To some extent all these techniques have been employed in this thesis but triangulation in particular was used to ensure credibility.

Prolonged engagement

Prolonged engagement is recommended as it takes time to develop trust and learn about a culture (Lincoln & Guba, 1985, p.301). At the start of the thesis it was envisioned that more time would be spent in the schools but gaining access to the classrooms over an extended period of time was problematic. While the time spent collecting data in both schools was relatively short, a relationship had already been established with the West Sheffield school (see 4.8 Ethics). However, no prior relationship existed with the East Sheffield school.

Persistent observation

Persistent observation increases the likelihood that something will be noticed (Lincoln & Guba, 1985, p. 304). Only three classes were observed so this cannot be thought of as persistent observation. However, these observations were used to validate rather than build the representation scheme.

Triangulation

Triangulation means that the research has been considered from two or more viewpoints (Flick, 2011) and can be achieved by either varying the data, investigator, theory or method (Denzin, 1970, p. 301). Both data and method triangulation were used in this thesis. Denzin (1970, p. 301) suggests varying time, space and person to triangulate data source. This was achieved by using data collected at different times, sampling schools in two diverse locations, and by using both teachers and children as data sources. Denzin (1970, p. 307) also suggests that within-method and multiple methods can be used to triangulate method, both of which were used here. Within-method triangulation was achieved by analysing the interviews using two techniques: thematic analysis and an analytic framework. Multiple methods were also employed and the observations (phase 2) were used to verify the interviews (phase 1). Gorman & Clayton (2005, p. 112) claim this to be "one of the real strengths of the technique of observation".

Peer debriefing

Peer debriefing is "a process of exposing oneself to a disinterested peer in a manner paralleling an analytic session" (Lincoln & Guba, 1985, p.308) and is useful for trying out ideas, testing hypothesis and exploring meanings from another perspective. This technique was not explicitly used but throughout the PhD this research was discussed at formal events (for example PhD training sessions and seminars) and informally with fellow research group members and PhD students.

Negative case analysis

With negative case analysis the idea is to continuously revise a hypothesis until "it accounts for all known cases without exception" (Lincoln & Guba, 1985, p.309) and data that does not support current hypothesis should be looked for. Miles & Huberman (p.241) suggest that when considering a finding one should ask "are there any data that would oppose this conclusion, or are inconsistent with this conclusion". Particularly when considering how the environment influences the design of search tasks this technique was used and alternative explanations are offered in the discussion in Chapter 7.

Referential adequacy

Lincoln & Guba (1985, p. 313) recommend archiving a section of the raw data so that others can test the validity of the analysis. While the raw data has not been archived (as it might be hard to conceal identities particularly in the class observation data), the teachers were quoted at length in phase 1 and for the observation studies a list of the children's queries can be found in Appendix M.

Member checking

Lincoln and Guba (1985) suggest that credibility can be achieved through member validation, by submitting research findings to participants. The findings from this project have been sent to both schools for their feedback. However, member checking in itself is not sufficient as just because someone is a member of the group being studied it does not mean that they are able to validate interpretation (Mason, 2002, p.193) and based on previous experience (Rutter, Ford, & Clough, 2015) it may be that little formal feedback is obtained.

4.7.2   Transferability

Transferability is the extent to which similar findings may be found in other contexts. From a naturalistic perspective, the transferability of a study cannot be stated by those doing the research. All that can be given is a rich description of the context of the study so that those in other contexts can determine the likely transferability (Lincoln & Guba, 1985, p. 316). In this thesis, the schools in general are described in this chapter under 4.5.2 Study settings and the context within which search takes place is described in considerable detail in the phase 1 and phase 2 results.

Taking a different approach from Lincoln & Guba (1985), Mason (2002, p. 195) argues that "it is important that qualitative researchers do work hard to establish a wider resonance", and it is thought that the findings of this thesis will be transferable to many other primary schools. While the findings are based on just two schools and so cannot be considered a statistically representative sample, the cases are rich and the analysis was thorough and this is arguably more important when considering "the validity, meaningfulness and insights generated from qualitative inquiry" (Patton, 2015, p. 313). Mason (2002, p.195) also suggests that it is possible for qualitative research to attain theoretical generalisation. This may be achieved through "strategic comparisons" and the findings of both phase 1 and 2 were grounded in the research literature. Furthermore, an assumption of the conceptual framework used to guide this thesis is that similar results will be seen in related environments (Taylor, 1991). Therefore, it is anticipated that findings could be similar in other primary schools. Whether the schools can be considered as information use environments and the potential transferability of the findings is deliberated in Chapter 7.

4.7.3   Dependability

Dependability is likened to the criteria of reliability that is used to judge quality in quantitative studies. A study is considered reliable if similar results would be found if the study was repeated. However, this is clearly not straightforward in naturalistic studies as by its very nature the study cannot be repeated (Lincoln & Guba, 1985, p. 299). There are, though, techniques to ensure that the data collected in qualitative research can be considered reliable.

Inquiry audit

Lincoln & Guba (1985, p. 317) recommend an inquiry audit and Ford (2012, p. 186) suggests that for research to be considered reliable, data collection and data analysis should be consistent. The decisions taken from sampling to analysing and reporting the data have been fully documented. Furthermore, the analysis was consistent with the same basic framework, developed in chapter 3, used to analyse the data in phases 1 and 2.

Inter-rater reliability

Inter-rater reliability is where codes generated during data analysis are cross-checked with another researcher (Creswell, 2014, p. 202). However, codes cannot be quickly conveyed to other researchers who are not familiar with the data, and Patton (2015, p. 667) argues that inter-rater reliability can only be carried out using a "simplified coding scheme" and that it will "simplify the research to such extent that all of the richness attained from insight will be lost".

Inter-rater reliability was not employed as a technique here because it was thought unrealistic for another researcher to code this data as the analysis is complex and conducted over two phases. However, a full account is given on how the data was analysed and long quotes are used in the results so the reader may make their own judgements on the dependability of the research.

4.7.4   Confirmability

For research to have confirmability the neutrality of the researcher must be demonstrated. Lincoln & Guba (1985, p. 319) suggest employing a confirmability audit. It should be noted that the audit is also a technique used to determine dependability. Audit is discussed further here because for Lincoln & Guba (1985, p. 319) the audit is key to determining confirmability.

The confirmability audit has two parts; the audit trail and the audit process. While this thesis has not undergone a formal audit process beyond that that occurs as part of the supervision process, an audit trail is provided. Based on Halpern (1983, as cited in Lincoln & Guba, 1985), Lincoln & Guba (1985, p. 319) suggest that the following records should be available: "raw data", "data reduction and analysis products", "data reconstruction and synthesis products", "process notes", "materials relating to intentions and dispositions", and "instrument development information". With the exception of "raw data", all of these have been fully documented in the Methods section of the two phases. For brevity and ethical reasons "raw data" have not been included but have been archived.

4.7.5   Summary

Different techniques were employed to ensure research quality. In particular, triangulation (both within method and multiple methods) was used to ensure credibility. Rich descriptions, linking findings to the research literature and employing Taylor's (1991) concept of an IUE helped with establishing transferability. An audit was used to confer dependability and confirmability.

4.8   Ethics

Data were collected for this thesis at three different times and so three different ethics applications were made. Two of the sets of data were collected for other projects. One of these was a pilot test for a study that was discontinued as part of this PhD. The other was for a Master's project (Rutter, 2013). As part of the consent process participants in all studies had been asked to agree to "I give permission for the research team to re-use my data for future research", a standard field in the University of Sheffield Information School consent form. As such there was no ethical reason why the earlier data collections could not be used in this study.

The three different ethics applications are described next in the order of application submission date.

West Sheffield observation

This research project was classified as high risk because the participants are children and they may not be able to judge whether the research could be against their best interests. As this study takes a naturalistic approach, where the participants are observed taking part in everyday activities, there is little likelihood of the nature of the research causing any physical and /or psychological harm / distress. However, an additional concern when considering the ethics of this data collection is that a relationship with the school already existed. My two children attended this school and I have also worked on a voluntary basis as a classroom assistant a half-day a week for two years in Foundation, Y1 and Y2 years. Care had to be taken that the school did not feel obliged to take part. After a full ethics review permission was received to carry out the research from the university ethics committee.

Informed consent was obtained from the school headmaster, class teacher, ICT teacher, parents of the children, and the children themselves. The research was explained in person and by letter to the headmaster and school teachers. A letter was given to parents of participating children, and the study was explained in person to the children by the class teachers and by the researcher. It was made clear to the children that they could withdraw at any time.

To ensure confidentiality neither the school nor the children are identifiable in this thesis or any other report. The school is referred to as West Sheffield and the children are referred to by a code; each pair of children has been assigned a letter between A and F, and each child in the pair assigned the number 1 or 2, so for example Pair A is Child A1 and Child A2.

Only anonymised data has been saved and this is stored electronically on the information school secure data servers. While working on this thesis at home the anonymised data has been temporarily stored on a privately owned laptop. No other person has access to this laptop.

East Sheffield observation studies

This research project was classified as high risk because the participants are children. As with the West Sheffield observation study, this study takes a naturalistic approach, where the participants are observed taking part in everyday activities, so there is little likelihood of the nature of the research causing any physical and /or psychological harm / distress. After a full ethics review permission was received to carry out the research from the university ethics committee.

Informed consent was obtained from the school deputy head, class teacher, and children. Parents were asked in letter sent home by the school if they wished for their child to withdraw from the study. The research was explained in person and by letter to the deputy head and class teacher. The study was explained in person to the children by the class teacher and by the researcher. It was made clear to the children that they could withdraw at any time.

To ensure confidentiality neither the school nor the children are identifiable in this thesis or any other report. The school is referred to as East Sheffield and the children are referred to by

a code; each child has been assigned a table number and individual number according to where they sat in the class, so for example Child 1 Table 1 sat at the first desk on the first table.

Only anonymised data has been saved and this is stored electronically on the information school secure data servers. While working on this thesis at home the anonymised data has been temporarily stored on a privately owned laptop. No other person has access to this laptop.

West Sheffield interview study

The potential for risk in participating in this study is regarded as low as the participants are not considered vulnerable and the topic is not sensitive. However, as with the earlier data collection, that a relationship with this school already existed needed to be taken into consideration. When approaching the teachers, care had to be taken to make sure that they did not feel obliged to take part. After a full ethics review permission was received to carry out the research from the university ethics committee.

Informed consent was obtained from the headmaster and all teachers who participated in the research. The research was explained in person and by letter to the headmaster and teachers. It was made clear to the teachers that they could withdraw from the study at any time.

To ensure confidentiality neither the school nor the children are identifiable in this thesis or any other report. The school is again referred to as West Sheffield and teachers are referred to by the class they teach in or in the case of the computing specialist teachers by their job title.

Only anonymised data has been saved and this is stored electronically on the information school secure data servers. While working on this thesis at home the anonymised data has been temporarily stored on a privately owned laptop. No other person has access to this laptop.

4.9   Summary

A qualitative approach based on a lightly naturalistic philosophy was used to investigate primary school children's search activities and real-life search tasks. The research was split into two phases. In phase, 1 an interview study employing maximal variation sampling was used to identify different occurrences of search in a primary school. In phase 2, three observation studies were used to extend and validate the phase 1 findings. The data were analysed both inductively (using thematic analysis) and deductively (using analytic frameworks). To ensure research quality within method and multiple method triangulation, rich descriptions, using frameworks from the research literature, and an audit were employed. Ethics approval was received for all data collection.

5   PHASE 1: IDENTIFICATION OF SEARCH ACTIVITIES AND TASKS IN PRIMARY SCHOOL

5.1   Introduction

This chapter reports on the first phase of the research. In this phase, ten teachers from a West Sheffield primary school were interviewed to provide insights on primary school children's search activities and tasks. Using thematic analysis and the provisional search task representation scheme developed in chapter 3, the interviews were analysed to answer the study's research questions of

> RQ1: What is shaping primary school children's search activities?
> RQ2: What are primary school children's real-life search tasks?

The findings of this phase were then verified in phase 2.

5.2   Method

The research instruments, who the participants were and how they were recruited, how data was collected and analysed, and how research quality was achieved is described in this section.

5.2.1   Research instruments

The plan was to collect data using two instruments: interviews and documents. Interviews were planned to discover the range of search tasks and how search activities took place. It was hoped that from homework information sheets and lesson plans, the wording of some of the search tasks as given to children could be analysed. The research instruments were selected to complement each other. However, in the event documents were not collected.

Interviews

To collect as wide a range of responses as possible teachers were asked to reflect back over the academic year (September 2014 to July 2015) and to think about situations in which children might search for information

1) formally in class either as part of a Computing lesson or for another subject
2) informally in class, for example "why don't you check that at home on Google"
3) to complete homework, and
4) in any other ways the Internet is used to search for information.

No particular questions were prepared to find out what is shaping search activities (RQ1) and teachers were free to describe the above situations as they wished. To build a description of the search tasks (RQ2) an interview guide based on what Li & Belkin (2008, p.1833) suggest should be answered in a description of a task was prepared (see Table 4). The wording of the questions was adapted for the context so that they were less discipline-centric and would make more sense to the teachers. An additional question was prepared to assess the representativeness of the sample.

Table 4: Interview guide

Interview questions	Li & Belkin's (2008, p.1833) questions
What is the purpose of the search? Why are the children searching for this? How does the search fit into learning objectives?	Q1. Where is this task from? Q6. What is (are) its products? Q4. What is it about (topic or content)?
What do children do with the information they find?	Q6. What is (are) its products?
How is search / work assessed? How much is known prior to the search – by the teacher / children?	Q5. How should this task be completed?
Is this search assigned / mediated / child's free choice?	Q1. Where is this task from?
How are children arranged when using computers – in pairs, in groups, individually.	Q2. Who carries it out?
How much time is given to conduct task / search task? Within a single lesson / over multiple lessons?	Q3. How long does this task last?
Is this typical for year x?	Additional questions to assess representativeness of sample

Documents

Teachers were asked to provide copies of lesson plans and homework information sheets that they had given to children. However, none of the teachers did this. The reasons given were firstly, that the school was using third party lesson plans so they could not share because of copyright. Secondly, much of the required information was simply not written down. For example, in Y6 the homework is given verbally; in Foundation the teacher communicates to parents, activities to do at home via an old fashioned blackboard in the school yard; and the Y5 teacher explained that search is so embedded in what they do that it would not be stipulated on a lesson plan, the teachers would just know to do it.

5.2.2   Participants and recruitment

How participants were selected and recruited is described next.

Participant selection

A priori maximal variation sampling was used in this study (Patton, 2002, pp. 230–242), whereby participants were selected for heterogeneity. The sampling was designed to find out all the different ways children are using search in primary school. The sampling plan included selecting both year group teachers and teachers who specialise in Computing (see Table 5) and is described in more detail next.

So that children of all ages could be represented data was collected from every year group. The selected school is a large primary school with 2 or 3 classes of 30+ pupils per year group (F to Y6)[1]. It was decided that only one teacher need be selected from each of the 7 year groups. Apart from the Y3 teacher (who also specialised in teaching Computing), within each year

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[1] In the UK, children start primary school in a Foundation (F) class the September before they are 5, and for the next 7 years move up a class until they complete Year 6 (Y6).

group there was no preference for one teacher over another, and teachers had an equal chance of being approached. At the end of each interview, each teacher was asked if the other teachers in the same year group would answer the questions differently (see 5.8 Research Quality).

As the selected school also has two teachers who have a formal role in teaching Computing, and these teachers may have a different perspective, the sampling plan also included recruiting these teachers. One of the Computing teachers is the deputy head and the other is also a Y4 teacher. The deputy head in his role of Computing Lead teaches Computing to all of the Foundation, Y1, Y2, Y5 and Y6 classes. One of the Y4 teachers teaches Computing to both Y4 classes and is also the Computing Coordinator. Recently, one of the Y3 teaches had taken on teaching Computing to all three Y3 classes. This teacher had no formal role in Computing and so it was decided that if possible this teacher would be recruited as a year group teacher.

Recruitment

The headmaster was initially approached informally in person. This was followed up by a letter explaining the research (see Appendix E) after which formal approval was sought and given. All teachers in the school were potential participants, and the headmaster sent an email to all teachers at the school informing them of the study. Teachers were then approached at the start and end of the day when they were in the school playground. On the first approach the study was explained. Teachers were also given a brief letter summarising the research and a copy of the consent form (see Appendix F). Consent was not sought at this stage, though some teachers immediately offered to participate. Teachers were approached a second time after they had had time to reflect on whether they wished to participate or not. After a teacher had been recruited from a particular year group other teachers for that year group were not approached. All teachers approached agreed to take part in the research. The Y5 teacher asked if she could do a joint interview with her colleague, who also agreed to participate. At every stage of the recruitment process, it was made clear to each teacher that participating in the research was entirely voluntary.

5.2.3 Data collection procedure

The interviews took place at the end of the academic year between May 2015 and July 2015 and were audio-recorded on a digital voice recorder. The interviews were conducted at times that were the most convenient for teachers and if interviews went over thirty minutes, teachers were asked if they wanted to stop (none did). The interviews took from 20 to 51 minutes. The plan had been to interview all the teachers on the school premises but two of the interviews took place in a coffee shop and a third in a teacher's house. This was because the Y6 teacher asked to be interviewed on his day off, and two of the infant school teachers were so busy completing end of year activities that their interviews were conducted at the start of the school holidays.

Table 5: Participant interview schedule

Participant	Interview location	Length of interview	Date
Foundation teacher	Coffee shop	40 minutes	20/07/2015
Y1 teacher	School classroom	20 minutes	24/06/2015
Y2 teacher	Teacher's house	41 minutes	27/07/2015
Y3 teacher	School classroom	35 minutes	15/06/2015
Y4 teacher	School classroom	30 minutes	19/05/2015
Y5 teachers (2)	School classroom	33 minutes	10/07/2015
Y6 teacher	Coffee shop	46 minutes	03/07/2015
Computing Lead / Deputy head	School office	51 minutes	13/07/2015
Computing Co-ordinator / Y4 teacher	School classroom	42 minutes	09/06/2015

The information letter given to teachers (see Appendix F) at the recruiting stage briefly stated what the interview would be about. Although not asked to do so, many teachers came to the interviews prepared. For example, the Y6 teacher arrived with the year lesson plan, and used this to jolt his memory of the various search tasks for subjects across the year. The Foundation and Y3 teachers started off by describing activities before a question was even asked. As the plan was for the interviews to be semi-structured, the teachers were not constrained to the interview guide. However, at the end of each interview that all question areas in the interview guide had been covered was checked.

5.2.4 Data analysis

The data was analysed using two processes. Described next is how the interview data was prepared, then an overview of the two processes, followed by a detailed description of each process.

5.2.4.1 Data preparation

Altogether there were 9 interviews with 10 teachers totalling 5 hours and 38 minutes. The interviews were transcribed verbatim. While transcribing thoughts about how the data could be analysed were recorded in memos. The following conventions have been applied when using quotations (Bryman, 2015, p. 482).

- Each quote was attributed to the interviewee. So that individual teachers could not be identified, the attributions were anonymised but linked to the teacher's year group.
- Where a quotation contains material extraneous to the point being made in this thesis, this material has been removed to aid clarity. The missing words are indicated by three consecutive dots (…).
- If the interviewee has missed a word in a sentence, then to aid clarification an equivalent word has been given in square brackets
- To aid readability, quotes used in the results were corrected for minor grammatical errors and verbal tics were removed. For example, "one of those groups would be working with an adult to you know using the search engines" was modified to "one of those groups would be working with an adult using the search engines".

- Where teachers use terms that have a particular meaning in primary schools, these terms have been explained in footnotes.

5.2.4.2   Overview of the two data analysis processes

Two different processes were used to analyse the interviews. Firstly, thematic analysis was used to identify how the IUE shaped how search was approached in the classroom. Secondly, the representation scheme developed in Chapter 3 was revised against the findings of the thematic analysis. Then this revised scheme was used to document all the elements for each search task that teacher's described. An overview of the differences between the two processes can be found in Table 6.

Table 6: Overview of the different processes used to analyse the interviews

	The IUE	Search tasks
What is analysed	What is shaping search activities (RQ1)	Elements of search tasks (RQ2)
Tool	NVIVO	Excel
Approach	Inductive	Deductive / Inductive
Dataset	Interviews pooled together with codes generated across interviews	Search tasks isolated from each interview. Codes applied to each task, resulting in a populated representation scheme
Technique	Thematic analysis	Use of analytic framework: initial framework derived from review of literature in chapter 3 then revised against the thematic analysis

Each data analysis process is described separately in more detail below. It should be noted though that although the processes are described linearly, in practice it was iterative. As although the thematic analysis was used to inform the identification of task elements, the analysis of the individual tasks also helped elucidate the different themes.

5.2.4.3   DATA ANALYSIS 1: Influence of the IUE on search activities

Using thematic analysis, the interviews were examined inductively for what is influencing search activities in the primary classroom.

Thematic analysis was conducted following the steps advocated by Braun & Clarke (2006). Although the steps are laid out in a linear pattern, the process of analysis was iterative as while completing one step, previous steps were returned to. Therefore, the process of analysing this data was more convoluted than is represented here. Described next are the steps taken to analyse the data, followed by a description of the themes and codes (Table 7).

STEP 1: "Familiarising yourself with your data"

Through transcribing the interviews and an initial reading of the transcripts the data became familiar prior to any formal coding. At this stage initial thoughts on codes were recorded in memos.

STEP 2: "Generating initial codes"

An initial set of codes was generated inductively from repeated readings of the interviews. Codes are "a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and /or evocative attribute for a portion of language-based or visual data" (Saldaña, 2016, p. 4). Each transcript was coded one after the other. To keep in context what was being said, the data was coded in large chunks. At the start of the coding process, new codes were generated for each transcript, but as could be expected this tailed off as more transcripts were coded. After the last transcript was coded, the transcripts were read again to check for codes that had been missed, particularly in the transcripts that had been coded first.

A semantic approach was taken to coding the data whereby the "themes are identified within the explicit or surface meanings of the data and the analysis is not looking for anything beyond what a participant has said or what has been written"(Braun & Clarke, 2006, p. 13). The transcripts were also analysed for what was not said. For example, in the interviews there were many references to the curriculum and so references to using search technologies outside of the curriculum were looked for and coded.

The codes were mostly generated inductively when reading the transcripts and had not been decided in advance. This was because although Taylor's (1991) concept of an IUE was used as a framework throughout this thesis, limiting analysis to this framework could be restrictive and may not provide a complete view of what is influencing search in primary schools. However, some codes were based on an awareness of the research literature. For example, research by Gärdén et al. (2014) on how the word "fact" is used in primary school influenced the initial coding.

The first round of coding produced over a hundred codes. Many of these codes were repetitious and were amalgamated. Some codes were found to be not relevant to the research question (for example, using the Internet to play Maths games) and these were set aside for future research. An example of how transcripts were coded is provided in Figure 7. The final set comprised 15 codes and 29 sub-codes (see Table 7).

Extract from transcript of interview with Y6 teacher	Initial code	Final code
First week where you do a brainstorm of all the things that we've found out. So you would pick up by just going around who has got some facts and who hasn't got some facts. If somebody has got a blank sheet you would say you know what are you doing? And you might need to help them [...] Or are you spending too much time looking at something that isn't perhaps relevant. You need to be more focused on what you are doing or are you answering our questions that we want to find out. [...] you can go off on a tangent and waste a lot of time.	Brainstorm Teacher uses word facts Supporting children Time	Brainstorm merged with similar initial codes to become "Sharing and discussing …" Teacher uses word facts is not relevant to research question so put aside. Supporting children / Time merged to become "Activity adapted in response to time restrictions"

Figure 7: Example section of a coded transcript

STEP 3: "Searching for themes"

The refined set of codes was then aggregated into different themes. A theme "captures something important about the data in relation to the research question, and represents some level of patterned response or meaning within the data set" (Braun & Clarke, 2006, p.10). This stage was particularly challenging, and two early attempts to group the codes were discarded (see Appendix G). There were two main problems. The first problem was distinguishing between what was happening in the environment and what was the consequence. For example, in the second attempt sharing is identified as a theme. However, sharing is the consequence of children having different skills (final theme 3) and lack of resource (final theme 5). The second problem was deciding the level of a theme. In the first attempt, the themes are at too low a level. They do not reflect the environment overall; not all the initial codes fall under these themes and there is considerable crossover in the impact of the environment. In the second attempt, some of the themes are now at a higher and more inclusive level (for example, national curriculum) but other themes (for example, learning should be open to all) are still at too low a level.

STEP 4: "Reviewing themes"

After settling on the themes they were then reviewed: firstly, for whether all codes within a theme were appropriate; secondly, for whether the themes as a whole fully covered what was influencing search in the environment.

STEP 5: "Defining and naming themes"

Theme names were finalised at this stage. Each theme was summarised with a brief

description and each code described (see Table 7).

STEP 6: "Producing the report"

The themes were then described in the results section of the report. After this the implications of the themes for describing the search tasks was considered (see 5.2.4.4)

Description of themes and codes

Altogether five themes were identified for how the environment influences search. It was found that this is a learning environment

- that is guided by an externally imposed curriculum
- where teaching is guided by best practice
- where people have different skills
- where children must be kept safe
- where time and resource are limited.

Table 7: Themes and codes for analysis of the IUE

Code	Code description	Example of coded transcript
Theme 1: A learning environment that is guided by an externally imposed curriculum. How the curriculum influences how search is taught, what parts of the curriculum search technologies are used, and why they are used.		
Teaching search	Teaching of search in the curriculum. How teaching search fits into the curriculum.	"It would only be part of the lesson objective if you were doing it in an ICT lesson."
	Who teaches search. Whether search is taught by the class teacher or a specialist Computing teacher.	"I don't actually teach it. [The Computing Lead] teaches it."
	Teacher priorities. The importance of search in the curriculum.	"Obviously you focus on Maths and English because you can't do everything."
Use of search in the curriculum	Uses of search in the curriculum for subject areas and topics.	"I use it all the time, all the time. Especially in French." "We are doing the Maya civilization."
	Uses of search beyond the curriculum. The search activity could be stated as not on the curriculum or it is inferred.	"Some kids might be actually wanting to do [Maths] that is not in our curriculum." "Going to Scarborough, there was a few children on the coach who recognised Cliffside Hotel because they searched it on the Internet."
How using search technologies helps fulfil curricular requirements	An intended outcome is to gain knowledge about a topic / area. Knowledge is the acquiring of "factual content" (Department of Education and Science, 1985).	"We did a history booklet and each week they did a different topic and each week before they had to go home and research it."

Code	Code description	Example of coded transcript
	An intended outcome is to gain a conceptual understanding of a topic. Concepts are "generalisations usually arrived at through a process of abstraction from a number of discrete examples. They enable pupils to classify and to organise knowledge and experience and to predict" (Department of Education and Science, 1985).	"If I want to explain the life cycle of a bean or a plant, you know it is very hard to explain it."
	An intended outcome is to gain analytical skills.	"We talk about the importance of looking at more than one website."
	An intended outcome is to gain operational skills.	"We are looking at using a data file… so we went on Rightmove."
	An intended outcome is to gain a better learning experience.	By following best practice a better learning experience may be achieved: see theme 2.
Theme 2: A learning environment that is guided by best practice. How search activities stem from following best practices.		
Sharing and discussing aids learning	How information is discussed in class before, during and after search activities.	"Right let's brainstorm. Let's talk about what we know about them already."
	How information brought in from home is discussed and may lead to new search activites.	"And I said you know what when I was looking last week I found a really good website. … I found the one I remembered."
Child-led learning	A choice of what to research is given. The research questions maybe broad or children are given a choice of question.	"They are quite open ended and that is how we've intended them to be so the children can hopefully choose something that they are actually interested in." "We've got all our different questions, pick one."
	There is a choice of ways to present information.	"And that was very much free for the children to produce however they wanted."
	Lessons evolve according to children's interests.	"You often know how the lesson is going to go but sometimes they change it."
Bring learning to life	Using the Internet to find information that makes learning feel more real.	"If we are not going out there you can still look at it on Google Maps. Which is brilliant."
Children learn better when they find out for themselves	Children should search for information rather than have adults tell them.	"Rather than telling them I said OK some of you might be really interested to have a look at that tonight."

Code	Code description	Example of coded transcript
Learning should be enjoyable	How teaching is influenced by children's enjoyment. Includes, children's emotional responses to using search technologies both positive and negative.	"We've been having fun." "They completely freak out."
Incentives to learning	How children get rewarded for information.	"It is nice for them to show off."
Theme 3: A learning environment where people have different skills. How accommodating different skills influences the teaching of search technologies and design of search activites.		
Children within a class have different skills	Alternative resources are provided.	"You know for the scientist we found a really good one. We showed them."
	Children can support each other by searching in pairs / small groups.	"We tend to use mixed ability because then the poorer readers are supported."
Teachers and children have different skills	Children and teachers' competency in using technology.	"Children are so computer literate these days, they know how to use Google, Bing, or whatever it is." "But I think we perhaps need to look at CPD for staff. Because again it is moving at such a pace."
	Teacher searches on behalf of the class.	"Basically we are searching as a class together and me putting it in Google."
Theme 4: A learning environment where children must be kept safe. How keeping children safe influence how search is taught and what is searched for.		
Restricting access	How access to information is restricted.	"They are not allowed to use YouTube."
Adapting practices	How teachers adapt what they do to keep children safe.	"I'd always put the big board off and I'd put it on the little screen so they can't see. Just while it is loading up. Just in case there is anything on that page."
Theme 5: A learning environment where time and resource are limited. How the constraints in the environment influence who searches and the design of search activities.		
Time	How activities are adapted in response to time restrictions.	"You don't want them to spend an hour and not to have answered any of the questions." "And it'll give them time to research more on the habitat."
	Why the Internet is used with regards to time.	"That was an instant right."
Resource	Access to computers.	"There is not enough computers for one each."
	Shortcomings of other resources.	"Our dictionaries are rubbish for very young children."

5.2.4.4   DATA ANALYSIS 2: Elements of search tasks

After conducting the thematic analysis, the interview transcripts were analysed for the different elements of the search tasks. To identify the elements, the representation scheme

developed in Chapter 3 was used as an analytic framework. When applying this framework, it became necessary to adapt it. Described below are the steps taken to analysing the data (the steps were based on what the researcher considered logical and were not derived from pre-existing guidance). Why and how the framework was adapted is described in steps 1 to 5, and how the adapted framework was applied is described in steps 6 to 11. To make it easier for the reader to understand, the development and the application of the representation scheme are documented here as if they were two separate processes, occurring one after the other. In practice they were concurrent processes, and the scheme developed at the same time as it was applied. The steps taken are described in more detail below.

STEP 1: Consult research literature to develop provisional scheme (Chapter 3)

Based on a review of the literature, twelve questions were initially considered when developing the representation scheme. How these questions were derived is described in Chapter 3. The summary of the questions and potential answers to the questions is given again here (Table 8), to make it easier for the reader to understand how the scheme develops. The questions are also numbered (LR_Qn) to make it easier to follow the ensuing changes.

Table 8: Provisional representation scheme derived from literature review

Questions to ask	Potential answers
LR_Q1: What are the work tasks that motivate the search task?	This can be answered by considering units of work as equivalent to work tasks. However, it may not be possible to succinctly represent units of work.
LR_Q2: What is the nature of the motivating work task?	Work tasks may be routine, typical or unusual (based on Xie, 2009).
LR_Q3: How does the search task originate?	Origination can be internally-generated, externally assigned, and generated in collaboration (based on Y. Li & Belkin, 2008).
LR_Q4: If the search task originates from a teacher, how flexible is it?	Teachers design tasks where children may be given some choice of what aspect to research but openness of topics can be restricted by frameworks (based on Shenton & Dixon, 2004a).
LR_Q5: Who does the search task?	Tasks are done by individuals, pairs or groups (based on Crow, 2011).
LR_Q6: How much time is spent searching?	The time period within which a task needs to be completed could be short term or long term (based on Y. Li & Belkin, 2008).
LR_Q7: What content is searched for?	Potentially unlimited but categorising by subject area may be a possibility (Department for Education, 2013c).
LR_Q8: What is information used for?	Information may be used for enlightenment, problem understanding, instrumental, factual, confirmational, projective, motivational, personal or political (based on Taylor, 1991).
LR_Q9: At what stage in the work task is the search task?	Search tasks may occur at the beginning, middle or end of work tasks (based on Y. Li & Belkin, 2008).
LR_Q10: What resources are used?	Books, information from a computer, Internet, library, newspapers & magazines, TV & radio, friends, relatives and teachers may be used as resources (based on Madden et al., 2007).
LR_Q11What is the product?	No pre-existing categorisation of output to base answers on. Outcomes may be difficult to determine and are likely subjective.
LR_Q12: What is the search goal?	Goals can be categorised as either general topical or specific item (based on Toms, 2011).

STEP 2: Review findings from the thematic analysis

After completing the thematic analysis, the representation scheme was reconsidered for those findings. The changes are described below and summarised in Table 9.

Work task (LR_Q1): A search task maybe conducted for more than one work task. In this thesis the motivating task is considered the unit of work that the search activity occurs in, but the topic of the search task may be shared with other work tasks. For example, when learning multimedia skills (the motivating task) the computing teacher tells the class to search for information on Ancient Greece (uniting topic) because the children are studying this topic in History (another work task). This also has implications for LR_Q2 and LR_Q9.

Work task (LR_Q1): Search tasks could be identified for distinct work tasks but teachers did not describe any work task as being of a particular type. As such work tasks cannot be categorised into different groups and therefore cannot be succinctly represented.

Nature of work task (LR_Q2): No change is made here. However, it is noted that there is little variation in nature of work task. The nature of work task is based on the motivating task.

Origination (LR_Q3): Elements should be based on who originates the search task (teacher, child, class, teacher with class). This is because it is not always teachers who originate search tasks. Furthermore, categorising origination as self / externally generated is from an individual's perspective and cannot be used to describe origination within an IUE as a search externally-generated for a teacher may be internally-generated for a child, and vice versa.

Flexibility (LR_Q4): Elements need to be redefined and extended to include choice of specific questions and semi-specific question. This is because how teachers describe designing search tasks goes beyond the process described by Shenton and Dixon (2004a). How Shenton & Dixon's continuum was redefined and extended is described in Appendix H.

Doer (LR_Q5): Elements should be based on who does the search (teacher, child) as well as whether individuals, pairs or groups conduct searches. This is because both teachers and children are doers of tasks in the IUE. Teachers search in preparation for lessons, and in lessons they search on behalf of children and with children. Furthermore, they do tasks that children originate.

Doer (LR_Q5): The question needs to be extended to include whether a search task is compulsory, optional or elective. This is because search tasks are assigned but some are optional and children do not need to complete them.

Time (LR_Q6): Time is now reconceived as planning and location. This is because time is accounted for by teachers adapting and designing search activities for the situation (location and planning) of the search. For example, searches occur unplanned if it is thought the information can be found quickly, and searches that could take a long time are given to children as homework.

Content (LR_Q7): The scheme needs to be extended to include events, topics and generic. Often the teachers described the search task as for a topic or subject area rather than for a unit of work. Teachers also describe some search tasks as typical and not particular to a subject area (for example, dictionary searches). Furthermore, as content need not be related to the subject area (see below) this question needs rephrasing.

Content (LR_Q7): Teachers report two different uses of content. Content can either be used (1) directly to increase knowledge of a subject area (2) indirectly to support learning of a subject area, for example searching for information about animals when learning how to write reports in Literacy.

Information use (LR_Q8): Taylor's (1991) classes of information use need to be extended as teachers describe different uses of information (see Appendix J).

Stage (LR_Q9): The stage of task should be considered for the uniting topic rather than motivating work task. This is because as knowledge of a topic increases this changes what is

looked for and how (Vakkari, 2016). As knowledge of the topic changes in the uniting topic rather than solely the motivating work task, it is the uniting topic that is considered more important here. This does, however, require further investigation in future work.

Stage (LR_Q9): The elements need to be extended to include "any". This is because some search tasks could occur at any stage in a uniting topic.

Resources (LR_Q10): The question needs to be reworded as people were invariably an information resource. Children searched together and discussed what they knew both before and after search activities.

Product (LR_Q11): Multiple selections need to be allowed for outputs. Firstly, this is because there are both immediate and future outputs. For example, note-taking is an immediate output of a search but note-taking can be a precursor to another output such as a report. Secondly, within a class there may be different outputs for the same search task. For example, in Y4 for their Egyptian homework children could make cakes, necklaces, PowerPoint presentations and so on. See Appendix I for how outputs were categorised.

Product (LR_Q11): Outcomes cannot be represented in the scheme. Although the teachers did describe intended outcomes each search task had the same set of intended outcomes (gain factual content, a conceptual understanding, analytical skills, operational skills and a better learning experience) albeit the proportions of each type of intended outcome varied across the tasks. Furthermore, what the actual outcomes of the search tasks are cannot be known in advance and are likely different for each child.

Search goal (LR_Q12): No change necessary. All search tasks could be represented using Toms' (2011) categorisation of search goal.

Table 9: Summary of changes to representation scheme post thematic analysis

Questions derived from literature review	Refinement of representation scheme post thematic analysis
LR_Q1: What are the work tasks that motivate the search task?	Representation dropped.
LR_Q2: What is the nature of the motivating work task?	Remains as Table 8.
LR_Q3: How does the search task originate?	Origination with an IUE needs to be represented by who originates the search task.
LR_Q4: If the search task originates from a teacher, how flexible is it?	Shenton and Dixon's (2004) continuum needs to be adapted and extended (see Appendix H).
LR_Q5: Who does the search task?	Doer with an IUE needs to be categorised by who does the search and whether this is done independently or collaboratively. This question needs to be extended to also ask whether children have a choice to complete the task.
LR_Q6: How much time is spent searching?	This question is reconceived for planning (whether the activity is planned or unplanned) and location (where the search task is conducted).
LR_Q7: What content is searched for?	Elements need to be extended to include events, topics and generic. How information is used also needs to be considered.
LR_Q8: What is information used for?	Taylor's (1991) information uses need to be adapted and extended (see Appendix J).
LR_Q9: At what stage in the work task is the search task?	This question needs to be reconcieved as "at what stage in the uniting topic is the search task". Stage needs to be extended to include Any.
LR_Q10: What resources are used?	Question needs to be reworded as "other people" invariably used as information resource.
LR_Q11: What is the output?	Outputs should be categorised for the different types (see Appendix I). That children may be given a choice of output and that there may be more than one output per task needs to be taken into consideration. Outcomes cannot be represented.
LR_Q12: What is the search goal?	Remains as Table 8.

STEP 3: Consider relationship between elements

Whether elements can and should be considered independently or in combination was considered next. When determining how to categorise flexibility (see Appendix H), it became apparent that how teachers made search tasks flexible differed depending on the search goal. This was incorporated into the categorisation. All the other elements could be categorised independently of each other. However, based on the findings of the thematic analysis, it was thought that it would be fruitful to investigate the relationship between elements for planning and location against doer and search goal, and search goal against origination and doer. Furthermore, given that in the research literature age there is a strong link between what and

how information is searched for and age, whether elements change across year groups is also considered.

STEP 4: Review comprehensiveness of the dataset

Using semi-structured interviews as the research instrument meant that it was possible to identify a range of elements that had not previously been identified. However, there are some disadvantages of using semi-structured interviews. That the questions were not fixed with pre-determined answers and that teachers can only report on what they see, did impact on how the data could be analysed.

That the teachers were able to answer interview questions freely rather than pick from a predefined set of answers was particularly a problem for documenting unit of work and subject area (LR_Q1 & LR_Q7). This was because firstly, teachers sometimes described how children were searching for information on a topic but did not state the unit of work / subject area. Secondly, some searches were also described as typical and were not particular to any unit of work / subject area. For example, the Y5 teachers described how at the end of the day they might suggest to children "shall we quickly Google that?". This was accommodated by including topic, events and generic in the representation scheme. For all other questions, it was often but not always possible to identify (see Step 7) all the representations.

That teachers can only report on what they see meant that teachers could not report on what children were doing outside of school. This was particularly a problem for LR_Q4 as teachers did not know who did children's search tasks outside of the classroom. This was circumvented by representing doer of homework search tasks as nominally child.

STEP 5: Review categorisation in multi-dimensional schemes (again)

The multi-dimensional schemes were reviewed again against the emerging representation scheme. Similarities and differences between the application of categories were documented and recorded in two ways: firstly, by examining each of the multi-dimensional schemes in turn and checking whether equivalent categorisations had been applied, and if so how (see Appendix D); secondly, using the emerging scheme as the base, the equivalent categorisations in the multi-dimensional schemes were recorded (see Appendix D). Then, using this documentation gaps in the emerging scheme were identified. Why there are gaps is considered next.

Subjective categorisations: Some multi-dimensional schemes employ subjective categorisations of search tasks where it is the task doer's perception of the task that is categorised (Li & Belkin, 2008; Kim & Soergel, 2006). In this study, these subjective categorisations were not sought because these are considered characteristics of the user not the task.

Categorisation of work tasks: Fewer work task characteristics have been represented in the emerging scheme than in the multi-dimensional schemes. In Li & Belkin's (2008) scheme work tasks and search tasks are categorised for the same aspects, and in Kim & Soergel's (2006) scheme the task types are mostly not distinguished. In this study, the focus is on the search and aspects of work tasks are categorised if the analysis of the interviews indicates that this is important to the search. This means that the scheme is not encumbered with irrelevant

categorisations. However, it could also mean that important aspects of work tasks might be missed.

Categorisation not relevant to IUE: Both Xie (2009) and Li & Belkin (2008) categorise the timeframe of work tasks but it was not possible to differentiate between the timeframe of children's work tasks nor their search tasks. However, it is noted that although it may not be possible to timeframe in this study, consistency in timeframe may distinguish primary school IUE from other IUE.

Finally, the terminology of the different schemes was reviewed. The intention had been to appropriate existing operationalisations but few could be directly imposed onto this study.

STEP 6: Operationalise and identify search tasks in the transcripts

The next step was to identify search tasks in the interview transcripts, and operationalise what a search task is. As in the research literature information tasks that lead to search are usually distinguished as information seeking tasks, search tasks and retrieval tasks (Byström & Hansen, 2005; Y. Li & Belkin, 2008; Pharo & Järvelin, 2004), these were looked for. However, these could not be found as defined in the research literature but the search task at a general level could be identified. Teachers described search as "look for" (Y5 Teacher), "finding information for" (Y2 Teacher), and what they "can come up with" (Y6 Teacher) and did not appear to distinguish between different levels of task.

In this thesis, each search task was operationalised as the specification of an information requirement as stated by the teacher. If the teacher states a new but related information requirement this was treated as a new (albeit related) search task. For example, the Y4 teacher describes how the class were told to research the habitat of a Rainforest animal. While doing this research, children start searching for Latin names of animals. These were documented as two search tasks.

Each description of a search task was identified in a printed transcript, and the text highlighted in a different colour. This was particularly helpful as some descriptions were scattered throughout an interview. This occurred when teachers returned to discuss earlier activities or when not wishing to interrupt the flow of the conversation, follow-up questions were asked later.

STEP 7: Identify elements for each search task

Different techniques were needed to identify elements (described below) and for some search tasks not all the elements could be determined. What data is missing can be seen in Table 36. Furthermore, in Table 11 the number of occurrences for each element is given and so if there is missing data this can be determined.

A description of a search task could be brief but often the elements could still be inferred from general descriptions. For example, the Computing Lead said "the majority of the time the children are working with a partner, and only because there is not enough computers for one each". From this it was inferred that for all classroom search activities in the Computing class children will work in pairs (although there may be circumstances in which some children in the class can work individually. For example, if some children are absent). Therefore, it was

possible to categorise the doer of all the searches that children conduct in the Computing class as children – pairs, even though this may not be stated for the individual search task.

Using Taylor's (1991) definitions of classes of information use as a guideline and the more general research literature information use could be inferred for all search tasks. The definitions needed refining for this study (see Appendix J).

How information is used and outputs were not described for every search task and could not be inferred. If elements were not described these fields were left blank in the spreadsheet.

Identifying stage was difficult and could only be determined for 60 search tasks. To help identify stage and understand the relationship between search task elements across topics and work tasks, the connections between search tasks were mapped (see Appendix L).

STEP 8: Record the data

The elements of every search task were documented in an Excel spreadsheet. Each search task was entered as a new row.

STEP 9: Label each search task

Each search task was differentiated by a brief portrayal of the information requirement. This information requirement was then treated as a label for the task. When providing examples of different search tasks in 5.3 Results, it was the information requirement that was given; for example, research the habitat of a creature.

Ideally the descriptions would be the words used by teachers in class. However, as the descriptions of the search tasks have all been collected retrospectively, this was not possible. Occasionally the information requirement stated by the teacher was succinct and this was used verbatim. However, mostly the information requirements were summaries. For example, "so what I'm looking for is that you can research and collect information to create a fact sheet about your chosen minibeast" was summarised to "research a minibeast".

STEP 10: Apply the representation scheme

A description of all of the different elements was recorded in a code book (see Table 10). This was used to document each search task according to the derived representation scheme.

STEP 11: Produce the report

In the result section, each of the questions is answered with a brief description of the elements found in the dataset and an example of a search task is given for each element. Also included in the table is the number of search tasks for each of the elements.

Numbers are given for three reasons. Firstly, the comprehensiveness of the dataset is more transparent to the reader, as the numbers indicate where data was not collected. Secondly, if numbers were not used then elements where there are zero entries could not be displayed. By displaying these zero entries it is easier to show what elements are not represented in primary school and this also allows for easier comparison with other datasets when the same base definitions are used. For example, under flexibility there are zero entries for "own topic no framework" which was not the case in Shenton & Dixon's (2004a) study. Thirdly, the numbers

are used here to indicate how frequently this element was found in the dataset. However, the numbers should not be interpreted as an indication of how common the element is in the IUE. The dataset is small and the data collection method unstructured so the frequency of elements can easily be distorted.

Table 10: Phase 2 representation scheme

Element		Definition
What is the nature of the motivating work task?		
Routine		"Regular tasks that participants have to perform repeatedly" (Xie, 2009, p. 348)
Typical		"Tasks that participants are used to performing, but they have not preformed the exact same task before" (Xie, 2009, p. 348)
Unusual		"Tasks that participants have not encountered before" (Xie, 2009, p. 348)
From whom does the search task originate?		
Teacher		The task is generated by the teacher
Child		The task can be identified as coming from one child
Class		The task is generated unplanned through discussion, and cannot be identified as stemming from any particular individual
Teacher with class		The teacher plans a class discussion to generate search tasks
If the search task originates from a teacher, how flexible is it?		
Own topic and no framework		Children can choose their own topic and there are no particular information requirements
Own topic and framework		Children can choose their own topic but particular information is required or criteria are given
Own area of interest and no framework		The broad topic is specified. Children can choose their own area of interest and there are no particular information requirements
Own area of interest and framework		The broad topic is specified. Children can choose their own area of interest but particular information is required or criteria are given
Topic specified, any true		Topic is more narrowly specified but children can find any true information for that topic
Topic specified and framework		Topic is highly defined and there is little or no room for individualisation
Choice of specific question		The children are given a choice of questions
Semi-specific information		The information requirement is specific but there is some flexibility in how to answer
Specific information		The information requirement is specific and there is no flexibility in interpretation
Who does the search task?		
Doer	Teacher	The teacher does the search task
	Child – individually	Children do the search task individually
	Children – pairs	Children do the search task in pairs
	Children – small groups	Children do the search task in groups (2+)

	Nominally child	The search task is nominally conducted by the child at home but it is also possible that someone else conducts this search task on the child's behalf
	Teacher or child	The search task could be conducted by either the teacher or the child
Optionality	Compulsory	The teacher gives the search task to all children
	Compulsory, some	The teacher gives the search task to some children
	Optional	The teacher gives the children a search task but they are not required to do it
	Elective	Children choose to do the search task

Does the search task occur as part of a planned search activity?

Planned	The teacher has planned for a search activity
Unplanned	The teacher has not planned for a search activity

What is the location of the search activity?

Class	The search activity occurs in a school lesson
Outside of class	The search activity is not in a school lesson
Both class and outside of class	The search activity occurs both in a school lesson and outside of school
Either class or outside of class	The search activity could occur in either location

What subject area is the search task for?

National curriculum subject areas	List taken from national curriculum documentation (Department for Education, 2013c)
Topic	Where the search task is for a topic and the curriculum subject area is not described
Event	Where the search task is for an event and is not related to a particular subject area (e.g. assembly)
Generic	Where the search task is described as typical and is not related to any particular subject area (e.g. search for spelling a word)

How is information used?

Directly to increase knowledge of a subject area	Where information is directly related to the subject area
Indirectly to support learning of a subject area	Where information is not directly related to the subject area but it is used as content with which to gain knowledge of a subject area

What is information used for?

To orient	To orient to a topic by seeking a broad and general understanding
To extend	To find out about a particular aspect of a topic
To make sense	To bridge a gap in understanding (Dervin, 1983, 2003)
To illustrate	To explain or represent an object or concept
To decorate	To visually enhance presentation of an information object
To verify	To confirm information already known
To navigate	To "reach a particular site" (Broder, 2002, p. 5)
To define	To find out the meaning, spelling, synonym or translation of words
To get instruction	To find out "what to do and how to do something" (Taylor, 1991, p. 230)

As precise data		To use data (such as price or location data) as specific unambiguous units of information
What stage in the uniting topic is the search task?		
Any		The search task is not specific to a stage and could occur at any time
Start		The search task occurs at the beginning
Mid		The search task occurs in the middle
End		The search task occurs at the end
Other than people what resources are used?		
Any other resource		The resource is not stipulated
A general resource	Library / book shelf	Any book on the book shelf / library can be used
	The Internet	Any website can be used
A specific resource	A book	The teacher stipulates or uses a particular book
	An app / program / CD Rom	The teacher stipulates or uses a particular app, program or CD Rom is used, for example Simple City (http://www.2simple.com/product/simple-city)
	A particular website / search service	The teacher stipulates or uses a particular website or search service. For example BBC Learning Zone (www.bbc.co.uk/programmes/p01b8f09) or Google Translate
What are the outputs?		
Articulation		Share information with others
Construction		Where something is made e.g. a cake
Formal writing		A final piece of written work
Illustration		A drawing
Notes		Taking notes
Spreadsheet		Populate a spreadsheet
Vocalisation		Saying a word outloud to practice pronounciation
What is the search goal?		
General topical		The goal is to find information on that topic but no specific information is looked for
Specific item		The goal is to find particular information

5.2.5   Research quality

This research was designed to reveal the variation of children's search. For this reason, semi-structured interviews were used as the research instrument, participants were selected for maximal variation, and the data were analysed using two techniques (thematic analysis and analytical frameworks). Every research design will have its strengths and weakness. How research quality has been achieved overall is discussed in the Research Design chapter under 4.7 Research Quality. In this section, techniques (member checking and assessing the representativeness of the sample with participants) particular to this phase are recounted.

Member checking

A summary of key findings of the thesis was prepared for the teachers who participated in phase 1 and phase 2 (Appendix O). However, not all of the teachers could be contacted. Four of the teachers who participated in the West Sheffield interview study had left the school and

the whereabouts of two of these teachers was not known. Similarly, the teacher who had taken part in the West Sheffield observation had also left the area.

Further assessment of the representativeness of the sample

The sampling procedure and the appropriateness of the sample are discussed in the Research Design chapter under 4.5.1 Sampling. An additional assessment was also made during phase 2 whereby interview participants were asked "is this typical for year x?". This question was used to establish firstly whether the teacher interviewed thought there would be any differences if another teacher from the same year group in the same school were interviewed, and secondly whether there would be any differences if another teacher from the same year group in a different school were interviewed. The results are presented here.

All the teachers thought they were representative of the year group they taught at the school, mostly because within a year group the teachers work together and cover the same topics. They did agree there could be some differences based on the teacher's experience and that classes within a year group can themselves be different.

> "More or less. [names teachers] We work very closely in Y1. So we all share ideas and do the same thing. It is probably not exactly the same. And probably because they are younger than me they are more savvy with the computer. Whereas for me it is more like discovering it with them at the same time [laughs]". (Y1 Teacher)

> "Yes, we work quite closely together and we do similar, very similar. … Different classes throw up different things. And sometimes you can say 'Oh my class found this, this and this, and you are finding this'. So it can lead to different things. And again some classes can be very different how they tackle things. And throw up things the other class doesn't find." (Y6 Teacher)

Teachers also thought that teaching is likely to be similar in other schools.

> "Yep. The topics would be different but the objectives would be the same. So such as 'we are learning to research and find facts' they might be finding facts about the Victorians but it is still the same objective. The outcomes might be slightly different and what the children produce but they are still learning the same skills to get them there." (Y4 Teacher)

However, they did think there would be some differences because the West Sheffield school lacks resource. Also in five of the interviews the teachers identified the school as being particularly creative. To some extent the lack of resource and creativity are intertwined.

> "It is a big issue in this school, because we are not a school in the inner city where you get tonnes of pupil premium money. We are not awash with equipment. Which you would see a lot more if you were in a city school with a lot more kids on free school meals. We are kind of caught in that trap of having very few kids on free school meals and therefore the income we get per head from local authorities is significantly less than a lot of those other schools. That means the amount of money you could spend on buying new equipment is really limited." (Computing Lead)

"We don't have anything like that. We have to be a little bit more creative on how we use the computers and how we use ICT and how we teach it at [name of this school]. But I think that, I went on a moderation course actually and gave a talk about this, I think we're, because we haven't got the resources at [name of this school] we have to be a little bit more sassy in how we are teaching it" (Foundation Teacher)

5.3   Results

The results are presented in two parts. The results of the thematic analysis of what in the primary school environment shapes search activities are reported in part 1. The different elements of children's search tasks are reported in part 2.

5.3.1   RESULTS PART 1: Influence of the IUE on search activities

The interviews were analysed thematically for how the environment impacts on search activities. It was found that this is a learning environment

- that is guided by an externally imposed curriculum
- where teaching is guided by best practice
- where people have different skills
- where children must be kept safe
- where time and resource are limited

and that together all these factors influence the occurrence of search activities. How the environment influences search activities is described next.

5.3.1.1   THEME 1: A learning environment that is guided by an externally imposed curriculum

The national curriculum influences how search technologies are taught, why search technologies are used, and what for. Under this theme the teaching of search and the use of search both in and beyond the curriculum are examined.

Teaching of search

The teaching of search technologies, and how to use them, falls under Computing[2] in the curriculum. In this school, three teachers specialise in teaching computing (Y4, Y3 and Deputy Head) and between them they teach all classes in the school. A consequence is that Computing, and hence use of search technologies, is taught outside of usual classroom lessons.

"I think there needs to be standalone lessons. But the thing is the ICT lessons are very standalone … We are not actually in those lessons." (Y5 Teacher)

As is also the case for other subject areas, the school do not devise their own lesson plans for Computing. Instead they make use of plans devised by external agencies. Mostly, the school

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[2] Computing is "an umbrella term to refer to subjects which are focused on teaching about digital technology and its use, including: Computer Science, Information Technology, and Digital Literacy." (Education Technology Action Group, 2015, p. 12). At the time of starting this study, the term used to describe the subject area in the national curriculum changed from ICT to Computing. In the interviews, teachers used both terms to refer to the subject area.

follows one scheme of work[3] and in this scheme how to use search technologies is only taught in Y5. However, the Computing Lead did not follow this particular lesson.

> "I didn't particularly for those, no. I haven't done a specific lesson around search engines." (Computing Lead)

The reason given for not specifically teaching children about search technologies is the belief that other areas of the curriculum are more important to teach. The teachers report that they cannot cover the whole curriculum. This was particularly the case in 2015, as a new curriculum had just been introduced into UK schools and the teachers were still trying to get to grips with it[4]. For the class teachers their priorities are core subjects, such as Literacy and Maths, and for the Computing teachers programming is more important.

> "There's the new curriculum. Obviously you focus on Maths and English because you can't do everything … So it is something we'll get around to next year and pick up a lot more because no there hasn't been a focus on that. … It's been a huge change. It is just not practical to do everything. You can't. So the focus has been mainly English." (Y5 Teacher)

> "There has been a huge change as you are probably aware with the Computing curriculum, and a lot more pressure on the programming side of things." (Computing Lead)

Despite the claim not to teach children how to use search technologies there is some instruction. The Foundation teacher describes modelling Internet searches so these young children can learn from her example, and as discussed below children are taught research skills when using the Internet to search for information in other subject areas. Also all children are taught how to use the Internet safely and safe search is increasingly an important component in the school curriculum. At the start of every year the Computing Lead explains the school computer use rules to each class and what to do if an inappropriate image or text is viewed. The Computing Lead also has whole lessons dedicated to e-safety; for example, in Y2 children are taught how to search for images safely.

> "We don't really use the Internet too much to search for information by themselves. I'll do it for them and you know model it to them. They haven't really got the skills yet to do it themselves." (Foundation teacher)

> "One of the things we are really looking for at the moment is a focus on Internet safety. Particularly there is a new e-safety scheme of work come out from Sheffield council which will be taken on board in September. And with that there is a lot more talk about lots of things but bringing it a lot lower to school. So things that you would associate with secondary school, bringing it into year 5 and 6. And things in year 5 and 6, dropping it further down the school because it is so important. And children of such a young age are now very happily surfing the net." (Computing Lead)

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[3] A scheme of work is "a plan that defines work to be done in the classroom" (British Council, 2009). See for example http://sheffieldclc.net/about-the-sheffield-primary-computing-scheme-of-work

[4] Not only does the new curriculum incorporates a number of changes to how computing is taught but also there is an increase in what children are expected to attain for different subject areas (for an overview see http://www.bbc.co.uk/news/education-28989714).

Use of search in the curriculum

Search technologies are used to find information that both indirectly and directly supports the curriculum. Very little reference is made in the interviews to any searching that is not addressing the national curriculum in some way. Events taking place outside of school may lead to the use of search technologies but what the information is used for is also related back to the curriculum. For example, during morning registration Foundation children learn to say hello in a different language. At Christmas time, the children learn to say "Merry Christmas" instead. The Internet may be used to support events that are taking place in school. Both the Y6 teacher and the Computing Lead (in his role as Deputy Head) search for images of two Olympic swimmers who are attending assembly. In Y6, children off their own bat prepare for a school trip by doing some research at home.

Even when teachers state that they are not searching for information for the curriculum, they are using it to go beyond the curriculum. For example, the Y4 teacher suggests different Maths theories and codes for children to search for at home. The Y1 teacher is concerned that when they are making an African village in the classroom the children still acquire a broad view of Africa.

> "Because we've got to cram all the other stuff … we don't always get to do it. Some kids might be actually wanting to do [Maths] that is not in our curriculum." (Y4 Teacher)

> "We are doing a project on Africa so we are making an African village but I don't want them to just think that everybody in Africa lives in a village so I want to give them the experience of seeing that there are people in Africa who live in, that most people in Africa live in, cities. Or that there are wealthy people. Or that people live in big houses just like we live in here." (Y1 Teacher)

Search technologies are used to directly support a range of national curriculum subjects. In particular, the teachers report using search technologies during Literacy, Geography, History, Computing and Science lessons. However, in the interviews which subject area a search activity was conducted for was not always clear. This is because the school use topics as a way of unifying teaching across different subject areas. Every half term, a class studies a single topic, but the theme of a topic may be incorporated into many subject areas.

The topics are taken from an old version of the national curriculum, and it is these topics that provide the subject matter for many of the children's searches. Although each year group studies different topics, there does appear to be some crossover in what is searched for. For example, teachers report children searching for animals in the following topics: animals (F), nocturnal animals (Y2), habitats (Y4), minibeasts (Y4), and lifecycles (Y5). Furthermore, both the Foundation teacher and the Y2 teacher independently report children searching for the same animal (an aye-aye, a type of lemur native to Madagascar). It is likely that the reason why they report this is because the animal is unusual but it is striking that children are searching for the same animal in two different year groups for what are nominally two different topics.

"One child brought in a Deadly 60 CD like DVD thing. Which had, what animal was it, an aye-aye. We were looking at an aye-aye. … I didn't even know it existed" (Foundation Teacher)

"The children writing about aye-ayes knew just as much as I did, if not more." (Y2 Teacher)

Because the topics stem from an old national curriculum, other schools may be using these topics. Some of these topics are adapted by the school ("Victorian Sheffield", Y3) and are unique to the school / area; others are likely to be studied in a similar way in many other English primary schools. This point is made by the Y2 teacher who explains that Y2 children across the country are likely to be searching for nocturnal animals as one of the options on a national test was for children to write a non-chronological report on night time:

"[They were using the Internet] when they were preparing for their big non-chronological report about nocturnal animals. Which you know nearly every 7-year-old child was doing in the land." (Y2 Teacher)

The Y2 teacher also describes how this national test influences the frequency with which search technologies are used. The test was changing the year after the interviews, and the writing component would be based on children's own experiences (for example, their favourite toy). As a result of the change, the teacher thought it likely that they would use search technologies less often in class.

"As part of our ongoing normal class writing work I imagine I definitely will get them to look things up. And we will be using search engines. I suppose I can imagine I might do it slightly less. I might be less driven to make sure that they have got lots of knowledge about that they know lots of stuff about something in order to be able to write it down." (Y2 Teacher)

How using search technologies helps fulfil curricular requirements

The teachers describe five intended outcomes: (1) to gain factual content, (2) to gain understanding of concepts, (3) to acquire analytical skills, (4) to acquire operational skills, and (5) to gain a better learning experience. The first intended outcome for using search technologies is to gain factual content about a topic / area. The information searched for may be directly or indirectly related to a subject area. So for example, in Y3 when studying History children search for information on Victorian Sheffield, a topic directly related to the subject area, whereas in Y6 when learning Literacy children search for biographical information about celebrities. Through this, children learn about biographies but knowledge of celebrities is not directly related to Literacy.

"We did a history booklet and each week they did a different topic and each week before, they had to go home and research it." (Y3 Teacher)

"We do all our literacy through genres, so like biography … You can choose who you want to do. David Beckham or Venus Williams or whoever it is." (Y6 Teacher)

The second intended outcome is to gain an understanding of concepts either through information that is available on the Internet or through the act of searching. That the Internet

provides easy access to multi-media is one of the reasons why it is used when trying to explain concepts. For example, the Foundation teacher uses video to advance children's conceptual understanding of lifecycles. Search technologies are also used to gain a conceptual understanding through searching. In Foundation and Y1 the children are learning the difference between fiction and non-fiction. In these lessons, children search for facts so as to understand what facts are. In Y3, in a Computing lesson, the teacher explains data files and data handling by searching Rightmove[5]:

> "If I want to explain the life cycle of a bean or a plant, you know it is very hard to explain it. They need to see that happening. So we plant a bean and we do lots of growing. Still what this bean is going to turn out like, they need to physically see it. So that is when you might get a video ... the speeding up time." (Foundation teacher)

> "We are teaching them that if they are writing a fact book about animals, the facts have got to be correct. You know you can't make up a fact about them so you need to search to find out the truth and find out those facts and find out about that animal." (Foundation Teacher)

> "We looked at Rightmove and I said here is my first question. Where do I want to live? That breaks it down. I've got millions of houses and it breaks it down to that. And then I go, right what size, how many rooms do I want? And it breaks it down to that. What else do I need? It breaks it down to that." (Y3 teacher)

The third intended outcome for searching for information is that children are also practicing their research skills. The Y4 teacher in particular describes how it was an important part of the curriculum for children to learn how to research effectively. Being able to find the information that they want, finding accurate information, finding enough information and not plagiarising were all mentioned as research skills that the children need. These skills, though, are not exclusive to using the Internet and as the teachers point out all these research skills are also required when using books.

> "There is lots of areas of the curriculum where research is a really important part of a lesson objective. … So what I'm looking for is that you can research and collect information to create a fact sheet about your chosen minibeast." (Y4 Teacher)

> "They don't find the skill of going to get the book hard and to flick through. But when they are faced with a large book and they are finding a certain particular animal in that book. That is when they find it hard to search for that particular animal." (Foundation Teacher)

The fourth intended outcome is that when children are using search technologies they are also acquiring operational skills. For example, when the children are using Rightmove[5] in Y3 to gain a conceptual understanding of data files they are at the same time also learning how to use a different type of search system. At a more basic level children are also learning to type, and both the Computing Lead and Y6 teachers are concerned that some children have poor keyboard skills with a potential impact on their learning.

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[5] a UK-based property portal, www.rightmove.co.uk.

"I feel that kids are leaving me at year 6 and they will all in their work and in their life they will be on a computer but they don't know how to type properly." (Y6 Teacher)

The fifth intended outcome is that teachers want to gain a better learning experience. This can be achieved by following best practice. How best practice influences search is discussed next in theme 2.

The intended outcomes are not discrete. For each search activity multiple intended outcomes are hoped for and depending on the search task some intended outcomes will be more dominant than others. A search task may have a primary intended outcome of gaining factual content and a conceptual understanding. Gaining analytical skills, gaining operational search skills and a better learning experience, are always additional intended outcomes. When using search technologies not only are children acquiring information from the search results, through the act of searching they are also gaining research skills, operational skills and an understanding of concepts. To illustrate this two examples are given next. The first example, is where the focus is on gaining factual content. In Y4 the children search for Rainforest animals. The primary purpose here is to gain knowledge of the topic (intended outcome 1) but the teacher also uses this as an opportunity to teach research skills (intended outcome 3) and using the Internet means that children are not constrained by the books available in the classroom (intended outcome 5). The second example, is where the focus is on conceptual understanding. In Y3 children search Rightmove (www.rightmove.co.uk) for house information. Children do not need to know about houses for their school work but through the act of searching it is hoped that children will gain a conceptual understanding of data files (intended outcome 2). Furthermore, it is hoped that children will gain an operational understanding (intended outcome 4) and find it easier to understand data files by using a real-life example (intended outcome 5).
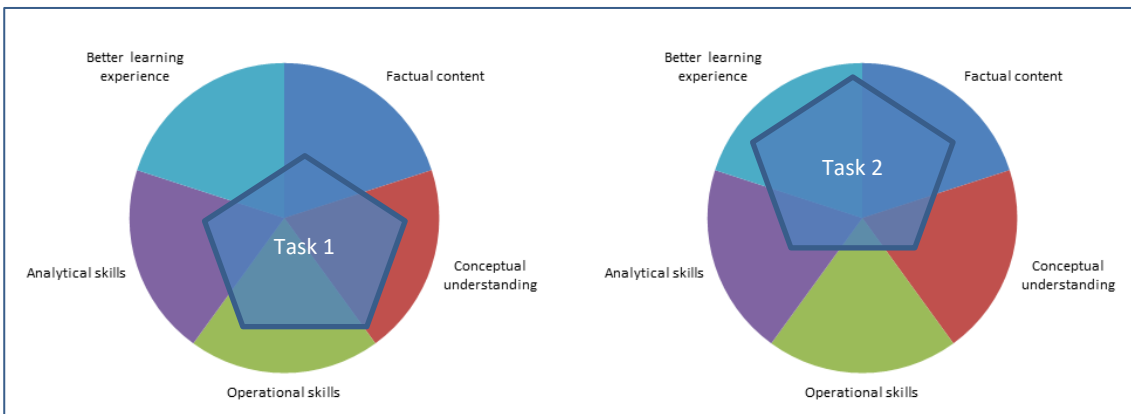
Figure 8: Intended outcomes of search tasks

5.3.1.2 THEME 2: A learning environment where teaching is guided by best practice

How search activities are shaped by what are considered good classroom practices such as sharing and discussing, child led learning, bringing information to life, finding out for themselves, making learning enjoyable, are described.

Sharing and discussing aids learning

That information is shared and discussed is emphasised in the interviews. Discussions may occur as part of a planned search activity but also search activities may occur as a result of a

discussion. When search activities are planned, discussions occur before, during and after that activity. Before a planned search activity, teachers typically discuss with a class what they already know. During an activity, children usually work in pairs so they can discuss their findings with each other. After the search activity is complete children are encouraged to articulate what they have found and discuss with the class.

> "That was our first lesson about weather. It was basically, we are going to talk about weather this half term. What are all the different types of weather? Right let's brainstorm. Let's talk about what we know about them already. Briefly, let's find out what they actually are. What causes them, etc. And then we share that information at the end and we discuss what we find out. … So it is not just if they bring it in they can use information on their own. We share it. We don't just say we've got that information go off and write. We talk about the different things that they've found out. We say, why is what you've got different to what you've got. Obviously you've looked at a different site. There is obviously discussion before they go off and use it." (Y3 Teacher)

Not all search activities are planned. Both children and teachers share information that they have found outside of school back with the class. This can lead to further search activities as information may need to be navigated to or verified.

> "So one boy in my class this year when we were doing mini-beasts said that some spiders could be vegetarian. And then I said 'I'm not sure that they can be because you know a vegetable wouldn't wander into their web' and 'how would they catch a vegetable like that' and they said 'no, they can be vegetarian as well' so we did look up are there vegetarian spiders". (Y2 Teacher)

> "And I said you know what when I was looking last week I found a really good website. So I typed in present perfect and I found the one I remembered I looked at and we had a look at it and we explained about the different tenses." (Y3 Teacher)

While discussing information in class, children also ask questions that the teacher may not know the answer to. This again can lead to unplanned searches where the teacher either uses the computer at the front of the class to search for an answer or they give the children the option of finding out at home.

> "And also because as a reader you do sometimes, there is a particular thing. Some child will ask a really good question and you think I've no idea what the answer is to that." (Y2 Teacher)

> "And then Science is often, we obviously go on, we show them clips during the lesson. But generally that throws up things, we might be talking about something, I don't know, say we are doing Light…. and then a kid asked me how fast does light travel or something. I might go 'oh I know that it takes 7 minutes or whatever for the light from the sun to reach the earth' but if I don't know 'you find out tonight and let me know tomorrow'." (Y6 Teacher)

Child-led learning

Wanting to give children opportunities to lead their own learning influences search activities in three ways. The first way child-led learning influences search activities is that lessons can

evolve in the direction of children's interests. When starting a topic there may be some skills or particular pieces of knowledge that teachers wish children to know but a topic can go off in different directions. As these different directions are not known in advance the teacher may not be knowledgeable in these areas and will need to search with the class for more information.

> "A lot of the time I'm finding out about stuff. We did fire as our topic in spring. It was the first time for a while that I had taught the Great Fire of London so I was learning stuff about that as you do all the time. I also learnt a lot about fire engines and how they work because we decided let's find out about fire engines. I don't know anything about them other than they go neenah and they are red." (Y2 Teacher)

The second way child-led learning influences search activities is that children may be given a choice over how to present what they have found out. This is particularly the case for research that children do at home.

> "And that was very much free for the children to produce however they wanted to. So you end up with models coming in of the labyrinth for the Minotaurs, you end up with Plaster of Paris heads, you end up with a Medusa's head up, or you end up with someone who has done a PowerPoint presentation. So the staff try to make those homework projects as broad as possible. So actually it is more to do with the individual." (Computing Lead)

The third way child-led learning influences search activities is that children may be given a choice of what to research. This is done by incorporating some flexibility into what is being researched by setting open questions and by giving children a selection of questions. For some subject areas information is needed that is not directly related to the subject area. When this is the case open questions are set and the Internet is used as a way of providing content that engages the children by allowing them to follow their own interests. For example, when learning how to write explanations in their Literacy lesson, the Y6 children can choose what explanation to write. When researching information on a subject area, the search question may be broad so that children can choose an aspect that interests them. However, the openness of these searches can also be constrained by frameworks, whereby the teacher works with the class to define criteria that must be met. For example, in Y3 the children need to find out about different types of weather but there are particular information requirements.

> "We have done it before where we say we want you to do the water cycle, and that is OK but sometimes they don't want to do that. They want to do something that they are interested in. It makes them more interested in their own learning and get more into it, we feel." (Y6 Teacher)

> "I think they are quite open because we never ask them to search for anything, or research things, that are really specific. They are quite open ended and that is how we've intended them to be so the children can hopefully choose something that they are actually interested in. Because I don't really see the point in them doing stuff that they don't want to do." (Y4 Teacher)

> "So a technically accurate description. Rather than just rain for instance, it is wet. They had to know what it actually is. Perhaps what causes it. And perhaps a bit of

information about it, especially the higher level children we'd expect, you know what causes it, what would you expect to see. You might, if it was a hurricane, put that it was a risk to people." (Y3 Teacher)

Even when the search questions are specific, the teachers still had ways of giving children choice. For example, when learning Computing skills children search for specific types of information that they can use as data to be manipulated in class. In these instances, children may be given a choice of source from which to collect their data. Another technique teachers use is to get the class to generate search questions together. Not only are the children involved in the production of the questions but they also get a choice of which question to answer.

> "For example, in spreadsheet modelling towards the end of the unit we ask the children to come up with a party idea. And we use Tesco or Asda[6] websites. And the children went on and searched for what food they wanted, or what drinks they wanted, and we gave them a budget and they had to look at search around that to decide how much. And have a spreadsheet. Oh we've got too much of that. And play around with the spreadsheet." (Y6 Teacher)

> "So this year we did the polar regions. So they asked lots of questions about Penguins and Polar Bears and how people live there, and what do people eat when they are there and what do people wear? And do children go to school there? Do they have school there? Do people learn to read in the arctic? … And then having done all that I would usually say to them in the guided reading, here we've got all our different questions, pick one that you are interested in and stick it in the search engine and see what comes out." (Y2 Teacher)

Bring information to life

The Internet is also used to make what is being taught feel more real for the children. This is done in two ways: using information that children could readily associate with and showing images of unfamiliar places and objects. For example, in Y6 when they are learning to create spreadsheets rather than give the class data the Computing Lead has the children collect their own data on the local area. In Y4 and Y5, the teachers described using the Internet to make what they are teaching about more real and life-like.

> "We are doing about using Excel spreadsheets and they had to create their own for attractions around Sheffield. So again they were using the search to find attractions around Sheffield. So the costs of going to the cinema, or the Odeon or the Crucible." (Computing Lead)

> "We are doing *Kensuke's Kingdom* and you know in *Kensuke's Kingdom* there is all the journeys to the different places and you can use this [interactive whiteboard] to look up the different things so it really brings it to life." (Y5 Teacher)

Children should find out for themselves

The teachers do not want children to be reliant on being given information. They feel that

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[6] Supermarkets based in the UK

children should be given opportunities to find information by themselves, partly because finding information is considered an important skill and also because it is thought that children learn better this way.

> "There has been a big shift, certainly, more recently, where it is not all about giving kids knowledge. They have got to know how to do it. In the real world, if me or you didn't know anything, we could find out probably on a search engine and it is a skill that you need to know." (Y6 Teacher)

Learning should be enjoyable

Search technologies are used because children enjoy using the Internet and because the Internet provides access to information in appealing formats. For example, the Y1 teacher searched a poetry website (www.poetrystation.org.uk/) with the class because the children enjoy hearing poets reading aloud their own poems. Similarly, in Y5 the class use Google Street View (www.google.co.uk/maps/streetview) to look at the view that can be seen outside the classroom window because the children find it fun.

> "We've been having fun because I've found this site. Looking at the poetry station and there is some fantastic, and you know, we just found it and they've just loved it. … It is absolutely fantastic because it is all poets reading their own poem so it is really exciting." (Y1 Teacher)

> "We were looking at the local area and you know comparing different areas. And you know Google Street View is fantastic for that. We can go on, they get so excited, we are walking down [name of school road]. You can see it outside [points to window]." (Y5 Teacher)

However, while teachers report that children enjoy using technology, they also report that younger children in particular can get anxious.

> "They love using it. They will fight over using it. You'll look around and there is about ten children over there, when there should only be three. So they love using the computer and the interactive whiteboard but it is when things go wrong or things happen or when a message pops up. They completely freak out and think something terrible has gone wrong." (Foundation Teacher)

Incentivizing children

Children are rewarded for information they find, particularly information brought in from home. Teachers do this by facilitating situations where children can display what they know to others or by making use of class reward systems.

> "We always have half a morning or half an afternoon aside. It often runs over that for the children to share it back with the class because I think it is really important that it is not just me that is seeing it especially if they have tried really hard it is nice for them to show off to their peers. But also not only that, sometimes if it is our assembly time, because each class has an assembly every half term, and if it is just after we have brought in our homework, they take it into the hall and show the entire school which they are really keen to do." (Y4 Teacher)

"I'd say find out and the first three people to tell me the answer in the morning will get a point [on a sticker chart reward system]." (Y6 Teacher)

5.3.1.3   THEME 3: A learning environment where people have different skills

Teachers describe how children in a class have different skills. Furthermore, children and teachers have different skills. Teaching is also restricted by a teacher's lack of knowledge.

Children within a class have different skills

Children in a class have different abilities and some children may find it harder to use search technologies than others. The different skills need to be accommodated so that information is available for everyone in the class. This is done by encouraging children to support each other by working in pairs and occasionally in small groups, and by teachers providing alternative resources. In each year group the teachers stressed that the Internet was not the only means to find information. In part this is so that children know that there are alternative resources but it is also so that the teachers can support children who are finding it difficult. When children are learning a topic in class, the teachers will also have ordered in books about the topic from the school library service. They also prepare for lessons by searching in advance so that they can provide links to good websites.

> "The thing is we'd often try and pair up less able with more able. We wouldn't tend to have two less able children sat because they haven't got the skills. Likewise, it is good to have two very able children together because they can find things that we haven't thought about and they can take our learning even further" (Y6 Teacher)

> "So the children who are finding it very difficult to find something then I might, we have access to some online books by Pearson and other support books and again by Pearson, that they have online so I might direct the children to a book from that collection so they are still using the iPads and they are still, they feel they are doing the same thing as everybody else. And they are because they are finding out about penguins but I've picked the text for them. Because I know they won't be able to access an awful lot of what they come across." (Y2 Teacher)

> "So if it is the Rainforest, I'll look first and see if there are any websites that I can find. Because quite often after they have had a search themselves I'll put some up on the whiteboard to help them and give them a push if they can't find anything. But if it is one where I want them to, I know it is not really using the search engine, because the websites are already there for them but I could give them the websites that are already planned into our planning [externally sourced lesson plan]." (Y4 Teacher)

Teachers and children have different skills

Particularly in the younger year groups, teachers describe searching for information on behalf of the class. This is done because children can find it difficult to do on their own. The teachers report this as an activity shared between the teacher and class, with the teacher simply acting as the operator.

> "Basically we are searching as a class together and me putting it in Google." (Foundation teacher)

> "I might put in a search for something like 'big cats in Africa' and then you can see the pictures down the side … They'll choose that." (Y1 Teacher)

However, it is not always teachers that are leading children. Teachers are also concerned that children know more about technology than them and that children are keeping up with changes in a way that they are not. This also has an impact on teaching as teachers feel it is not necessary to teach some skills.

> "I think we perhaps need to look at CPD [continued professional development] for staff. Because again it is moving at such a pace. Even my son he is at [name of secondary school] and he is doing things that I didn't even know was around. So I think it is keeping pace with it. And there is lots of teachers, and I think this is nationally, and parents, who are not skilled. Kids are out-performing them and know things that they don't know and I think the kids are leading the way. And potentially that is a danger as well. We haven't got a lid on it. We haven't got control. Kids are moving at such a pace." (Computing Lead)

> "We've not done a massive [amount], because they come to Year 4 and they are used to using it". (Computing Coordinator)

5.3.1.4 THEME 4: A learning environment where children must be kept safe

As well as teaching e-safety as part of the curriculum (see Theme 1), to keep children safe the school limits what information children can access, and teachers adapt how they search for information in front of the class.

Restricting access

To protect children from websites deemed to be inappropriate the school uses a firewall, and some sites can only be accessed via a login. This limits what teachers and children can access and sometimes innocuous content is restricted. However, without these restrictions in place the Computing Lead feels that there would need to be an even greater focus on Internet safety in school.

> "Well myself and staff have a login for that [YouTube] but every time you want to do that you have to login and do that. You know there are times when you do think the children are looking for appropriate footage, images and things that they want to use. Again, to go back to the PowerPoint presentation a couple of them found YouTube stories of Greek myths and legends. Theseus and the Minotaur cartoon version by other children but they couldn't access that. So there is that restriction. But again, that is part of it. If the restriction wasn't there, there would need to be an increasing amount of work about how we do safer searches." (Computing Lead)

Adapting practices

While the firewall stops children from viewing some content that could be inappropriate, it is not always effective. As a result, teachers also describe incorporating safe search practices into their teaching, particularly when teaching younger children. For example, in Foundation the teacher is cautious about using Google Images in front of the children, and in Y2 the teacher prefers the children to use search technologies in the presence of an adult.

"I wouldn't use it in front of the children. I'd always put the big board off and I'd put it on the little screen so they can't see. Just while it is loading up. Just in case there is anything on that page. I use it a lot for my phonics. I take pictures off Google Images and put it on my phonics flipchart. As I'm searching for those I need to do it in my own PPA[7] time. As I'm searching those images, sometimes the most bizarre things come up. A lot of it is fancy dress things. People in fancy dress but you know not appropriate for young children. I'd always be quite wary of having that on the big screen whilst it is up or having them using it while I wasn't supporting them really". (Foundation teacher)

"One of those groups would be working with an adult using the search engines … because I've become a cropper before because kids have ended up looking at stuff where, just not relevant to the topic or actually looking at stuff I really don't want them to look at. Or when you are looking up animals and things like that things often go into procreation and all sorts of things like that that, that isn't on the curriculum for this age group, or that their parents might not want them to know about just yet." (Y2 Teacher)

5.3.1.5   THEME 5: A learning environment where there are constraints on time and resource

The teachers describe how constraints such as time and lack of resource influence search activities.

Time constraints

Time affects search activities in three ways. Firstly, when teachers feel that there is not enough time in class, search activities are given to children to do at home, where the teachers believe the children have more time to conduct searches. Sometimes these activities are planned and given as homework. At other times the search activity is not planned and is in response to something that has cropped up in class. If the teacher does not have time to respond in class, then they may suggest that the children search at home.

> "They are making a shoe box of a certain habitat. And it'll give them time to research more on the habitat of a certain animal or creature, and give the time to actually make it because we've not got time. It is almost as if the stuff we haven't got time to fit in, the nice creative activities we send home to do. … Sometimes it is when I don't know the answer. Sometimes I do but I don't have time to cover it or sometimes it is just an idea off the top of my head at that moment and I think oh they are actually quite into that they might want to go away and have a look at it." (Y4 Teacher)

Secondly, when conducting searches in class, because time is limited, teachers may support children with their searches. In particular, they may ensure that children are focused and stay on track.

> "Or are you spending too much time looking at something that isn't perhaps relevant. You need to be more focused on what you are doing or are you answering our questions that we want to find out. And you do. You know that's the thing about the Internet. You can go off on a tangent and waste a lot of times because things crop up

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[7] PPA time is time allocated to teachers during the school day for planning, preparation and assessment. For more on this see www.teachers.org.uk/files/PPA_207sq%20(3996).pdf

that might interest you. It might send you down a road that you weren't planning on going." (Y6 Teacher)

Thirdly, some activities take place because the activity can be accomplished quickly. This is particularly the case when the activity is unplanned.

> "We were reading [Helen Keller], and the kids were really interested and I said wait there I'm going to get a picture of her, so I quickly went over and typed in Helen Keller, and I got a picture and a little bit of background. And I put it up on the white board, straight away, instantly." (Y6 Teacher)

Lack of resource

Lack of resource affects search activities in two ways. Firstly, the teachers need to take into account difficulties accessing technology. Secondly, the Internet is used in response to shortcomings with other resources.

Each classroom in the school is set up with a single computer that is connected to an interactive whiteboard (IWB)[8]. This computer is for the teacher's use, and any searches that the teachers do on the computer can be displayed on the IWB. The school also have banks of netbooks and iPads that the children can use. This equipment is stored on racks that can be moved between classrooms and is shared between the classes. If the teachers want the class to use this equipment they must book it in advance. All of the teachers reported that there is more demand for equipment than there is equipment available. This means that it is not always possible to conduct activities where children need to use technology.

> "The biggest problem is that we don't have equipment in every classroom at all times. You can't program to do, you can't plan ahead, and say OK we are going to do a literacy project today and it is going to be all about research and we are all going to use the tablets. You know because the tablets will be being used by somebody else doing book study or whatever." (Computing Co-ordinator)

That there is only one computer in each classroom also means that if the search activity is unplanned and the activity is to be conducted immediately, either the teacher must search for the information on behalf of the children or the teacher must give permission for the children to use the class computer.

> "It is under my control [class computer] and for them to use it they ask for my permission. I don't generally have children on it but sometimes you know if we haven't got the laptops out. Some lessons you can't have the laptops, well lots of lessons you can't have the laptops out. So yes, in a lesson and a child wants to see a picture or wants to find a spelling. You know a spelling when you are not 100% how to spell that and or to find synonyms of a name of a word or a thesaurus thing. And just say we haven't got one to hand, you could quickly type in and get a definition of what that means or something like that." (Y6 Teacher)

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[8] An interactive whiteboard (IWB) is "an instructional tool that allows computer images to be displayed onto a board using a digital projector. … They are a powerful tool in the classroom adding interactivity and collaboration, allowing the integration of media content into the lecture and supporting collaborative learning." (BBC, 2010).

There is also not enough equipment for each child in a class to use a computer on their own, so children usually work in pairs or occasionally in small groups. Those teaching younger children did not consider this to be a problem because the teachers feel that children work better in pairs anyway. However, those teaching older children did consider it more of a problem as then children cannot always research what interests them (as opposed to their partner).

> "I prefer them to work in pairs I think. I do actually. They don't stay in the same pairs all year. I think paired work is quite good. Monitoring each other of what you are doing. And who is reading it together. Particularly for children struggling with reading, it really supports them. So no, I don't think I would want them to have their own. I like the idea of one recording. Of one acting as a scribe if you are making notes. You are not just reliant on that technology as well." (Y3 Teacher)

> "You've got to both do the same area. Say if you are doing South America you've both got to do the same country because they're sharing a computer. … they might disagree so you say you've got to compromise, you want that one, you want that one. Go for a different one. So, if you can't agree …" (Y5 Teacher)

The Internet is also used in response to shortcomings of other resources. Getting hold of a range of books that can fulfil all the information requirements of the class and getting enough copies for the whole class to use, is a problem for teachers. Some classroom resources are also outdated and provide inadequate support. As a result, the Internet is used in preference.

> "I think it is really useful. Going back 10, 15 years it was harder to do because you would have to have encyclopaedias and it was a little bit drier. And sometimes you just didn't have the books. If you were doing about the Maya civilisation you would have to go to the school library the half term before; "have you got any books on the Maya civilisation". And they say well we've got two here. And then you are there in your room with two books. And you can't really do that same research. The finding out. Because you've got two books that the whole class has got to use. So it does enable everybody to have a go at finding information. Rather than be very resource led." (Y6 Teacher)

> "Our dictionaries are rubbish for very young children. They are useful for teaching children how to learn dictionary skills but they rarely have words in them that the kids don't already know." (Y2 Teacher)

5.3.2   RESULTS PART 2: Elements of search tasks

Altogether the teachers described 105 search tasks. Generally, more search tasks were described in the older year groups (F – 14, Y1 – 9, Y2 – 10, Y3 – 16, Y4 – 13, Y5 – 22, Y6 – 20). One search task is not considered particular to a year group. This search was done by the Computing Lead / Deputy Head for pictures of two Olympic swimmers to show to the school during assembly.

Table 11: Elements of search tasks using the phase 2 representation scheme

Elements		No. tasks	Example search task
What is the nature of the motivating work task?			
Routine		3	Find "x" country on a map. (Foundation)
Typical		99	Research a rainforest animal. (Y4)
Unusual		3	Where to buy "x". (Y5)
From whom does the search task originate?			
Teacher		67	Research Ancient Greece. (Y5)
Child		23	What is merguez? (Y3)
Class		9	What does the word coast mean? (Foundation)
Teacher with class		6	Questions about coasts e.g. Why do some coasts erode quicker than others? (Y6)
If the search task originates from a teacher, how flexible is it?			
Own topic and no framework		0	-
Own topic and framework		1	Search on any topic to write an explanation. (Y6)
Own area of interest and no framework		16	Research the habitat of a creature. (Y4)
Own area of interest and framework		12	Find out about different types of weather. (Y3)
Topic specified and any true		3	Facts about Africa. (Y1)
Topic specified and framework		2	Differences between climate and weather. (Y4)
Choice of specific question		5	Choice of questions about penguins and polar Bears: how people live there [Polar Regions]; what do people eat when they are there; what do people wear; do children go to school there; do they have school there; do people learn to read in the Arctic? (Y2)
Semi-specific information		4	Any food and any drink prices in Tesco or Asda website. (Y6)
Specific information		11	Meaning of words in the *Highwayman* poem (words selected by teacher). (Y5)
Who does the search task?			
Doer	Teacher	31	How "greeting" is said in language "x". (Foundation)
	Child – individually	10	Spelling of a word. (Y2, Y6)
	Children – pairs	29	Incomplete metamorphosis. (Y5)
	Children – small groups	9	Facts about Africa. (Y1)
	Nominally child	24	Lifecycle of an amphibian. (Y5)
	Teacher or child	2	What is the longest python in Australia? (Y5)
Optionality	Compulsory	46	Find information about any nocturnal animal. (Y2)
	Compulsory – some	1	Additional information about a particular nocturnal animal. (Y2)
	Optional	14	Maths theory or code. (Y5)

Elements		No. tasks	Example search task
	Elective	14	Spelling of a word. (Y6)
Does the search task occur as part of a planned search activity?			
Planning	Planned	78	Research a minibeast. (Y4)
	Unplanned	27	Answers to children's questions. (Y3)
What is the location of the search activity?			
Location	Class	73	Look up journeys in *Kensuke's Kingdom*. (Y5)
	Outside of class	30	Prepare for school trip. (Y6)
	Both class and outside of class	1	What is the longest python in Australia? (Y5)
	Either class or outside of class	1	Answers to children's questions. (Y3)
What subject area is the search task for?			
National curriculum subject area	Art	3	"Find images of either a land creature, sea creature or flying creature. And find some different images to practice drawing it." (Y3)
	Computing	10	Any food and drink prices in Tesco or Asda websites. (Y6)
	Geography	15	Differences between climate and weather. (Y3)
	History	6	Mayan civlization. (Y6)
	Literacy	25	Find information on any nocturnal animal. (Y2)
	Maths	3	Maths theory or code. (Y4)
	Modern Foreign Languages	3	How to pronounce words in French. (Y3)
	Science	9	Video of plant lifecycle. (Foundation)
	Dance & Music	0	-
	Design & Technology	0	-
	Physical Education	0	-
Topic		18	Seaside topic: What is a rock pool and what does the word coast mean? (Foundation)
Event		6	Picture of Rebecca Turner. (Y6)
Generic		7	Something they ask you at the end of the day. (Y5)
How is the information used?			
Directly to increase knowledge of a subject area		40	Research Ancient Egypt. (Y4)
Indirectly to support learning of a subject area		24	Search on any topic to write an explanation. (Y6)
What is information used for?			
To orient		20	Research Ancient Egypt. (Y4)
To extend		22	Find out about transport in Victorian Sheffield. (Y3)
To make sense		11	How are whales like other mammals. (Y2)

Elements		No. tasks	Example search task
To illustrate		16	For evidence that not everybody in Africa lives in a village. (Y1)
To decorate		3	Picture to decorate a science fiction story. (Y6)
To verify		2	Verification that Wolf Spiders are from all over the world, not just England. That some are deadly and poisonous. But not ones found in England. (Y2)
To navigate		5	Refind Scientist page. (Y5)
To define		12	What is merguez. (Y3)
To get instruction		2	How to make lemonade. (Y5)
As precise data		10	Cost of a meal at a local restaurant. (Y6)
What stage in the uniting topic is the search task?			
Any		26	Something they ask you at the end of the day. (Y5)
Start		17	Where is South America in the world? (Y5)
Mid		18	Find in-depth information about a particular animal. (Foundation)
End		4	Picture to decorate biography. (Y6)
Other than people what resources are used?			
Any other resource		15	Information on African animals. (Y1)
A general resource	Library	2	An image of a real animal. (F)
	The Internet	72	Weather in different countries. (Y3)
A specific resource	A book	1	Find answer to a single question for a fiction book. (F)
	Apps	2	Browse Simple City to find more information for class topic. (F)
	A particular website / search service	13	Find Amazon Rainforest on a map. (Y4)
What are the outputs?			
Articulation		15	What can you find out about the Mayan civilization. (Y6)
Construction		9	Research the habitat of a creature. (Y4)
Formal writing		25	Facts about Africa. (Y1)
Illustration		4	An image of a real animal. (Foundation)
Notes		6	Research a Rainforest animal. (Y4)
Spreadsheet		3	Cost of attractions in Sheffield. (Y6)
Vocalisation		2	"Greeting" in language "x". (Foundation)
What is the search goal?			
General topical		44	Research a country in South America. (Y4)
Specific item		59	How to pronounce words in French. (Y3)
Not identifiable		2	Shall we quickly Google that. (Y5)

5.3.2.1   What is the nature of the motivating work task?

Most of the search tasks were for motivating tasks that are categorised here as typical. Children are taught in units and topics. These tend to follow a similar pattern and although each unit/topic is different, how they are taught will be familiar. For example, children may learn different time periods and cultures in History (Mayan civilisation, Ancient Egypt) but the requirements will be similar. Three search tasks are categorised here as occurring in motivating tasks that are unusual. All three of these search tasks occurred in an Enterprise task where children raise money for charity. This task only occurred in two year groups (Y1 & Y5)

and what children do is different from usual school work. Three search tasks are categorised as occurring in a routine motivating task, Registration. This is a regular activity that takes place twice a day. The Registration search tasks are also routine. Two to three times a week, the class search for the same information but for different languages and countries.

5.3.2.2   From whom does the search task originate?

Search tasks could originate from the teacher, children, the class and teacher with the class. Mostly search tasks originated from teachers. Teachers generate search tasks for children and for themselves. Search tasks that teachers generate for themselves may be conducted in front of the class or outside of the class in preparation for a lesson.

Search tasks also originated from children. This happened in four ways. Firstly, there are dictionary type searches to find out the spelling, meaning, synonym or translation of a word. Secondly, children ask questions in class that are then answered by searching the Internet. Thirdly, in some circumstances children decide on the search tasks. For example, in Y5 children raise money for charity; they decide how to do this and this may lead to a search activity. Finally, search tasks given to the class may evolve into search tasks that have been defined by the children. For example, the Y4 teacher described how she instructed the class to find information about animals in the rainforest but after two children came across Latin names, the rest of the class began searching for Latin names of rainforest animals too.

Search tasks also originate in collaboration from class discussion. If a teacher has planned a search activity they may get the class to work together to generate the search tasks. So although the work task and the search activity originate from the teacher, the actual search tasks originate from the children.

Search activities can also be generated unplanned through class discussion with no particular person considered to have ownership of the search task. For example, the Foundation teacher described how a discussion about rock pools led to the class realising that they need to understand what the word coast means.

5.3.2.3   If the search task originates from a teacher, how flexible is it?

When teachers generate search tasks for children, these tasks are designed with varying degrees of flexibility. The way teachers make these tasks flexible depends on whether the search goal is general topical or specific item.

For most general topical searches, children have some choice over what to research. However, this choice might be constrained by a framework of information requirements. For only two search tasks was the topic fully defined. However, there were no examples of own topic with no framework, and so to some extent all the activities are directed.

The specific item searches could be made flexible by giving children a choice of which questions to answer and by making the searches semi-specific. For example, in Y6 when learning about spreadsheets the children collect their own data on the cost of Sheffield attractions. They must find price data for Sheffield attractions but it is up to each pair to decide which attractions. Some search tasks were inflexible when the teachers wanted the children to find specific information such as the meaning of words.

5.3.2.4   Who does the search task?

Both teachers and children are the doers of search tasks. Search tasks assigned by teachers need not be done by all children, and some children also elect to do certain search tasks.

Most search tasks were conducted by children in the classroom, where they usually worked in mixed ability pairs. Children could also search in small groups or on their own using the interactive whiteboard located at the front of the class. Search tasks were also given to children to complete at home. Whether the children or their carers or friends conducted the searches is not known.

Just over half of the search tasks that teachers described the children as doing, must be done by all children. One search task only needed to be completed by some children. In this instance, when preparing for the national tests, the Y2 teacher gave an additional task to children that needed extra information. Some search tasks were elective in that individual children requested information (for example, how to spell a word) from a teacher and having requested the information must find the answer. Other search tasks given to the entire class were optional, particularly those that stemmed from children's impromptu questions. These search activities could be conducted by either the teacher in class or the child at home. If the children complete the search they may the next day share the information with the class but there is no obligation for them to do so. Also at the start of a topic, the teachers may suggest that children do some research at home but again there is no requirement for the children to do this. The Y6 teacher also described suggesting to the children that they could decorate their writing with pictures from the Internet.

5.3.2.5   What is the situation of the search activity?

Search activities could be planned or unplanned, and activities could be conducted in class, outside of class or a combination of the two.

When teachers had planned search activities, the search tasks were mostly conducted by children. If the planned activity was conducted in class, the search goals could be general or specific. When the searches were given as homework the search goals were often general. The teachers explained that this is because children have more time to search at home. For unplanned search activities, the search tasks usually had specific goals and were often in response to children's questions. These searches could be conducted in the classroom if there was time or it might be suggested that children do these searches at home. One search that the Y5 teacher described was conducted both in school and at home.

Table 12: Planning and location of search tasks

Doer / Location	Search goal	No.	Example search task
Planned			
Teacher / in class	General	6	Investigate charities. (Y1)
	Specific	8	Look up journeys in *Kensuke's Kingdom*. (Y5)
Teacher / outside of class	General	2	For evidence not everybody in Africa lives in a village. (Y1)
	Specific	5	Search for images to use in phonics. (Foundation)
Children / in class	General	21	Information about volcanoes. (Computing Lead)
	Specific	18	Locate points on a map to measure distance between. (Y5)
Children / outside class	General	14	Search on any topic to write an explanation. (Y6)
	Specific	4	Picture to decorate biography. (Y6)
Unplanned			
Teacher / in class	General	1	Find out about fire engines. (Y2)
	Specific	8	How are whales like other mammals? What do they share? Do they feed their babies milk? (Y2)
	Not identifiable	1	Shall we quickly Google that. (Y5)
Children / in class	General	0	
	Specific	9	Spelling of a word. (Y2)
Children / outside of class	General	1	Prepare for school trip. (Y6)
	Specific	5	Do apes have better eyesight than humans. (Y4)
Teacher / in class & Children / outside of class	Specific	2	Answers to children's questions. (Y3)

5.3.2.6 What content is searched for?

Teachers reported search tasks across a range of subject areas, particularly Literacy, Geography, History, Computing and Science. Perhaps not surprisingly search tasks were not reported for Dance and Music, Design and Technology, and Physical Education. The subject area could not be identified for all search tasks, and this was for three reasons. Firstly, some search tasks were generic and not particular to a subject area. Secondly, sometimes the teachers only specified what topic the search task was for, and the same topic could cover more than one subject area. Thirdly, some searches were for events.

5.3.2.7 How is the information used?

Information is used in two different ways. Firstly, it could be used directly to increase knowledge of a subject area, or secondly it could be used indirectly to support learning of a subject area.

Directly to increase knowledge of a subject area

For some search tasks children are searching for information that relates directly to subject areas. For example, in Science they search for images of lifecycles (Y5); in History for information on Ancient Egypt (Y4); and in Geography information about coasts (Y6).

Indirectly to support learning of a subject area

For other search tasks, the children find information that can be used in lessons but the information is not directly related to the subject area. For example, in Y2 the children are learning about non-chronological reports (a non-fiction report that is not ordered by time) in their literacy lesson. Through writing about nocturnal animals the children learn about literacy (non-chronological reports) but the information searched for (nocturnal animals) is not about literacy. Similarly, in Y6 when the children are learning how to write a biography, they search for information about a particular person. The children are taught what information should be included in a biography, but who the subject of the biography is has no bearing on the underlying lesson, and the children are given free rein on who to choose.

> "Literacy has to have some kind of content. … And that is what I rely on the Internet to do, it is to provide me a lot of the time with the content of what we are doing." (Y2 Teacher)

> "[You know] what you need to include in a biography to be good. And from that you say it is over to you. You can choose who you want to do. David Beckham or Venus Williams or whoever it is, whoever they are interested in. It could be sporting, it could be actors. Whatever they are interested in" (Y6 Teacher)

Some search tasks fulfil both ways of using information as a search activity can provide information for more than one subject area at the same time. For example, in Computing children use the Internet to find content to use when learning technical skills. When this happens the Computing Lead usually selects what information to search for based on what the children are learning about with their usual class teacher. So, in Y5 when the children are learning to design PowerPoint presentations in their Computing lesson they search for text and images about Ancient Greece, a topic they are learning about in their History class. Again, learning about Ancient Greece is incidental to learning about PowerPoint. However, what the children learn about Ancient Greece in their Computing lesson could be used in their History lesson, and vice versa.

> "With the year 5s in the Autumn term we were researching the Ancient Greeks on the Internet and getting the information that was then feeding into the children's PowerPoint. But I know the staff [Y5 teachers] are also doing that so there were some projects around Troy. And I know the children also went off and did that around home as well." (Computing Lead)

5.3.2.8   What is the information used for?

The teachers described 10 ways in which information is used. Namely, information is used

- To orient
- To extend
- To make sense
- To illustrate
- To decorate
- To verify
- To navigate
- To define
- To get instruction
- As precise data

For two search tasks there was no clear use of the information. A description of each of the different information uses is given next.

To orient

The information is used to orient to a topic by seeking a broad and general understanding. These searches usually occur at the start of a topic. There are two different ways the search tasks originate. The teacher either decides what information the class should look for or discusses with the class what information should be looked for. This can result in a search for particular information. So although teachers describe this as an open exploration of the topic, the search tasks could be very specific.

> "It will often be at the beginning of the topic where we are finding out broadly about our theme: Rainforests, Minibeasts whatever it is." (Y2 Teacher)

> "Often at the beginning of, generally in History and Geography, at the beginning of the unit. ... Sometimes the first lesson can be getting the laptops out and say for example we are doing the Maya civilization or investigating coasts or something, that first lesson might be right just go on the Internet very informally and see what you can come up with." (Y6 Teacher)

To extend

The information is used to find out about a particular aspect of a topic. The search activity materialises in two different ways depending on how the search originates. In version 1, the search activity is planned and the teacher decides what to look for. Children do this search. In version 2, the information requirements emerge from the class, and the teacher allows the lesson to evolve in the direction of children's interests. The teacher does these searches.

> "We did a history booklet and each week they did a different topic and each week before they had to go home and research it. So it might have been transport in Victorian Sheffield and they had to go home and research it." (Y3 Teacher)

> "We did fire as our topic in spring. It was the first time for a while that I had taught the great fire of London … I also learnt a lot about fire engines and how they work because we decided let's find out about fire engines." (Y2 Teacher).

To make sense

These searches are a result of children trying to make sense of information given to them, and the need for more information to do this. They have been called sense-making searches because they correspond to Dervin's (1983, 2003) model, whereby in order to make sense of a situation people need information to bridge a gap in their understanding. It is the discontinuity experienced by the child that leads to the information need. The search tasks originate from children and result from children's questions during class discussions. The search activity is not planned as the information requirements emerge spontaneously. If there is time the teacher may do the search immediately, otherwise children are given the option to do the search at home and bring the information back to school.

> "[child's name] today asked me a question. We'd been looking at similarities and differences in species and when we were looking at apes we watched a clip which was brilliant about how fast an ape could react to remembering the order of numbers on a screen and could beat a human. And she asked the question "well does he have better eyesight than humans have?" I've no idea. Go away and find out. (Laughing) I've no idea at all but it would make sense." (Y4 Teacher)

> "But generally that throws up things, we might be talking about something … say we were doing Light, and then a kid asked me how fast does light travel or something. I might go "Oh I know that it takes 7 minutes or whatever for the light from the sun to reach the earth" but I don't know. So you find out tonight and let me know tomorrow." (Y6 Teacher)

To illustrate

The information is used to explain or represent an object or concept. The information can be a text or a picture.

> "We are making an African village but I don't want them to just think that everybody in Africa lives in a village so I want to give them the experience of seeing that there are people in Africa who live in, that most people in Africa live in, cities. Or that there are wealthy people. Or that people live in big houses just like we live in here." (Y1 Teacher)

To decorate

Information is used to enhance the presentation of an information object.

> "They would write the science fiction story but we've said you are welcome to put pictures on, you know of aliens or space ships so they might want to search for pictures." (Y6 Teacher)

To verify

The information is used to confirm other information. The need to verify information occur for two reasons. Firstly, when children share information with a class and the teacher is uncertain of the veracity of the information or requires more detail this can lead to a search task. The second reason is when the teacher is unsure of their own knowledge they may want to search for confirmatory information.

"So one boy in my class this year when we were doing mini-beasts said that some spiders could be vegetarian. And then I said 'I'm not sure that they can be because you know a vegetable wouldn't wander into their web' and 'how would they catch a vegetable like that' and they said 'no, they can be vegetarian as well' so we did look up 'are there vegetarian spiders'". (Y2 Teacher)

"We were looking at present perfect in SPAG [spelling, punctuation and grammar] … I looked at that [website] to check if I was secure in it". (Y3 Teacher)

To navigate

This information is used to re-find information objects or to find information objects as directed by someone else. The first version occurs when the teacher wants to re-find information they have used before. The second version occurs when teachers share information with a class and a particular website needs to be re-found. To navigate could be the entire search activity or part of a search activity.

"Well originally I wanted to have a poem about some animals. And I just happened to find this poem about an animal but it is a very big website with lots and lots of different things coming into it. It is absolutely fantastic because it is all poets reading their own poem so it is really exciting. So I would have shared my excitement with the children about that." (Y1 Teacher)

"We were looking at present perfect in SPAG. And I said you know what when I was looking last week I found a really good website so I typed in present perfect and I found the one I remembered I looked at and we had a look at it and we explained about the different tenses. So some of the things I'll find them and I'll save them and I'll use them. Some of the things when they are not getting something I think when I looked at that to check if I was secure in it I'll just show it to them so that they can use it." (Y3 Teacher)

To get instruction

Information is used to find out how to make and do things. The West Sheffield Y3 teacher described searching for making activities as a common search activity for teachers during lesson preparation time. Surprisingly using the Internet to find out how to do something during class was only described once, and this was during an unusual lesson that lies outside the curriculum. Here the Y5 class were raising money for charity, and a small group of children searched for how to make lemonade. However, given that construction was an output of many search activities conducted at home it seems likely that children do this task (or their carers) more often than recounted by teachers.

"Some of ours are making lemonade. And 'it's got to be un-waxed lemons' … they're kind of working things out for themselves" (Y5 Teacher)

To define

The information is used to find out the meaning, spelling, synonym and translation of words. The Internet is used because it provides quick and instant access to the information, and the

dictionaries in the classrooms do not contain all the terms that are needed. Furthermore, computers provide audio of how to pronounce words.

A search activity may be planned particularly for some subject areas like Modern Foreign Languages and Literacy if the teacher knows a text is likely to contain difficult words. The search may also occur unplanned if children come across words they do not understand or know how to spell when reading and writing.

> "I use it [the Internet] all the time, all the time. Especially in French (laughs) when I can't remember what a word is. And I want to pronounce properly." (Y3 Teacher)

> "So the way you and I use a dictionary to look up a word that we've never heard of before, or to check the spelling of a word they are not very good." (Y2 Teacher)

As precise data

The information is used as precise data. Precise data is specific unambiguous units of information, for example price or location data. The term precise data is used to distinguish it from fact finding because researchers commonly use the term fact finding to describe how children search for information and the way they treat information (Gärdén et al., 2014) rather than what it is used for.

> "We are doing about using Excel spreadsheets and they had to create their own for attractions around Sheffield. So again they were using the search to find attractions around Sheffield. So the costs of going to the cinema, or the Odeon or the Crucible" (Computing Lead)

> "We use Google Maps. We used them loads when we were looking at Ancient Egypt. Because we could look at the Sphynx. Because you know when you actually look at the, and looking at the local area, if we are not going out there you can still look at it on Google Maps." (Y4 Teacher)

No clear use

For two search tasks there is no clear use of the information. In these cases, the searches are conducted so as to gain an understanding of concepts through the act of searching. The search tasks originate from the teacher.

> "And this week we are looking at using a data file? How do we use that? So we went on RightMove. And I showed them how it worked." (Y4 Teacher)

> "We do measurement as well. They've not got a real concept but then you can do it with maps [Google Street View]. OK from here to [name of secondary school]. … It becomes more real for them, distances." (Y5 Teacher)

5.3.2.9   What stage in the uniting topic is the search task?

From the interviews it is only possible to ascertain when in a unit/topic/event the search task occurred for 64 out of the 105 search tasks. Of these, 26 search tasks were not specific to a particular stage. This was particularly the case for dictionary searches and searches that resulted from children's questions.

Search tasks occurred at the start, middle and end of uniting topic. Search tasks given as homework and searches that occurred because lessons evolved tended to occur mid uniting topic. Some search tasks could only take place once a certain amount of knowledge had been acquired so these occurred either mid or end of the uniting topic. Searches for decorative materials occurred at the end.

5.3.2.10   Other than people, what resources are used?

The Internet was used as a resource for most of the search tasks. However, it was not the only resource used. In each year group the teachers stressed that the Internet was not the only means to find information. When children are learning a topic in class the teachers will also have ordered in books about the topic from the school library service. Teachers also provide links to good websites or other resources like Pearson (uk.pearson.com). Particularly when it comes to homework which systems should be used to find information is very open and unconstrained. Children can use any data resource whether it be books, Internet or other people.

For some search tasks specific resources are specified. For example, the resource could be restricted to a particular websites / search service (Rightmove, Google Earth, Street View) or with an App (Simple City – 2simple.com/simple-city-0).

5.3.2.11   What are the outputs?

Some search tasks are used to produce or to contribute to more than one output. Note taking and articulating what information was found were usually stated in conjunction with another output such as formal writing. Perhaps not surprisingly formal writing was the most common output but the range of formal writing products was vast and included leaflets, brochures, posters, postcards, decorated texts, booklets, fact sheets / fact files, and glossaries. For some tasks, particularly homework, children could choose between outputs, and the teachers reported a range of ways children presented their research beyond written documents (for example, videos, sugar cube pyramids, fabric necklaces, cakes in the shape of Tutankhamen, Plaster of Paris heads of Medusa and so on).

5.3.2.12   What is the search goal?

Of the search tasks described, teachers originated slightly more general topical (where the goal is to find information on that topic but no particular information is looked for) than specific item searches (where the goal is to find particular information), whereas children originated considerably more specific item than general topical searches. Teachers also describe doing specific item search tasks whereas children do more general topical. However, children are described doing more specific item searches as individuals.

Table 13: Search goal based on originator / doer

Elements	General topical	Specific item
From whom does the search task originate?		
Teacher	37	30
Child	2	21
Class	3	4
Teacher with class	2	4
Who does the search task?		
Teacher	2	22
Child – individually	2	7
Children – pairs	16	13
Children – small groups	3	6
Nominally child	15	9
Teacher or child	2	-

5.3.2.13   Elements associated with year group

More search tasks were described by teachers in the older year groups. Search tasks mostly originate from teachers but teachers of older year groups describe more search tasks that originate from children. However, in the younger year groups teachers describe working with the children to originate search tasks. It is particularly the Foundation teacher who describes doing search tasks and it is in the older year groups that children are given search tasks to do at home. It is also mostly in Foundation where specific resources are used whereas in the older year groups children have more choice over what resource they can use. How information is used and what it is used for does not appear to vary across the different year groups.

Table 14: Occurrence of elements across year groups

Elements		F	Y1	Y2	Y3	Y4	Y5	Y6
Total number of search tasks described								
		14	9	10	16	13	22	20
From whom does the search task originate?								
Teacher		6	7	5	13	8	15	12
Child		2		2	3	5	4	7
Class		3	1	2			3	
Teacher with class		3	1	1				1
Who does the search task?								
Teacher		10	2		2			1
Child – individually		1		3			1	5
Children – pairs			1	2	6	6	11	3
Children – small groups		3	2	1			3	
Nominally child			1	1	3	6	3	10
Teacher or child					1		1	
How is the information used?								
Direct to increase knowledge of a subject area		4	2	2	12	5	8	7
Indirect to support learning of a subject area		1	2	4	1	3	7	6
What is information used for?								
To orient		2	3	3	1	5	2	4
To extend		3	4	3	4	3	3	2
To make sense		2		2	1	2	4	1
To learn by doing					1		1	
To illustrate		2	1		3		5	4
To decorate		1						2
To verify		1			1			
To navigate		1	1		1		1	1
To define		1		2	2		2	5
To get instruction					1		1	
As precise data		1			1	3	4	1
Other than people what resources are used?								
Any other resource			3	1	1	4	3	3
A general resource	Library	2						
	The Internet	4	5	9	13	7	17	17
A specific resource	A book	1						
	An app	2						
	A particular website / search service	5	1		2	2	2	
What is the search goal?								
General topical		4	8	5	8	7	5	7
Specific item		10	1	5	8	6	5	3

5.4   Summary

In phase 1, what is shaping primary school children's search activities (RQ1) and descriptions of real-life search tasks (RQ2) were determined from interviews with teachers. It was found that search activities are influenced by primary schools being a learning environment that is guided by an externally imposed curriculum (theme 1), where teaching is guided by best practice

(theme 2), where people have different skills (theme 3), where children must be kept safe (theme 4), and where time and resource are limited (theme 5). This influence meant that search task representation schemes from the more general literature needed to be adjusted to describe search tasks in primary schools.

However, whether these findings would apply to other schools and whether the adjusted search task representation scheme could be used to describe search tasks as they occur in the primary school classroom is uncertain.

6 PHASE 2: VALIDATION OF SEARCH ACTIVITIES AND TASKS IN PRIMARY SCHOOL

6.1 Introduction

In phase 1, answers to the research questions, what is shaping primary school children's search activities (RQ1) and what are primary school children's real-life search tasks (RQ2) were determined based on interviews with 10 teachers. As the interview participants represented each of the primary school year groups as well as those who specialised in computing, a good understanding of search across the entire school was gained. However, whether what is identified as shaping children's search activities is common to other schools is not clear. Equally unclear is whether the representation scheme developed in phase 1 can be used to describe search tasks as they occur in the primary classroom. To validate phase 1 findings, observation data was used to triangulate the methods, and as well as observing lessons in the same school, a lesson in a second school was also observed.

In this next phase, observations of classroom search activities are compared with the interview descriptions. Using data collected from three lessons (two in the same school as the interview study and one in another school in East Sheffield) the findings of phase 1 are now verified and extended.

6.2 Method

This phase re-uses data collected in previous research projects. Described next is who the participants were and how they were recruited in the original studies. Then how the research instruments were employed and how data was analysed in this study is described, including the difficulties of data re-use.

6.2.1 Participants and recruitment

As this phase re-uses data collected in previous research projects, the participants were not recruited for this study. However, when considering the validity of a study participant recruitment is important, and so how participants were recruited in the original studies is described next.

At the West Sheffield school, the headmaster and the Computing[9] teacher were approached informally in person. The Computing teacher suggested doing the research in the Y4 (age 8-9) class, and so these class teachers were approached informally too. A letter explaining the research was then sent to all, after which formal approval was sought and given. Both the Y4 teachers explained the research to their classes. In each class, the class teacher suggested that those who wanted to participate should put their names in a hat. Then six children's names were drawn from each hat. These children were sent home with a letter asking their parents for consent for their child to participate in the research. All parents agreed. On the day of the

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[9] When this study was conducted in 2012 the term used to describe the subject area in the national curriculum was ICT. This changed to Computing in 2014. For consistency with the phase 1 study conducted in 2015 the term Computing is used here.

research, it was again explained to the children that participating in the research is entirely voluntary, and they could withdraw at any time.

At the East Sheffield school, the deputy head was initially approached informally in person. This was followed up by a letter explaining the research after which formal approval was sought and given. The deputy head of the school then arranged with a Year 6 teacher for the research to take place in that classroom. A letter detailing the research was sent home with all the class children (aged 10-11), and parents were asked if they wished to withdraw their child from the research. The children were further briefed about the research on the day of data collection. It was explained to the children that participating in the research was entirely voluntary, and they could withdraw at any time. No child, or parent/carer representative of a child, declined to take part in the research. On the day of the observation, Morae screen recording software was installed on 8 of the school computers. These computers were put on a separate table from the others, and the teacher told the class that if they were happy to have their searches recorded they should pick one of these computers. More children wanted to take part than there were computers available.

6.2.2   Research instruments

For both the West and East Sheffield observations the research instruments had been designed for other projects. Re-using previously collected data means that the data collection could not have been influenced by phase 1. However, there is a time gap between the observations and the interview study, and perhaps more importantly the research instruments had not been designed for the purpose of the study.

Next is an overview of the research instruments employed in each of the original studies, and how these instruments have then been used in this study.

Overview of research instruments in original studies

Data was collected from West Sheffield school, on Tuesday 26th June 2012, during two Computing lessons that ran consecutively. For each lesson, approximately 30 children, aged 8-9, worked in pairs at a computer while completing a search activity. The lessons were audio-recorded and 6 pairs' searches were screen recorded using Camtasia screen recording software. Children made notes of their searches in MS Word and a copy of these documents was also taken. The children and Computing teacher were interviewed a few days later.

Data was collected from the East Sheffield school on Thursday 12th June 2014. In the lesson 25 pupils, aged 10-11, had a computer each while completing a search activity. The lessons were audio-recorded and 8 children's searches were recorded using Morae screen recording software. Children made notes of their searches on a portable whiteboard and a photograph of all 25 whiteboards were taken. A record was also taken of the browser log history of all 25 children's searches.

Table 15: Original observation study research instruments

Research instruments	West Sheffield	East Sheffield
Audio recording of teacher start and end of lesson	Yes	Yes
Screen and audio recording of children's search activities	Yes	Yes
Interviews: teacher and children	Yes	No
Browser history log	No	Yes
Photographs / copies of children's work	Yes	Yes
Photographs of classroom	No	Yes

Selection of research instruments for this study

A consequence of re-using observation data is that different data had been collected for each of the schools (see Table 15), and so what sources could be used varied (see Table 16). For some analysis, the difference in sources is cosmetic. For example, the wording of the search task was taken from the audio recording of the lesson in West Sheffield and a photographic image in East Sheffield. Both sources were apt and neither source was preferable to the other. However, for each school some analysis was restricted by the data collected. For example, there is no interview data for East Sheffield and no browser log data for West Sheffield. Where these data sources had been employed, the data was valuable. Rather than restrict the analysis to data sources used in both schools, it was decided that it would be preferable to analyse each school with all the data sources available.

A further consequence of re-using data is that none of the research instruments had been designed for the purpose of this study. This was particularly apparent in the interviews. For example, the children in West Sheffield spoke eloquently on their search experiences but unfortunately the questions asked were not relevant to this study.

Table 16: Observation study source selection

Data source	What was looked for	What it was used for
Screen & audio recording of searches	Children's search processes (queries entered and examination of results), the conversations they had and the information they extracted	Identification of elements
		Vignettes
Audio recording of lesson	The teachers' instruction and debriefing	Overview of lesson
		Identification of elements
	Wording of the search tasks (West Sheffield)	Identification of search tasks
Artefacts: Photographic image (East Sheffield)	Wording of the search tasks	Identification of search tasks
Artefacts: Portable white boards (East Sheffield), Word documents (West Sheffield)	Supporting evidence of the information children had extracted.	Vignettes
Browser log (East Sheffield)	Search queries	Vignettes
Teacher interview (West Sheffield)	Explanation of classroom observations	Identification of elements

6.2.3　Data analysis

The data was analysed two ways. Described next is how the data was prepared, and then an overview of the different processes, followed by a detailed description of each process.

6.2.3.1　Data preparation

The data had already been prepared for analysis in the previous research projects, and there was no need to do any new preparation. How the data had originally been prepared is described next.

Anonymising the data

In the previous studies, the data was anonymised shortly after data collection to ensure participant confidentiality. Different naming schemes were employed in each study. As this helps to differentiate the children according to the school, the naming schemes are kept for this study. How the data was anonymised in the original studies is described next.

In the West Sheffield school, the children worked in pairs. Each pair of children were assigned a letter between A and F, and each child in the pair assigned the number 1 or 2. So for example, Pair A is Child A1 and Child A2.

In the East Sheffield school, the children worked independently and sat at three tables with eight children on each. The children were numbered according to where they sat in the classroom. This was done by allocating both a table number (T1-3) and a child number (C1-25). The child number was allocated by starting with the child nearest the door and assigning numbers clockwise around the table, and then moving on to the next table, and so on. So for example, C1T1 sat near the classroom entrance on the first table.

Transcription of screen recordings

The screen recordings of both studies had already been transcribed into an MS Word document. They had been transcribed in such a way to make it easy to identify what children are doing at the different stages of the search process (query reformulation, examination of the results pages and websites visited) and who is saying what to whom. Slightly different transcription techniques had been employed in the two studies.

In the West Sheffield transcriptions, the actions were illustrated with screenshots and the conversations the pair have with each other and the teacher were documented. As well as this, both the conversations and actions were annotated with explanatory notes. In the East Sheffield transcriptions, the actions were described and carefully formatted. Each new query, search result and website visitation was organised as a separate paragraph. Block capitals were used to denote actions. As best as possible the conversations were attributed. However, it was only possible to identify the children who were participating in the research and the teacher. The other conversations were attributed to "child 0". Again, both the conversations and actions were annotated with explanatory notes.

West Sheffield

B1: shall we go on Wikipedia?

B2: yup.

B1: Wikipedia, Wikipedia [said in a way that suggests she is sounding out the word]

East Sheffield

SEARCH RESULTS: Selects 1st search result. CHILD 0: "why red polka dot. Why not grey"

WEBSITE: Tour de France 101 - CS Monitor. Scrolls website. CHILD 0: "white for 5th, polka dot for 4th, green for 2nd". CHILD 0: "I know what white means. Do you know what white means?" CHILD C23T3: "fastest overall rider" [reading off screen]. CHILD 0: "what?". CHILD C23T3: "fastest overall rider" CHILD O: "Yeah, it is". CHILD 0: "well, it was kind of what I said". Scrolls. CHILD C23T3: "is yellow first?". Pause. TEACHER TO CLASS: "go on then. What does the yellow jersey mean?"

Figure 9: Screenshots of West and East Sheffield transcription of screen recordings

Transcription of teacher instruction and teacher interview

In both previous studies the start and end of the lessons had been recorded. In West Sheffield the teacher was interviewed too. Each of these audio files was transcribed. Where possible the transcription was annotated with observation data. Only the teacher was specifically identifed in the transcript of the lesson. Children were identified generically as "a pupil". No names were recorded in the transcript.

Teacher: We need to think of three questions. Something we would like to find out about the skeleton and this could be like a little introduction to your topic as well. [pause] Come on, have a think about a question we could ask. Something that you don't know that would be quite interesting as a start for your topic. <child's name>

A pupil: what is the longest bone?

Teacher: ahh, 'What is the longest bone' [said slowly while writing on white board – 'what is the bone'].

Figure 10: Screenshot of transcription of teacher instruction

Transcription children's queries

In the West Sheffield observation, the children's queries were elucidated from watching the screen recordings and therefore could only be determined for the 6 pairs in the study. Browser history log data had been collected from all children in the East Sheffield study so this was used to determine all of the class' queries. For each browser history log there is a record of queries submitted and websites visited. Only the queries are documented in Appendix M, as which websites were visited is not analysed in this thesis. It should be noted that repeat queries may be repeated submissions but may also be the result of clicking the back button.

6.2.3.2   Overview of the two data analysis

The data was analysed in two ways. Firstly, the rich descriptions of the lesson and vignettes of children's search activities are compared with the RQ1 phase 1 findings. Secondly, using the

representation scheme developed in phase 1, all the elements were documented for each search task. Additional elements were also looked for.

Table 17: Overview of the different processes used to analyse observations

	The IUE	Search tasks
What is analysed	The search activity (RQ1)	Elements of search tasks (RQ2)
Approach	Descriptive / Comparative	Deductive / Inductive
Dataset	Audio recording of lesson. Screen & audio recording of searches. Supported by browser log, teacher interview, artefacts	Screen & audio recording of searches. Supported by browser log, teacher interviews, artefacts
Technique	Rich description of lesson and vignettes of searches compared to phase 2 thematic analysis	Use of analytic framework derived from phase 1. Additional elements looked for

6.2.3.3   DATA ANALYSIS 1: The search activity

The search activity data were analysed by comparing descriptions of the search activity (using the audio recordings of the lessons and the screen recordings of the children's actual searches) with the phase 1 findings.

Rich description of the lesson

Largely derived from the audio-recordings a rich description of the lessons is reported. In particular, the instruction and support the teacher gave, how the children were assigned the task, the time given to the search activity and the actual search tasks are described.

Vignettes of searches

For each of the screen recordings children's search activities are described in vignettes. For each child / pair of children their search activities were summarised, and the different elements of the search tasks recorded. Although the vignettes were primarily prepared to analyse the search activity for RQ1, they were also used to support the analysis of RQ2. For RQ2, the vignettes were used to aid the analysis of the search tasks both in terms of operationalising and identifying elements. The vignettes are reported in Appendix N.

Comparison with phase 1 findings

The findings of the thematic analysis of what is influencing search activities in phase 1 were then juxtaposed with the descriptions of the lessons and vignettes of the search activities. Whether the phase 1 findings were relevant to phase 2 was considered.

6.2.3.4   DATA ANALYSIS 2: Elements of the search task

The data were analysed using the representation scheme developed in Chapter 3 and phase 1. Additional elements were also looked for. The different steps taken to analyse the data are described next.

STEP 1: Identifying the search task to represent

In phase 1, search task was operationalised as the specification of an information requirement as stated by the teacher. The elements were documented for each specification of an

information requirement in the representation scheme. Whether the same operationalisation could be used in phase 2 needed consideration. Altogether for phase 2, three classes were observed (two in West Sheffield, one in East Sheffield). In each of the West Sheffield classes there were three search tasks. In East Sheffield two search tasks were assigned and some children also conducted searches unauthorised for their own personal interest. When applying the representation scheme to the West Sheffield observation the elements remained the same across both classes for each of the six search tasks. However, when considering the representation for the East Sheffield school a different picture emerged. Here the elements of the three search tasks vary. Although the representation scheme could be applied to each of the assigned search tasks, it was thought unnecessary to repeat the same analysis six times for the West Sheffield observations. Therefore, in the analysis reported here all of the six West Sheffield search tasks were grouped as one but the three East Sheffield search tasks were treated separately.

A further issue was that in the West Sheffield interviews, teachers described how a search task could develop within a single search activity. For each development, a new statement about what was looked for was given. Therefore, each development could be treated as a new search task. In the observations, only the original task statement was given. Each development of the search has not been verbalised in a task statement. To some extent this could be overcome by identifying the developments from the queries entered and the conversations children have with each other. However, apart from for two elements (search goal, information use), these search tasks all share the same elements. It was therefore decided that the developments should not be separately listed in the representation scheme but that further consideration should be given to search goal and information use.

As both information use and search goal changed as the search progressed these changes should be either documented or acknowledged. This was resolved for information use by listing all the different information uses associated with each search task. However, a different approach was needed for goal as how the assigned search task is interpreted may differ depending on the task doer. For example, with the World Cup & Spain search task, not all the children approached this task by searching for general information: C21T3, C24T3 and C26T3 discuss this task with each other and search for specific information such as "most expensive Spanish player" (see Appendix M). For this reason, it was decided that in the representation scheme the heading "what is the search goal" needs to change to "what is the overall search goal".

STEP 2: Coding elements in the representation scheme

Using the representation scheme codes developed in chapter 3 and phase 1, the different elements of the children's search tasks were coded. Many of the elements were confirmed and mostly codes could be applied as they were. However, adjustments to the coding scheme were necessary as some of the codes needed tweaking. Which elements were confirmed, and which parts of the representation scheme needed adaptation is described in detail in the Results (6.3.2.1) and is summarised in Table 20.

Techniques used to identify elements varied. Identifying some elements (such as origination) was straightforward and easily observable. Due to the research design, some elements could not be identified (such as stage in uniting topic for the non-school work search task). In part

this was because phase 2 re-uses observation data from previous study; had the observations been designed for this study interviews with children could have alleviated this problem. Some elements could be identified but required appreciable inspection. For example, to identify the different information uses as there were no task statements for the search tasks that were not directly assigned by the teacher in the observations, information use had to be carefully determined from the queries and the children's conversations. For example, when Pair F say to each other "let's check it in Bing" the subsequent queries "Bing" and "how long is the spine in an average adult" were considered to be to navigate and to verify information use respectively.

STEP 3: Coding for elements as yet unidentified

As well as coding the observations using the representation scheme, the data were also coded inductively for any elements that had not been identified in phase 1. This was done by considering what else in the activity might be affecting how search is enacted. This coding scheme is summarised in Table 18.

Table 18: Additional search task elements coding scheme, phase 2

	Elements	Definition
Task transmission	Written and verbal	The search task is spoken, and the task is written down for all to see.
	Verbal	The search task is spoken.
	Self-administered	The search task is in the head of the doer.
Time	Time in minutes	Time of each child/pairs search activity in minutes.
Type of grouping	Any pairing	Children may freely choose their partner.
	Segregated to ability	Children are separated according to school test results.

STEP 4: Reporting the data

Which elements were confirmed and where the findings were different from phase 1 are recounted in the Results.

6.3   Results

The results are presented in two parts. The results of the rich description of the lesson are in part 1 and the different elements of children's search tasks are in part 2.

6.3.1   RESULTS PART 1: The influence of the IUE on search activities

6.3.1.1   Descriptions of the lessons and search activities

The lessons and search activities at the two schools are described.

The West Sheffield lesson

Two Computing classes that ran consecutively were observed in West Sheffield. In each class there were approximately 30 children (aged 8-9) and the Computing teacher. At the start of the lesson all the children sat on the carpet at the front of the class and the Computing teacher explained how to use the Internet safely and reliably. The Computing teacher asked each class

what topic they were learning about that term and then for that topic asked them to think of three questions that they would like to know the answer to. The teacher was concerned that the questions suggested in the second class were ambiguous and edited the questions with the class. The questions were then displayed on the interactive whiteboard and could be seen throughout the lesson. Questions could be answered in any order and if the questions were completed additional information could be searched for. The children worked in pairs. They were free to choose their partner. The only restriction was that the children who had agreed to participate in this study should pair up together. Each pair selected a computer from a central bank and returned to the class desks. During the search activity, the Computing teacher moved around the class observing the children, offering help when needed. The Computing teacher also told the researcher that if any child asked for help, they should be told to swap to a different search engine. The children recorded their searches in a Word document. At the end of the class the children sat on the carpet at the front of the class while the teacher asked what they found out.

Altogether the children were given around twenty minutes to complete their search activity. Network connection problems meant that some children had considerably less time.

The search tasks in the West Sheffield school were

- Class 1 (Pairs A, B & C):
    - What is the longest bone?
    - What is the shortest bone?
    - What is bone made out of?
- Class 2 (Pairs D, E & F):
    - How long is the spine in an average human adult?
    - How many bones are in your foot?
    - How many bones does a fully grown male / female [sic]?

The teacher also told the classes that if they completed the three tasks they could search on another question of their own choosing based on the same topic. None of the children observed in this study did this.

The West Sheffield search activity

Each screen recording pair's search activity is reported in vignettes in Appendix N. The vignettes are briefly summarised here.

The pairs worked together to answer one to two questions. There was considerable variation in how the pairs experienced the search activity. Pairs A and C were unable to find relevant information so made up the answer (Pair A) / made up a question to fit what they have found (Pair C), Pair B after much perseverance found the answers to two search tasks in quick succession, Pair D were unable to conduct many searches because of a connection failure, Pair E quickly found the (wrong) answer and spent the rest of the time formatting the presentation of their answer, and Pair F found and verify the answer to one search task. As such how the activity was conducted varies considerably across the pairs.

The East Sheffield lesson

The class consisted of twenty-five children (age 10-11) and the class teacher. At the start of the lesson all the children sat on the carpet at the front of the class while the teacher explained that in this lesson they would use the Internet to find out about the Tour de France. Earlier in the day, the Tour de France had been discussed in the school assembly, and this was a continuation of the discussion. The teacher displayed on the interactive whiteboard the PowerPoint presentation that had been used in the assembly and asked the children to search on one of the questions that had not yet been answered. Each child then picked up a computer and returned to their desks to use the Internet. The children recorded the answers to their searches on small portable whiteboards. After approximately six minutes some of the children told the teacher that they had found the answer. The teacher then orally gave the children a second search task, about Spain in the World Cup, to complete if they had finished the first task. As with the Tour de France, the World Cup was another current event the children had also been learning about. At the end of the class the children sat on the carpet at the front of the class while the teacher asked what they found out.

Altogether 24 children spent approximately seventeen minutes using the Internet (one child was absent for much of the class). The children sat at three tables with eight children on each. Which table they sat on was based on the levels of attainment achieved in recent national tests.

The search tasks for the East Sheffield school were

- There are different colour jerseys that the riders can win [in the Tour de France]. What are they for?
- Our country for the World Cup is Spain. I would like you to find out as much information about Spain and the World Cup as you can. So I don't want to know about culture, I don't want to know about food, I don't want to know about the tourist industry, I want to know about the World Cup, and Spain.

As well as the search task set by the teacher some children also searched unauthorised on topics of their own interest.

The East Sheffield search activity

Each screen recording child's search activity is reported in vignettes in Appendix N. The vignettes are briefly summarised here.

The children were nominally working independently. However, while they each had a computer they shared information and answers, and thus often worked collaboratively. This was particularly the case for the general topical search task (World Cup). There was considerable variation in how the children experienced the search activity. C2T1, C4T1, C5T1, C11T2, C15T2 and C16T2 found the specific item task (Tour de France) difficult. Apart from C11T2 who persevered with this task the others either swapped to the general topical task (World Cup) or made up their own search task. When the teacher realises what has happened the children return to the original task. Both C14T2 and C23T3 quickly found the answer to the specific item task (Tour de France). C23T3 moved on to the next task (World Cup) whereas

C14T2 spent the rest of the time copying out a detailed answer. As such how the activity was conducted varies considerably.

6.3.1.2   What is shaping primary school children's search activities

In phase 1 it was found that primary schools are a learning environment

- that is guided by an externally imposed curriculum
- where teaching is guided by best practice
- where people have different skills
- where children must be kept safe
- where time and resource are limited.

Whether the same influence can be seen in the search activity observations is now considered.

Guided by an externally imposed curriculum

The influence of the curriculum is not clear in any of the observation studies. However, this is likely a flaw in the research design. If teachers had been interviewed about this research in phase 2 the influence of the curriculum may have been established.

Teaching guided by best practice

That search activities were shaped by what are considered good classroom practices is discernible in all the observations. In particular, the sub-themes "sharing and discussing aids learning", "child-led learning" and "children should find out for themselves" could be easily identified. In all three observations, before and after search activities information is discussed and shared. In West Sheffield, although the topic was chosen by the teacher the class decided what to look for and children were given a choice of questions. In East Sheffield, the second search task (World Cup) was broad so that children could pursue their own interests within this topic. In both schools, although the teachers support the children they encourage children to find this information independently.

People have different skills

That people within the class have different skills is apparent in all three observations and this does impact on the search activity. In West Sheffield children are working in pairs in part because of a lack of resource but also so that they can support each other. While the East Sheffield teacher tells children not to share the answers for the first search task (Tour de France) the children are sat together in tables and do support each other. In both schools, the teacher helps children that are struggling and search tasks are completed together. It is very difficult to view the search activities in any of the observations as independent solo activities for any child.

Children must be kept safe

In all observations children were clicking on links to websites that had been blocked by the school filtering system. In all cases the websites were innocuous (checked later by the researcher on university campus) and children were frustrated by their inability to access the desired information. In the West Sheffield observations, the teacher starts the class by talking

about safe search and in the interviews describes the importance of learning to search safely in school.

Time and resource

The time given to the search activity in all three observations is very short (around 17 to 20 minutes). The time is dictated by the length of the lesson and the need to share and discuss information before and after the search activities. That for all three observations the search goal is specific is likely linked to the time constraints.

In the West Sheffield school, the children need to share computers because there is not enough for one each. In the East Sheffield school each child works at a separate computer. However, searching for information is still very much a social activity and it is difficult to conceive this as children working individually.

6.3.2   RESULTS PART 2: Elements of search tasks

This section is split into two parts. In the first part, are the results of the analysis using the representation scheme developed in phase 1. In the second part, are the results of the analysis of other elements that had not been identified in phase 1.

6.3.2.1   Using the phase 2 representation scheme

In this section, the different elements of the West Sheffield and East Sheffield search tasks are described and compared to those identified in phase 1. This is summarised in Table 19.

Table 19: Summary of search task elements, phase 2

Schools		West Sheffield	East Sheffield		
Search tasks		Human skeleton	Tour de France	World Cup & Spain	Non-school work
What is the nature of the motivating work task?		Typical	Typical	Typical	Typical
From whom does the search task originate?		Teacher with class	Teacher	Teacher	Child
If the search task originates from a teacher, how flexible is it?		Choice of specific question	Specific question (no flexibility)	Own area of interest and no framework	n/a
Who does the search task?	Doer	Pairs of children in group	Individual child in class setting	Individual child in class setting	Individual child in class setting
	Optionalilty	Compulsory	Compulsory	Compulsory – some, Elective	Elective
Does the search task occur as part of a planned search activity?		Planned	Planned	Unplanned planned	Unplanned planned
What is the location of the search activity?		Class	Class	Class	Class
What subject area is the search task for?		Computer Science	Event	Event	Non-school work
How is the information used?		Indirect to support learning of a subject area	Indirect to support learning of a subject area	Indirect to support learning of a subject area	Unclear
What is the information used for?		To extend, To navigate, To verify	To extend, To navigate	To orient, To extend	To entertain
What stage in the uniting topic is the search task?		Near start	Near start	Mid	Unclear
Other than people what resources are used?		Internet	Internet	Internet	Internet
What are the outputs?		Notes	Notes	Notes	-
What is the overall search goal		Specific	Specific	General	Specific

What is the nature of the motivating work task?

For all the searches the nature of the motivating work task is typical. That all should be typical stems from the research design. When schools were recruited for these studies, teachers were asked if children could be observed doing a typical search activity. Therefore, not surprisingly the motivating tasks are typical for both schools. How nature affects search is not clear from these observations.

From whom does the search task originate?

Three types of origination are confirmed in the observations: child, teacher, and teacher with class. The teacher with class origination was as described in the interviews where the teacher works with the class to generate questions. Although the elements child and teacher are confirmed, how children originated search tasks differs in this phase, and although search tasks originate from the teachers they may not have designed these tasks.

The way children originate tasks was different in phase 2. In phase 1, the teachers describe how search tasks originate from children but it was the teacher who decides whether the activity takes place. However, in the East Sheffield observation the activity was already taking place and some of the children take the opportunity to originate their own searches (without the teacher's knowledge).

It may be that the element "teacher" should be reconsidered. Although the Tour de France search activity originates from the teacher, the task has not been designed by the class teacher but by another teacher in the school. In retrospect, it is likely that this was the case for many of the search tasks described in the West Sheffield interviews. The teachers described using bought in lesson plans and it is likely that some of the search tasks were taken from these plans. However, the scheme has not been adapted to distinguish between whether the teacher or another teacher designs the search tasks as it is not clear how this would have an impact on how information is searched for in the classroom. This should of course be investigated in another study.

If the search task originates from a teacher how flexible is it?

Three types of flexibility are confirmed in the observations and are as described in the West Sheffield interviews: choice of question, specific question, and own area of interest and no framework.

The flexibility of the tasks does appear to influence the way search is enacted, both in conjunction with origination (as discussed above) and with doer. In the West Sheffield observation, the children were offered a choice of question. Each of the pairs takes it in turns on the keyboard, changing over for each question. For all pairs, the keyboard controller was reluctant to give up this coveted role, and they persevere with questions when stuck. By contrast, in East Sheffield where each child has their own computer, the children who were struggling with the Tour de France task were only too keen to drop this task and move on to the World Cup task.

Who does the search task?

For doer, the representation scheme is accurate in terms of who is entering the query but in none of these searches are the children operating entirely on their own or in pairs. While the scheme reflects the differences between how the children were doing the search activities in the two schools, it needs to be remembered that this scheme has been designed for a group environment. If comparisons are to be made with another environment it would be more accurate to describe the elements as individuals within a class setting, and pairs within a class setting.

Three types of optionality were confirmed in the observations: compulsory, compulsory-some, and elective. However, how compulsory-some and elective were enacted is slightly different from phase 1. In phase 1, only one search task was described as compulsory-some. This search task occurred when the teacher wanted the more able students to extend their learning for a national test. As such the task was only given to some members of the class. In the East Sheffield school, the teacher gives the second task, the World Cup & Spain, to children who have completed the first task. Thus this task is compulsory-some. However, children who had not finished the first task went on to the World Cup & Spain task despite being told not to do so. For these children the task was elective.

Does the search task occur as part of a planned search activity?

In both schools the search activities were planned. In the West Sheffield school, the search tasks have not been planned but that the children will be searching on the class topic has been planned. This fits the phase 2 representation scheme as the activity was planned and the flexibility of the search task was teacher / class. In the East Sheffield school, the phase 2 representation scheme can be used to represent the Tour de France search task as the activity as was both planned and designed by teacher. However, the other two search tasks are problematic. The World Cup & Spain task has not been planned but was done in a planned session. It is likely that this distinction matters. This task has aspects linked to it being unplanned in that the task was designed on the spur of the moment (so presented orally) and was a time filler (so the goal is general). The East Sheffield non-school work search tasks were also unplanned but occur in a planned search activity. A new element of unplanned-planned is added to the representation scheme to accommodate the planning of these search tasks.

What is the location of the search activity?

All of these search activities take place in class. This of course is inherent in the research design.

What subject area is the search task for?

That content was searched for Computer Science and events is confirmed. As well as this in East Sheffield, some children searched for non-school work for their own personal interest.

How is the information used?

Indirect to support learning of a subject area is confirmed. For none of the assigned search tasks was the information used to learn more about a subject area for the motivating task. For example, in the West Sheffield children were doing a search on their science topic and through doing this search they were learning how to use computers safely.

What is information used for?

To orient, to extend, to navigate, to define and to verify are all confirmed information uses. As well as this to entertain was observed in the East Sheffield observations. Although to entertain was not described as an information use in the West Sheffield interviews, one of the reasons teachers gave for using search technologies was that children enjoyed using them. For example, in Y1 when the teacher describes searching for poems in the literacy lesson the

information was used to extend the children's knowledge of poetry but by using search technologies they also "had fun".

What stage in the uniting topic is the search task?

That there are both motivating and uniting topic is confirmed. This is most clear in the West Sheffield observations where the Computing teacher asks the children what they are learning about in Science and then tells the children to search on this topic to develop their search skills in the Computing lesson.

The representation scheme elements of stage could not be confirmed. Firstly, it was not possible to identify stage in a work task of personal interest as it is impossible to know how long this interest will last. Secondly, the Human Skeleton and Tour de France searches occurred near the start rather than at the start of the work task. For all of these searches the children had some knowledge of the topic before searching. As it seems likely that there would be differences between how searches are enacted when there is and there is not domain knowledge (Hirsh, 2004), the stage here is categorised as Near Start, distinguishing it from Start.

Other than people what resources are used?

For all the search tasks the Internet was the resource and this is accommodated in the phase 1 representation scheme.

What are the outputs?

For all the assigned search tasks the output was note taking and this is accommodated in the phase 1 representation scheme. That other people were used a resource throughout the search activity is confirmed.

What is the overall search goal?

The goal of all of the searches in each activity could not be identified (see 6.2.3 Data analysis). However, the overall goal of the search activity could be determined. Both types of search goal, general topical and specific item, are confirmed.

Table 20: Phase 1 representation scheme compared to phase 2

Phase 1 representation scheme		Phase 2	
		Elements confirmed	**Adjustments made**
What is the nature of the motivating work task?	Routine, Typical, Unusual	Typical	None
From whom does the search task originate?	Teacher, Child, Class, Teacher with class	Child, Teacher, Teacher with class	None but origination more nuanced than can be reflected

If the search task originates from a teacher, how flexible is it?	Own topic and no framework, Own topic and framework, Own area of interest and no framework, Own area of interest and framework, Topic specified - any true, Topic specified and framework, Choice of specific question, Semi-specific information, Specific information	Own area of interest and no framework, Choice of question, Specific question	None
Who does the search task?	Doer: Teacher, Child – individually, Children – pairs, Children – small groups, Nominally child, Teacher or child	-	Yes. Elements should be changed to include Individual child in class setting, Pairs of children in class setting, as all the children are working in a wider group
	Optionality: Compulsory, Compulsory- some, Optional, Elective	Compulsory, Compulsory some, Elective	None but the enactment is slightly different
Does the search task occur as part of a planned search activity?	Planned, Unplanned	Planned	Yes. Scheme needs to be extended to include Planned unplanned. Planned unplanned is defined as the teacher has planned the search activity but what the activity is for has not been planned
What is the location of the search activity?	Class, Outside of class, Both class and outside of class, Either class or outside of class	Class	None
What subject area is the search task for?	National curriculum subject areas, Topic, Event, Generic	Subject areas (Science), Event	Yes. Needs to be extended to include Non-school Work. Non-school work is defined as content that is not used for school work
How is the information used?	Directly as subject area knowledge, Indirectly to support learning of a subject area	Indirectly to support learning of a subject area	None
What is information used for?	To orient, To extend, To make sense, To illustrate, To decorate, To verify, To navigate, To define, To get instruction, As precise data, Unclear use	To orient, To extend, To verify, To navigate	Yes. Scheme needs to be extended to include To entertain. To entertain is defined as information is used for amusement
What stage in the uniting	Any, Start, Mid, End	-	Yes. Searches occurred near the start but

topic is the search task?			crucially not at the start of units. The scheme needs to be extended to include Near Start
Other than people what resources are used?	Any other resource, A general resource (Library, The Internet), A specific resource (A book, An app, A particular website / search service)	Internet	None
What are the outputs?	Articulation, Construction, Formal writing, Illustration, Notes, Spreadseet, Vocalisation	Notes	None
What is the search goal?	General topical, Specific item	Specific item, General topical	Yes. The question needs to be changed to overall search goal as the goals may change during the search

6.3.2.2   Additional representations

The observations were also analysed for elements that had not been identified in phase 1. These are described next and summarised in Table 21.

It was also noted that all classes had some topic knowledge and that the search tasks were designed to be interesting. Topic knowledge is not considered further, partly because it was a user characteristic but also because this is to some extent represented by stage of unit. Similarly, whether something is interesting is likely to vary according to the individual. However, overall the World Cup & Spain task was probably of greater interest to the East Sheffield children than the Tour de France, and this could explain some differences in search. This cannot be accommodated in the representation scheme because whether something was found interesting is a user characteristic.

Table 21: Additional search task elements, phase 2

Additional elements	West Sheffield	East Sheffield		
	Human skeleton	Tour de France	World Cup & Spain	Non-school work
Task transmission	Written and verbal	Written and verbal	Verbal	Self-administered / verbal
Time	Less than 20 minutes	Less than 20 minutes		
Grouping	Any pairing	Segregated to ability	Segregated to ability	

Task transmission

The search tasks were transmitted differently and this could have affected the children's search performance. One child asked for the second search task to be repeated but there was no other indication that receiving this task aurally was a problem for the children.

Time

In both schools the amount of time given to the search activity was approximately the same. However, it should be noted that because of network connectivity problems some of the West Sheffield children were unable to use the Internet for as long as others.

Time had already been substituted in the phase 1 representation scheme by planning and location. Again, here there is nothing to indicate that time had a direct impact on how search tasks were enacted. Rather, the search tasks were designed according to the time available.

Grouping

The children in West Sheffield were allowed to choose their partner, whereas the children in East Sheffield had set places at tables that had been ordered by attainment level achieved in recent school tests. What affect this has, if any, on search is not clear, and requires further investigation. Grouping was not added to the representation scheme but this should be considered in future studies.

6.4 Summary

In this phase, whether the phase 1 findings would apply to other schools and whether the search task representation scheme could be used to describe search tasks as they occur in the primary school classroom was tested by analysing three classroom observations.

To an extent what is shaping search activities (RQ1) was confirmed. Aside from resource (theme 5) what is shaping the search activities was consistent across the two different schools. That school funding is linked to socio-economic areas accounts for the differences in resource between the two schools (Department for Education, 2016a; The Independent, 2016) and so the result is not surprising. Although the analysis of the observation confirms many influences some are neither confirmed nor repudiated. This is likely a weakness of the research design. More observations and having observations designed for the purpose of the study would have helped here.

With some minor adjustments (Table 22), the search task representation scheme developed in phase 1 could be used to describe the assigned search tasks (RQ2). However, it was difficult to use the scheme to describe the task as enacted. Furthermore, a limitation of this validation is that only two schools were observed. This scheme will be further tested in future work.

Table 22: Validated search task representation scheme

Element		Definition
What is the nature of the motivating work task?		
Routine		"Regular tasks that participants have to perform repeatedly" (Xie, 2009, p. 348)
Typical		"Tasks that participants are used to performing, but they have not preformed the exact same task before" (Xie, 2009, p. 348)
Unusual		"Tasks that participants have not encountered before" (Xie, 2009, p. 348)
From whom does the search task originate?		
Child		The task can be identified as coming from one child
Teacher		The task is generated by the teacher
Class		The task is generated unplanned through discussion, and cannot be identified as stemming from any particular individual
Teacher with class		The teacher plans a class discussion to generate search tasks
If the search task originates from a teacher, how flexible is it?		
Own topic and no framework		Children can choose their own topic and there are no particular information requirements
Own topic and framework		Children can choose their own topic but particular information is required or criteria are given
Own area of interest and no framework		The broad topic is specified. Children can choose their own area of interest and there are no particular information requirements
Own area of interest and framework		The broad topic is specified. Children can choose their own area of interest but particular information is required or criteria are given
Topic specified, any true		Topic is more narrowly specified but children can find any true information for that topic
Topic specified and framework		Topic is highly defined and there is little or no room for individualisation
Choice of specific question		The children are given a choice of questions
Semi-specific information		The information requirement is specific but there is some flexibility in how to answer
Specific information		The information requirement is specific and there is no flexibility in interpretation
Who does the search task?		
Doer	Teacher	The teacher does the task
	Individual child in class setting	Children use resources individually but are also working as part of a larger group
	Pairs of children in class setting	Children use resources in pairs but are also working as part of a larger group
	Small groups children in class setting	Children use resources in groups larger than two but are also working as part of a larger group
	Nominally child	The search task is nominally conducted by the child at home but it is also possible that someone else conducts this task on the child's behalf

	Teacher or child	The search task could be conducted by either the teacher or the child
Optionality	Compulsory	The teacher gives the search task to all children
	Compulsory, some	The teacher gives the search task to some children
	Optional	The teacher gives the children a search task but they are not required to do it
	Elective	Children choose to do the search task

Does the search task occur as part of a planned search activity?

Planning	Planned	The teacher has planned for a search activity
	Unplanned	The teacher has not planned for a search activity
	Planned unplanned	The teacher has planned a search activity but the search task has not been planned

What is the location of the search activity?

Location	Class	The search activity occurs in a school lesson
	Outside of class	The search activity is not in a school lesson
	Both class and outside of class	The search activity occurs both in a school lesson and outside of school
	Either class or outside of class	The search activity could occur in either location

What subject area is the search task for?

National curriculum subject areas	List taken from national curriculum documentation (Department for Education, 2013c)
Topic	Where the search task is described as for a topic.
Generic	Where the search task is described as typical and is not related to any particular subject area (e.g. search for spelling a word)
Event	Where the search task is for an event and is not related to a particular subject area (e.g. assembly).
Non-school work	Where the information found during a search task is not used for school work

How is information used?

Directly to increase knowledge of a subject area	Where information is directly related to the subject area
Indirectly to support learning of a subject area	Where information is not directly related to the subject area but it is used as content with which to gain knowledge of a subject area

What is information used for?

To orient	Orient to a topic by seeking a broad and general understanding
To extend	To find out about a particular aspect of a topic
To make sense	To bridge a gap in understanding
To illustrate	To explain or represent an object or concept
To decorate	To visually enhance an information object
To verify	To confirm information already known
To navigate	To "reach a particular site" (Broder, 2002, p. 5)
To define	To find out the meaning, spelling, synonym or translation of words

To get instruction		To find out "what to do and how to do something" (Taylor, 1991, p. 230)
To entertain		To amuse
As precise data		To use data (such as price or location data) as specific unambiguous units of information
What stage in the uniting topic is the search task?		
Any		The search activity is not specific to a stage and could occur at any time
Start		Occurs at the beginning
Near start		Occurs near the start
Mid		Occurs in the middle
End		Occurs at the end
Other than people what resources are used?		
Any other resource		The resource is not stipulated
A general resource	Library	Any book in the library can be used
	The Internet	Any website can be used
A specific resource	A book	The teacher stipulates or uses a particular book
	An app	The teacher stipulates or uses a particular app
	A particular website / search service	The teacher stipulates or uses a particular website or search service
What are the outputs?		
Articulate		Share information with others
Construction		Where something is made e.g. a cake
Formal writing		A final piece of written work
Illustration		A drawing
Notes		Taking notes
Spreadsheet		Populate a spreadsheet
Vocalise		Saying a word outloud to practice pronounciation
What is the overall search goal?		
General topical		The goal is to find information on that topic but no particular information is looked for
Specific item		The goal is to find particular information

7   DISCUSSION

Research was conducted in two phases. In phase 1, what is shaping primary school children's search activities (RQ1) was considered by analysing teacher's descriptions of search in primary schools. It was found that this is a learning environment

- that is guided by an externally imposed curriculum (theme 1)
- where teaching is guided by best practice (theme 2)
- where people have different skills (theme 3)
- where children must be kept safe (theme 4)
- where time and resource are limited (theme 5)

Then this analysis was mapped onto a task representation scheme that had initially been developed from the research literature (Figure 11). The revised scheme is then used to build a description of primary school search tasks (RQ2). In phase 2, using data previously collected during three classroom observations, whether the themes identified in phase 1 were observable and whether the influence would be the same at another school was considered. Furthermore, whether the representation scheme could be used to describe the search tasks was tested.

The findings of the two phases are now discussed in three sections. In section 7.1, the two phases and the different strands of the research (RQ1 and RQ2) are combined to discuss search in the primary school environment using Taylor's (1991) IUE as a framework. In section 7.2, the difficulties encountered building the representation scheme are recounted. In section 7.3, the findings of the two phases are summarised and discussed in relation to the research questions.
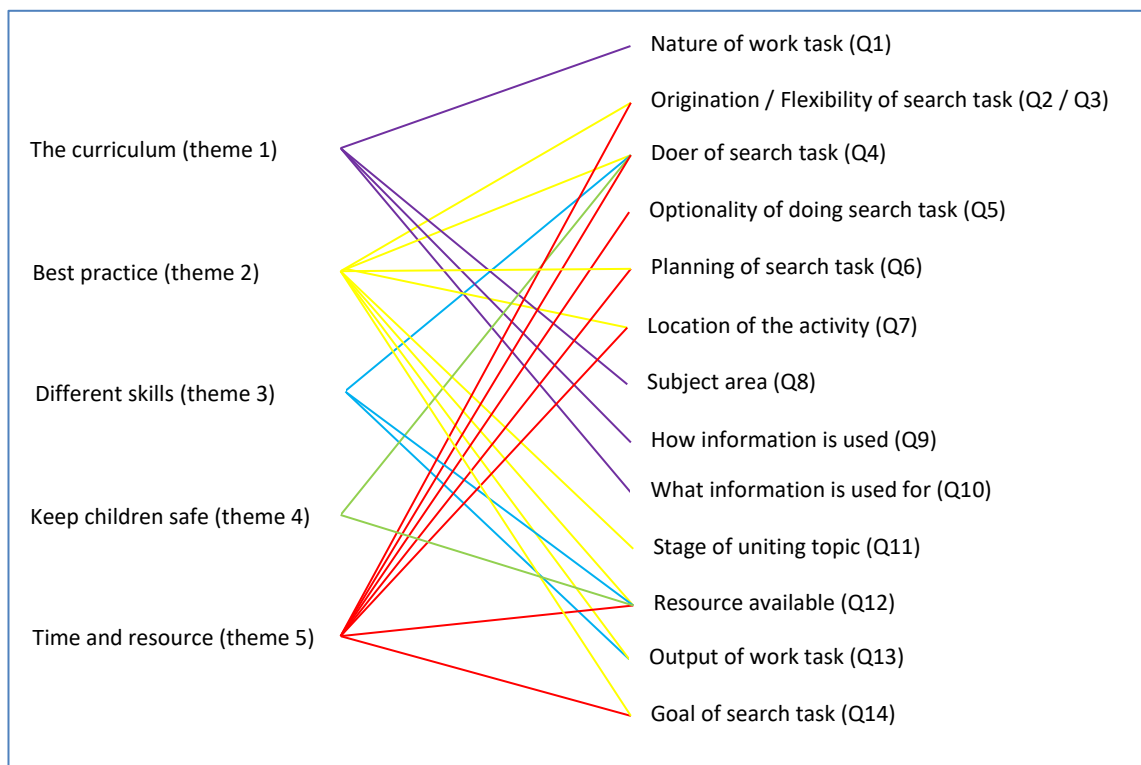
Figure 11: How primary school IUE influences search

7.1 Search in the primary school information use environment

The findings of what is influencing search in primary school in the two phases roughly approximate to Taylor's (1991) model. The set of people (themes 3 and 4), the problems of the setting (theme 1), what is considered resolution of the problem (theme 2) and the setting itself (theme 5) all shape search activities. It should be noted though, that the influence of each theme is not discrete, and that the themes come together in different combinations to influence various parts of the search. This can be clearly seen in Figure 11 which shows how the themes combine. These findings are discussed next using Taylor's (1991) model as a framework.

7.1.1 The set of people

In studies of children, age is considered a key determinant of search behaviour (Duarte Torres & Weber, 2011; Duarte Torres et al., 2014; Gossen et al., 2013; Large et al., 2008; Marchionini, 1989). In this study, it was found that age does influence children's search activities but this influence is in combination with other factors (see Figure 11). How age influences search activities is discussed next, followed by a discussion of whether primary school children can be considered a set of people.

7.1.1.1 How age influences search activities

Two of the themes, children's ability to conduct searches (theme 3) and the need to keep children safe (theme 4) are linked to age. In combination with the other themes, age influenced outputs, who did the searches and resources used.

To accommodate differing abilities (theme 3) and also as part of best practice (theme 2) children are often given some choice in the type of output (Q13) when completing research assignments. As such there is considerable variation in the type of outputs search technologies are used to support. Given that there is a link between paper-based outputs and what children search for and consider useful (Large & Beheshti, 2000, p. 1074; Nesset, 2007, p. 8), further research should be done to consider how the different types of outputs described in this study (for example, cake making, pyramid constructions and so on) change what is looked for and what is considered useful information. It is also possible that the range of output (Q13) is particular to the environment as it is hard to think of an IUE where there would be such a comparable range of outputs assigned to an individual person.

To keep children safe (theme 4) particularly in the younger groups teachers did searches on behalf of children (Q4). What resources (for example, no video content) can be used (Q12) is also restricted (note this is not entirely at the teachers' discretion as all schools are required to apply filters that limit what content children can access, Department for Education, 2015). That teachers were concerned to keep children safe is hardly surprising given that nationally and internationally there is considerable unease about the dangers children face when using the Internet (Sherbert Research, 2014). It is though something of a paradox that while teachers thought school was the best place for children to learn how to deal with exposure to the darker sides of the Internet, children were restricted on what they could access. Given that in their leisure time children are renowned for searching for videos on YouTube (Ofcom, 2016, p. 64) arguably some access to YouTube in schools should be allowed, as it is through schools that children can learn how to use this site safely.

As well as teachers conducting searches on behalf of children (theme 3) and because of a lack of resource (theme 5), children often searched in pairs so that they could support each other (Q4). This combined with following best practice (theme 2) whereby children are encouraged to share information with each other in class discussions that occur before and after search activities, means that children are able to use information regardless of whether they can successfully search for it. Although it can be argued that what is crucial is getting the information not how you get it (Solomon, 1993), it is also important that children do know how to use this tool (House of Lords, 2015). Not only are children able to use information without having searched for it there are three other reasons why teachers might not know how effectively children are using this tool. Firstly, beyond teaching children to search safely they are not specifically taught how to use technology and their skills are not tested. Secondly, as was seen in the two observation studies, in a busy classroom the teacher does not have time to oversee each individual child. Although it is quite likely that teachers will have a fair idea of who is and who is not finding the information, they do not know this for every child and for each search task. Thirdly, teachers do not necessarily know the answers themselves and may not be aware when the information is wrong (Rutter, 2013). As such, what is happening when children search for information is often unknown (see Figure 12). Similarly, in research studies search may be represented in the learning cycle but the activity is not actually examined so it is a black box (Tanni & Sormunen, 2008, p. 894). Overall, it is likely that neither teachers nor researchers have a full understanding of how children are using search technologies.
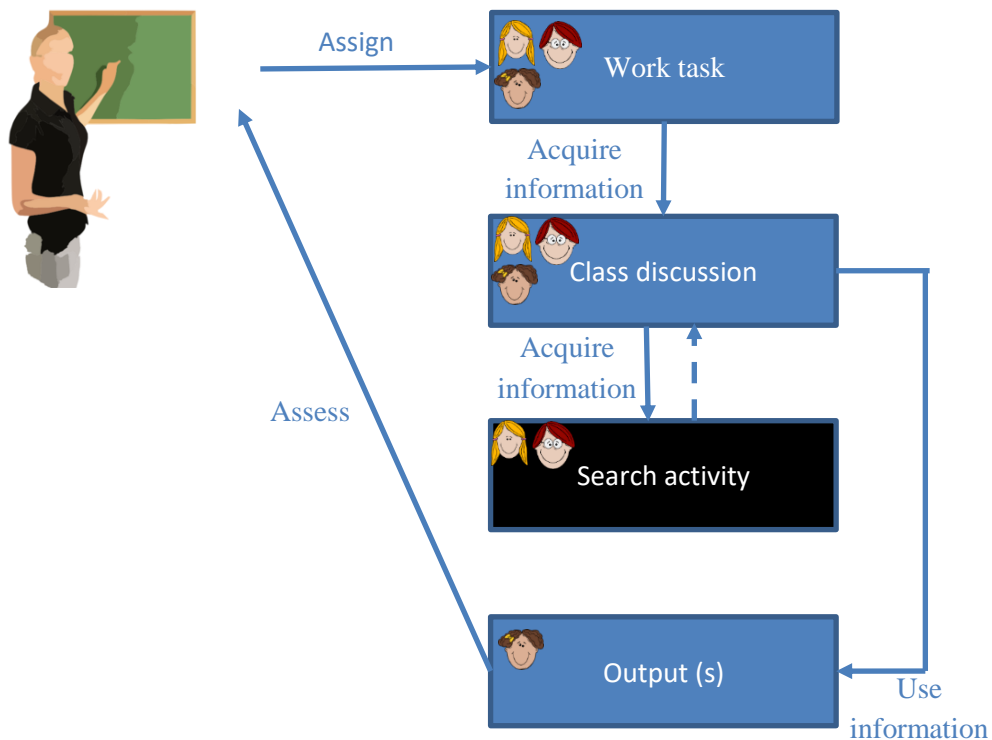
Figure 12: Search as black box in classroom.

7.1.1.2 Are primary school children a set?

In much research children are thought to be a distinct user group from adults with children at different ages also considered separately (Duarte Torres & Weber, 2011; Duarte Torres et al., 2014; Gossen et al., 2013; Large et al., 2008; Marchionini, 1989). If children of different ages are separate groups, then we could expect some variance in search activities and their tasks across the different primary school year groups (ages between 4 and 11). Taylor (1991), however, argues (in the more general field) that what distinguishes groups is that they are pre-defined by society and that demographic factors are not so critical. It is the setting within which the group of people use information that is important.

That age is influencing search activities was found in this study (see 7.1.1.1) and there were differences in the search activities across the age groups, particularly in terms of doer (Q4). However, when taking a close look at all the search tasks in the representation scheme it becomes apparent that many elements co-occur across the year groups and what children are using information for (Q10) does not change across the different year groups. This finding supports the argument that information use is particular to the people within a setting (Taylor, 1991), and therefore that primary school children could be considered a single group.

However, whether children are the only members of the group does also need to be considered. Contrary to earlier research (Gross, 2006), as best practice (theme 2) means that a lesson could evolve in different directions, teachers were not always originating search tasks for information they already had (Q2). Although teachers did have some additional search tasks (for example, finding teaching resources) they also did the same search tasks as children because they searched with children when children lacked skills (theme 3), and sometimes on behalf of children when resources and time were limited (theme 5). Furthermore, it was sometimes difficult in the interviews to untangle who did the searching as the activity could be shared (for example, teachers may enter terms into the search box but children pick the results). As such primary school children's search tasks are completed by not one set but two sets of people. This also means that role (Leckie et al., 1996) only partially accounts for differences in search tasks between teachers and children. Whether this is peculiar to the environment warrants further investigation.

7.1.2 Problems

What are typical problem and problem dimensions is discussed next.

7.1.2.1 Typical problems

Nearly all the search tasks that the teachers described were in response to the curriculum (theme 1). The few search tasks that were not for the curriculum, were for going beyond the curriculum or were for events (which are often related back to the curriculum anyway). So in terms of what the teacher's described, children's information problems in primary school mainly stem from the demands of the setting (Taylor, 1991). Given that the purpose of a curriculum is "so children learn the same things" (Department for Education, 2016b) and as many schools are following the same curriculum it could be expected that primary school children will have typical problems. Furthermore, it is likely that the curriculum will be similarly influential in other primary schools. However, seen in the East Sheffield observation study, children are also conducting search tasks "under the desk" (Maybin, 2007). Not everything they look for in school has been sanctioned by the teacher and children are also resolving their

personal information problems in school time. Therefore, while many of the information problems are likely to be typical and stem from the setting there will also be other more personal problems that may not be typical and do not stem from the setting.

Topics are also used to unify learning across work tasks (see Figure 13). This, therefore, means that information found in a search can be used to fulfil information requirements in one or more work tasks and the work tasks do not need to be connected beyond sharing the subject of the topic. This has implications for understanding what is motivating the search (Q1) and stage (Q11). The importance attached to the work task in the research literature is that the work task motivates the search task and it is from the work task that the search task gains its "value and cost structure" (Pirolli & Card, 1995). Given that a search task could potentially fulfil the information requirements of more than one work task, the question then has to be what value and what cost structure is derived from the different work tasks? Are both work tasks important or is one more important than the other? Furthermore, it has been demonstrated that what information (Kuhlthau, 2004) and how this information is sought (specificity of queries, relevance judgements and so on) varies (Vakkari, 2001, 2016; Vakkari et al., 2003) depending on stage of the work task. However, often in primary schools search tasks are occurring at different stages in different work tasks simultaneously.

Note, that a search task could be used to fulfil information requirements in more than one work task is not that remarkable and it is likely that there are connections between work tasks in many organisations. Nonetheless, that the work tasks in primary schools are occurring simultaneously and are otherwise unconnected is perhaps distinctive.
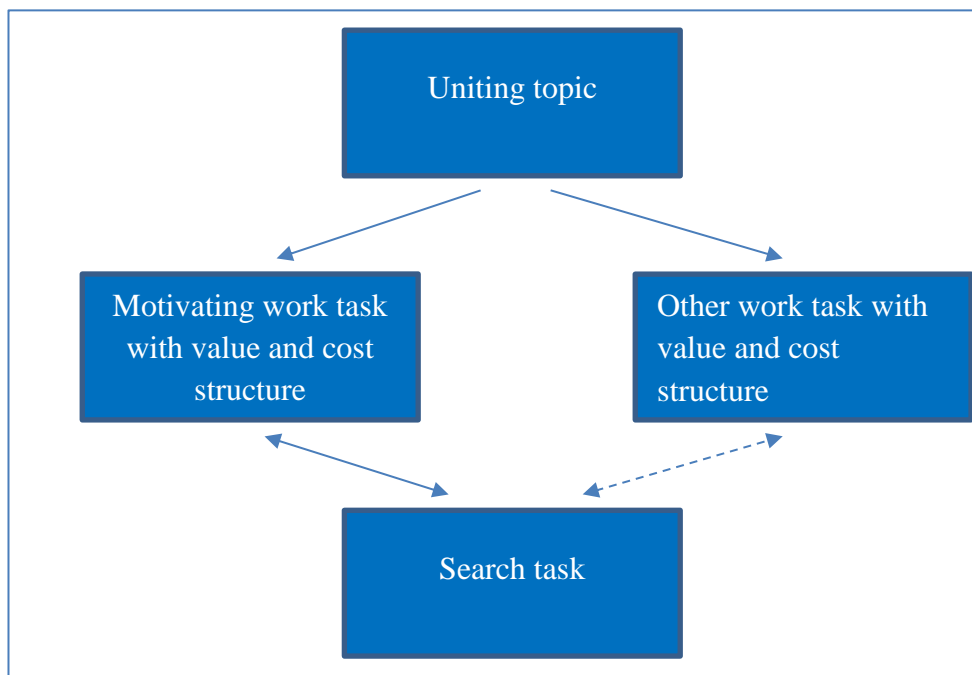
Figure 13: Relationship between topics, work tasks and search tasks

7.1.2.2   Problem dimensions

The findings are now considered in relation to what Taylor (1991) suggests are the most important problem dimensions: well-structured / ill-structured, complex / simple, assumptions agreed upon / not agreed upon, and familiar / new patterns.

Complex /simple

As what makes a task complex for children has not been universally established the complexity or simplicity of children's search tasks cannot be determined from this study. What is apparent, however, is the variation in tasks and information use. Children are likely to require a range of search skills.

Assumptions agreed upon / not agreed upon

That there are agreed upon assumptions as to what is considered good information in schools is widely agreed upon (Limberg, 2007, 1999; Lundh 2012, Gross, 2006). In this study these assumptions were not directly investigated in either phase. However, contrary to Gross's findings (2006) children were looking for information teachers did not already know (Q2). That said regardless of how the search tasks originate, children may still be looking for what is generally considered good information, and as has been reported in many studies children were often looking for factual information (see for example Chung & Neuman, 2007; Limberg, 1999).

Lundh & Alexandersson (2012, p. 248) found that when completing research assignments children's use of images is predominantly decorative because schools are predominantly "text-dominated" (Lundh & Limberg, 2012, p. n.p.). While images were used decoratively to support written assignments in this study too, images and multimedia were used in place of text to illustrate a concept or a point being made. In these work tasks, the affordances of images and multi-media meant they were considered more informative than text. For example, the Foundation teacher explains that it is difficult for children to understand the lifecycle of a plant and that they need to see it for themselves. Growing plants takes time and so children view videos showing the lifecycle sped up.

Well-structured / ill-structured

In studies of children the structure of a problem is often operationalised through the specificity of the search goal. While there is no agreed upon understanding of what affect search goal has, that it has an effect is generally agreed (Bilal, 2002b; Bilal et al., 2008; Borlund, 2016; Gwizdka & Bilal, 2017; Marchionini, 1989; Schacter et al., 1998).

As search goal is likely to have an effect on search behaviour and search success it is interesting that in this study search goal (Q14) appears to be linked to location (Q7) and origination (Q2) (see 5.3.2.12). General topical tasks were often given to children to complete at home but in school many of the search tasks are more specific. As discussed in 7.1.3.4, this is linked to the time constraints (theme 5). However, there is also some evidence from phase 1 that while teachers may design both general topical and specific item search tasks, the search tasks that children design are questions which are a type of specific item search task. None of the search tasks that teachers reported children designing are general topical. As it is thought that children's search behaviour is different for these two types of task (Bilal, 2000; Byrnes & Bernacki, 2015; Marchionini, 1989; Schacter et al., 1998; Wu & Cai, 2016), some of the search tasks designed by teachers could have different information behaviours from those designed by children.

Familiar / new patterns

As most of the tasks were in response to the national curriculum (theme 1), there was very little variation in nature of motivating task with mostly typical tasks reported (Q1). How nature compares with other settings is not clear. Xie (2009) also found in a corporate setting that most of the work tasks where search was reported were for typical work tasks with few reported for routine and unusual tasks. Xie (2009) only examined one type of work task in the university setting and found that this task was either typical or unusual in nature, depending upon whether the students had completed this type of task before. This calls into mind the subjective nature of task but is also possibly an anomaly of that particular work task, in that on the whole class cohorts tend to experience similar work tasks at the same time, and therefore the nature of tasks is likely to be similar within a cohort.

7.1.3   The setting

Discussed next are how the importance of organisation, the domain of interest and access to information, and the difficulties of differentiating settings.

7.1.3.1   Importance of organisation

The imposition on children within primary schools is likely high. Many of the information problems stem from the national curriculum (theme 1) and there are likely agreed upon assumptions of problems (see 7.1.2.2). As has been found in prior research teachers are the assigners and assessors of children's tasks (Gross, 2005, 2006; Limberg, 2007). Furthermore, it is teachers who decide if a search activity can take place in the classroom. However, as a result of best practice (theme 2) children do originate search tasks (Q2) and as Lundh (2010) and Shenton & Dixon (2004) found they do have some control over what to look for albeit still under the teacher's direction (Q3).

7.1.3.2   Domain of interest

That primary schools are a learning environment almost certainly influences search activities and tasks. This is seen in a number of areas in this study. As is common in learning environments the same task is multiply assigned. However, and this is probably particularly the case for primary schools where there are no entry requirements and children are not put in sets, the degree of skill in the class varies considerably (theme 3). To accommodate this, teachers design the search activity so that children of different abilities can participate (for example, doing search tasks (Q4) in mixed ability pairs).

Also key to this being a learning environment is what and how information is used. The presence and absence of information uses is likely linked to the environment (see 7.1.4.2). How information is used (see 7.1.4.3) is also likely linked to school tasks being somewhat artificial in that they do not resolve real-life problems (Gordon, 1999, p. 5).

7.1.3.3   Access to information / The local setting

Taylor (1991) does not consider the local setting to be a substantial factor. However, there were differences in the settings of the West Sheffield and East Sheffield primary schools that likely did impact on search activities. Each school did have its own unique information ecology (Nardi & O'Day, 1999). In the UK, school funding is based on a number of factors but in general schools in poorer areas tend to get allocated more funding (Department for Education, 2016a; The Independent, 2016). The West Sheffield school had limited resources compared to the

East Sheffield school. An obvious affect here is that the West Sheffield children had to search in pairs (Q4) as there was not enough equipment for children to search on their own as they could at the East Sheffield school (theme 5). A less obvious affect is that according to the teachers lack of resource resulted in this school being more creative in its use of technology than might be found in other schools.

7.1.3.4 Differentiating settings

Although primary schools are the setting within which information for school work is used it is difficult to see this as the only setting influencing search.

Firstly, primary schools are not the only setting within which children are searching for information for their school work. Information is brought in impromptu from home and teachers are also giving children search tasks as homework. Teachers plan activities (Q6) to take advantage of the differences between home and school settings. General topical search tasks (Q14) are given to children to complete at home (Q7) because it is thought that children will have more time to conduct the searches (theme 5). However, it is also recognised that there is an inequality of access (Livingstone & Helsper, 2007) and so what resources children should use is left open.

Secondly, children will be influenced by previous search experience, wherever this may have taken place. Thirdly, children will be using information retrieval systems that have been designed in another context possibly for another context (Ingwersen & Järvelin, 2005, p. 30). This is particularly noticeable with regard to the different topics children are researching. Based on the descriptions that the teachers provided in phase 1 of this study, it is thought likely that the intended audience of the documents that children might come across could vary considerably. Some topics are likely to be well-represented at a level appropriate to children and others not. Many of the topics described in phase 1 are taken from an old curriculum (http://webarchive.nationalarchives.gov.uk/content/20040105070638/http://standards.dfes.gov.uk/schemes3/) or from third party lesson plans (for example see https://www.hamilton-trust.org.uk/). As such it is likely that many primary schools will be study these topics and websites will have been designed especially for children. This was observed in the phase 2 study, when children from West Sheffield were searching for the Human Skeleton, a topic that is common to many schools (Rutter, 2013). However, teachers in phase 1 also described how they adapted topics. For example, The Victorians changed to Victorian Sheffield. Although not observed it seems likely that there would be little bespoke information for children to find.

7.1.4 Resolution of problems

Taylor (1991) discusses resolution of problems in relation to information traits and information use. This study did not expressly address information traits. There is some evidence in the research literature that there are certain information traits that primary school children look for, particularly in the focus and solution continuums. The findings of this study largely support the research literature in that many of the search tasks were specific item (Q12) with children looking for a single solution to a factual problem.

With regard to information use how problems are resolved in primary schools, the findings of this study build on Taylor's (1991) conceptualisation. As well as describing what information is used for, how information is used and the intended outcomes of use are also listed. This is

illustrated in Figure 14. In brief, information is needed for subjects in the curriculum (theme 1). In response to best practice (theme 2) and depending on the constraints of the setting (theme 5), search technologies may be used to fulfil information requirements. The design of the search activity is then influenced by the IUE (best practice – theme 2, different skills – theme 3, keeping children safe – theme 4, time & resource – theme 5). To meet curricula requirements (theme 1), search tasks are constructed for different information uses (to orient, to extend and so on). While searching it is hoped that children are gaining factual content, understanding of concepts, operational skills, analytical skills and a better learning experience. Information found is then used either directly to increase knowledge of a subject area or indirectly to support learning of a subject area. This in turn fulfils the requirements of the curriculum (theme 1).

Problems stemming from the curriculum

Search technologies used depending upon
- Best practice
- Time & resource

Search activity designed for
- Best practice
- Different skills
- Keeping children safe
- Time & resource

Resolution of problems

What information is used for:

- To orient
- To extend
- To make sense
- To illustrate
- To decorate
- To verify
- To navigate
- To define
- To get instruction
- To entertain
- As precise data

Intended outcomes:

- Factual content
- Understanding of concepts
- Operational skills
- Analytical skills
- A better learning experience

How information is used:

- Directly to increase knowledge of a subject area
- Indirectly to support learning of a subject area

Figure 14: Resolution of problems in primary schools

7.1.4.1   Why search technologies are used

Although many of the problems stem from the curriculum (theme 1) and in the curriculum there is some requirement to do research and to be able to use search technologies effectively, that information should be searched for is mostly not stipulated. The reason information is searched for is in response to what is considered best practice (theme 2) and the availability of information (theme 5).

Teachers could follow the curriculum (theme 1) by giving children the information they need to complete their work tasks. However, best practice (theme 2) suggests that children should lead their own learning and this means that not only should children find out for themselves but also that teachers do not know all the information requirements at the start of a topic. Search technologies are used because they readily provide access to this information (theme 5).

However, it should be noted that in both participating schools there was only one computer per classroom and computers needed to be brought into the class for children to use.

7.1.4.2 Information use

11 different information uses (Q10) were identified in this study. The different types of information use seen in this study are likely linked to the setting being a learning environment. In prior studies, some of the uses have been well described before but others less so (see Table 23 and Appendix J).

That children are using searching technologies to orient and to extend has been seen in many studies of children when they are completing research assignments (see Appendix B). In this study, teachers in West Sheffield describe how particularly at the start of a new topic information is used to orient by seeking a broad and general understanding; later in the topic information may be used to extend knowledge of a particular aspect. This fits with the pattern described in the research literature whereby information requirements are broad at the start of an assignment but become more specific as a focus is reached (Kuhlthau, 2004; Vakkari, Pennanen, & Serola, 2003). However, although the teachers described the start of new work tasks as an open exploration of the topic, the search tasks could be very specific (Q14). There appear to be two reasons for this that are linked to the setting. Firstly, as best practice (theme 2) suggests that children learn better when something is linked to their own experience (Pritchard, 2014) prior to any search activity topics were discussed and this lead to the generation of specific search tasks. Secondly, as time was a concern (theme 5) even at the start of a topic teachers were helping children narrow down what they were looking for so that they could find information in the time available. This could be problematic as Kuhlthau (2004) recommends that the initial exploratory stage of formulation is not missed. However, not forming a focus can be a major cause of breakdown as the "formulation of a focus or a guiding idea is a critical, pivotal point in a search" (Kuhlthau, 2004, p. 95).

While many of the information uses have been observed in other environments (see Table 23), the particular set of information uses observed in this study is likely related to the IUE. For example, although to define has not been reported in any other study, it is likely that this use is far more prevalent in primary schools. After all primary schools are a learning environment within which children will be learning to read, write and learn new words both in English and other languages.

Five information uses were not seen in this study. That these information uses were not observed is not surprising given the IUE. Children may do Motivational and Personal/Political searches but this would not be for school work. Children were not noticeably keeping track nor monitoring information in school. There are three possible reasons for this. Firstly, children may lack these information skills. Secondly, given that this is an information environment where new topics are taught every half-term (about 6 weeks) there may be no need to record for the long term and keep abreast of developments. A third possibility is that children do keep track but this was not uncovered in this study because only teachers were interviewed. As both the Foundation and Y2 teachers describe similar searches for aye-ayes, there is some evidence to support this possibility. A further information use of decision making has been reported in many studies (Freund, 2008; Morrison et al., 2001; Toze, 2014). The teachers did report on children using information to make decisions; for example, which charities to raise money for in Y1. They did this though by looking up charities they already knew to find

additional information about them. As this could be categorised as "to extend" and as all information seeking is part of a larger process of decision making (Rouse & Rouse, 1984) with decisions made throughout the search process (for example, what query terms to use and what search results to select), decision making is not considered a distinct information use here.

Table 23: What information is used for - comparison with other studies

This study	Taylor (1991)	Limberg (1999)	Morrison, Pirolli & Card (2001)	Freund (2008)	Toze (2014)	Lundh & Limberg (2012)
To orient	Enlightenment	Scrutinising and analysing		Learn about		
To extend	Problem understanding		Understand	Find a solution		
To make sense					Make sense	
To illustrate						Explaining, Narrating
To decorate						Decorating, Illustrating
To verify	Confirmational				Confirm	
To navigate					Re-find	
To define						
To get instruction	Instrumental			How to	How to	
As precise data	Factual	Fact finding	Find	Find facts	Fact-finding	
To entertain					Entertainment	
		Balancing infromation	Compare / choose	Make a decision	Decision Support	
					Keep track	
	Projective					
	Motivational					
	Personal or political					

7.1.4.3   How information is used

In primary schools, information is used to fulfil requirements of the curriculum. There are two ways how this information is used. Firstly, information can be used directly to increase knowledge of a subject area. For example, the Y3 class search for information on weather and climate. Secondly, information can also be used indirectly to support learning of a subject area. For example, when Y2 children search for information on nocturnal animals they use this information to write a non-chronological report in their literacy lesson. Information about nocturnal animals does not directly lead to a knowledge gain in literacy. It is through using this information, the children learn about literacy but the information itself is not about literacy.

How information is used (Q9) may be idiosyncratic to the IUE. It is hard to find parallels in the more general research literature. The nearest equivalent is Bartlett & Toms' (2013) interpretation and ("information used to aid understanding of a phenomenon") and input ("information is entered into another process") although as will be discussed next there are two key differences. The first difference is that input is used for "manipulation of data and/or information" and is not used to gain understanding of a phenomenon. In some of the examples in this study, there is no attempt to gain an understanding of a phenomenon. For example, in Y6 when the children are learning about spreadsheet modelling they collect price

data for local attractions. Here, there is no attempt to understand about the pricing of local attractions. The data is simply collected so that it can be manipulated in spreadsheets. However, it cannot be said when Y2 children are searching for information on nocturnal animals to write a non-chronological report that children do not gain an understanding of nocturnal animals, and it would be difficult to see how they could write a report on this if they did not gain an understanding. The second difference is the input information for gene sequencing is directly relevant to the task at hand whereas in this study the information is unrelated. So when sequencing a gene, at one stage in the process, data is translated from one format to another so that it can be input in another process. The data in question is still genetic data, and is therefore directly relevant to the task. In this study information used to indirectly support the learning of subject areas is not intrinsic to the task at hand.

That information may only indirectly connect to the task at hand is almost certainly associated with the IUE. While on the one hand tasks in education are real-life tasks in that they are not simulated, they are also somewhat artificial in that they do not resolve real-life problems, although real-life problems may be simulated (Gordon, 1999, p. 5). Returning to the previous example, in primary school the purpose of writing a non-chronological report about nocturnal animals is to learn how to write a non-chronological report, and the learning about nocturnal animals is secondary. In another environment, say that of a zoologist, the purpose of writing that report, would be to learn about nocturnal animals. Therefore, for the zoologist the information use fulfils the first category of information use where information is used to directly increase knowledge of a subject area.

7.1.4.4   Intended outcomes

Teachers at the West Sheffield school describe using search technologies for five intended outcomes gain factual content, aid conceptual understanding, gain operational skills, learn analytical skills and a better learning experience. Teachers expected that using search technologies would enable a combination of intended outcomes (see Figure 8) and no search activity was planned for just one outcome. Perhaps not surprisingly there is a close match to the intended outcomes and what are considered areas of learning in school: "knowledge, concepts, skills and attitudes" (Department for Education, 2013b; Department of Education and Science, 1985; Pritchard, 2014, p. 19).

The distinction between factual content and conceptual understanding is not clear cut, and one not normally made in the LIS research literature. However, as noted above these concepts are distinguished in Education. Furthermore, there are differences in the way search technologies are used when the main intention is to gain conceptual understanding. For example, in Y3 children search Rightmove (www.rightmove.co.uk) for house information so that they can gain a conceptual understanding of data files. It is through the act of searching not the research results that Y3 children learn about data files. Interestingly, Spavold (1990) also reports on how children can gain a conceptual understanding of a system, this time through populating databases. However, whether there really are differences in information behaviour when the main intended outcome is conceptual understanding rather than to gain factual content needs to be investigated further.

7.2   Building a representation scheme

The representation scheme was built to describe real-life tasks in primary schools. A "task qua task" approach was taken to building the representation scheme whereby it is the properties of the task that are represented (Hackman, 1969, p.103). The scheme was built in three stages. In the first stage, using the research literature a provisional representation scheme based on what is likely to be important when considering search in a primary school environment was built. In the next two stages, through interview and observation studies this scheme was adjusted according to what is happening in primary schools. In future work, whether the scheme does actually describe properties of the task that are important to search should be tested.

Described next are some of the difficulties encountered building the scheme.

7.2.1   Appropriating existing multi-dimensional schemes

The initial plan when developing a scheme to represent children's search tasks was to build upon existing schemes (Kim & Soergel, 2006; Y. Li & Belkin, 2008; Pharo & Järvelin, 2004; Xie, 2009) that had already been developed in the broader field. There were two key reasons for doing this. Firstly, given that a description of a task could be vast (Hackman, 1969, p. 110), prior work could guide this study as to what is important to describe. Secondly, the schemes could be used to operationalise elements to reduce the terminological overlap that makes it so hard to compare findings across studies. This could also mean that appropriating these schemes could facilitate some comparison of children's search tasks with those of others documented using these earlier schemes.

However, although the schemes (Kim & Soergel, 2006; Y. Li & Belkin, 2008; Pharo & Järvelin, 2004; Xie, 2009) were used to guide the development of this study's representation scheme they could not be used as much as was anticipated. This is in part because the existing schemes all represent the tasks of individuals but the scheme developed in this thesis represents tasks from the perspective of the information use environment. This leads to three differences. The first difference is that only the objective task is represented in this scheme as this description of task applies to all the people in the information use environment, whereas the subjective task (the task as it is understood) will differ for each individual in the environment. This, however, is a reduction in what can be represented rather than a fundamental difference. A subjective categorisation of how individual children perceive tasks is desirable and should be undertaken in future studies. Secondly, although at the outset it was thought that children and teachers had different parts to play and that elements of search tasks could be categorised from the point of view of the child (for example, that origination could be externally assigned or internally generated) this proved not to be the case. Teachers and children were both originators (Q2) and doers (Q4) of search tasks. For this reason, it was necessary to document who was doing and who was originating the search. Thirdly, some representations such as timeframe were not relevant to the primary school information use environment whereas other elements such as planning (Q6) were relevant to this environment but have not been included in prior representations.

So although the existing multi-dimensional schemes could not be used as much as was anticipated, they were still useful in guiding the development of the representation scheme. The schemes helped identify what is important to describe and provided a basis for many of

the categorisations. Furthermore, to some extent the differences between the schemes could be used to compare primary school IUE with other IUE.

7.2.2 Appropriating existing categorisation of elements

When the multi-dimensional schemes could not be applied categorisations from the children's and wider literature were sought. This worked well for some elements such as flexibility but was more problematic for others such as outputs and topic.

Flexibility

In Shenton & Dixon's (2004a) study it is only homework assignments that are examined and all these assignments had general topical goals. In this study, the categorisation scheme is extended by considering specific item tasks too (Q14). It was found that teachers were also able to manipulate topic flexibility (Q3) by either giving children a choice of question to answer or allowing them some freedom in how to answer the question.

Outputs

No pre-existing categorisation was found to base outputs (Q12) on. The categorisation here can only be considered an initial attempt.

Topic

Given that topics are potentially unlimited (Y. Li & Belkin, 2008, p. 1833) it had already been anticipated that it would not be possible to find a way to fruitfully categorise topics. Instead the search tasks are categorised for the subject areas of the national curriculum (Q8). However, given that topics unite work tasks across subject areas, the importance of the topic should not be underestimated. The impact the topic subject matter has on children's search should be investigated further in future research. It was evident in the West Sheffield school that there is some cross over in content in the different topics, and children are searching for similar content in different year groups. Given that prior knowledge is known to affect search (Hirsh, 2004) to what extent children are able to use prior knowledge in different topics should be investigated. So although it was not possible to document topic, it is likely that topic is important.

7.2.3 Describing the task as enacted

The representation scheme has been designed to describe the objective task and was developed in phase 1 from interviews with teachers. However, it is also important to consider "task as behaviour description" (Hackman, 1969, p. 102). When validating the scheme in phase 2 using classroom observations the scheme provided a good description of the assigned task. However, it did not always provide a good description of the task as enacted. This is partly because tasks changed as they were enacted and also because there are multiple task performers. This is not surprising as it is well known that tasks evolve (Bates, 1989) and that tasks are also subjective (Byström & Hansen, 2005; Hackman, 1969). However, there is also an additional reason that is linked to the IUE, namely that, children in the class have different levels of skill (theme 3). So although assigned search tasks are nominally given to children to do not all the children can do the search task and the teacher is also the doer for some children and not others (Q4). Furthermore, as Lundh (2011, p. 57) found "information activities

are profoundly social activities" and it is problematic to describe individuals as the sole doers (Q4) and originators (Q2) of search tasks.

Of course, if tasks are not enacted as per the objective task, this is a serious limitation of describing objective tasks. Nevertheless, tasks are assigned in real-life and in research studies, and the description of this objective task is important to consider. This after all is the task that is given.

7.2.4   Operationalising search task in the two phases

Identifying what in phase 1 and 2 should be the search task to represent in the scheme was not straightforward. In large part this is because a group perspective has been taken whereby all the tasks that are a search for information within an IUE are represented. However, this was further complicated by employing two different study methods: interviews and observation. Why search task was difficult to operationalise in the two phases is discussed next.

Phase 1 interview study

To represent tasks that are a search for information within an IUE, the task must be identified and a consistent approach to identification needs to be taken. In much of the research literature tasks are considered hierarchical (in that there are tasks and sub-tasks). Byström & Hansen (2005, p. 1056) suggest that there are three levels: work task, information seeking task and search task. So within a work task there may be multiple information seeking tasks, and within an information seeking task there may be multiple search tasks. An information seeking task is "the satisfaction of an entire information need" and a search task is "satisfaction of a separable fraction of an information need" (Byström & Hansen, 2005, p. 1056). Li & Belkin (2008) also suggest that there is another level of retrieval task. The hierarchy though is not rigid and a search task can also be an information seeking task (Byström & Hansen, 2005; Y. Li, 2009, p. 275; Y. Li & Belkin, 2008, p. 1823; Pharo & Järvelin, 2004).

In phase 1 in the interview transcripts it was hard to distinguish whether a task description related to a search task or to an information seeking task. In the research literature, the levels of the sub-tasks are differentiated by number of consultations, the specificity of the information goal and type of search system used. Information seeking tasks have general goals that usually cannot be answered by one source, and information may be sought from printed documents, people and electronic systems. By contrast search tasks have specific goals, the task may be completed in a single consultation (Byström & Hansen, 2005, p. 1056; Y. Li & Belkin, 2008, p. 1823) and electronic systems are used (Y. Li & Belkin, 2008, p. 1823). When considering the different tasks that the teachers described it was problematic to use these conceptualisations to identify whether a task was an information seeking task or a search task, for the following three reasons.

Firstly, the number of consultations and types of search system used (Q12) could depend on the location (Q7) of the task rather than the information requirements. For example, in Y4 "research a minibeast" was conducted in school whereas "research the habitat of a creature" was given as homework. The differences between these tasks was that homework tasks (it was hoped!) could be conducted on more than one occasion and using any resource (search technologies, people, books and so on) whereas at school the same task could only be conducted once using often only search technologies. To place these two tasks ("research a

minibeast" and "research the habitat of a creature") in separate categories based on possible number of consultations and search systems used is somewhat problematic when the information requirements are similar.

Secondly, what search systems are used may depend on the child not the task. Some children may only use electronic systems whereas other children may use people and books too. Particularly with the younger year groups the teachers would provide alternative sources of information for children who found using the Internet difficult.

Thirdly, work tasks with essentially the same information requirements can have sub-tasks of different goals (Q14). For example, the Y6 teacher describes how there are two ways that they will search for information at the start of a new work task. They may start with a general search or the class will share what they already know, and then based on this prior knowledge search for specific information. The initial work task information requirement is the same for both search/seeking tasks but in the first scenario the information is sought from one system (the Internet) and the search requirement remains general. In the second scenario, the information is sought from two systems (people and the Internet) and the search requirement when using the Internet is specific. Not only is it hard to consider these search/seeking tasks as occurring at different levels but also neither scenario fits any definition.

So although it is already recognised that task levels can collapse in some circumstances, for example a search task can become a seeking task if the information requirement is satisfied in one consultation (Byström & Hansen, 2005, p. 1065) the problem here is somewhat different. Regardless of whether the task levels have collapsed, it is difficult to use specificity of goal, the number of consultations and the type of search system to differentiate the level of task. It may be that in many cases the different task levels are there but they cannot be identified through this. However, in terms of providing a description it does not appear to matter whether a task is an information seeking task or a search task. The same representation scheme can be used regardless of the level of task (Y. Li & Belkin, 2008). Therefore, in this study tasks were not differentiated according to a hierarchy and all tasks that resulted in a search for information are called search tasks. During this phase, search task was operationalised as the specification of an information requirement as reported by a teacher.

Phase 2 observation study

Whether the same operationalisation could be used in phase 2 needed consideration. In theory in this phase, using the conceptualisations in the literature, the task assigned to the class could be categorised as an information seeking task and all the changes to information requirements could be categorised as search tasks that are sub-tasks of the overall information seeking task. However, practically this was also not straightforward for two reasons.

Firstly, how children performed the tasks differed. Although some children did split the task that was assigned to them into smaller sub-tasks, others did not. This is as could be expected: search tasks may become information seeking tasks if resolved in a single consultation (Byström & Hansen, 2005, p. 1065), and how the assigned task is perceived will depend on the task recipient (Byström & Hansen, 2005; Hackman, 1969). However, in terms of describing the task from a group perspective this is problematic as no single description applied to all in a class. Secondly, where there were sub-tasks it was difficult to identify the start and end points. Changes in information requirement could be identified from children's queries but the

154

information requirements were not always expressed and could not be identified as so many of the children's queries were broad. In part not being able to identify start and end points is linked to the research design. A task performer may only recognise start and end points of tasks retrospectively (Byström & Hansen, 2005; Hackos & Redish, 1998) and so a particular problem for this study is that the tasks have not been described by the task performer but are from class observations. Had children been interviewed it may have been possible to have identified the different sub-tasks. However, it is also well known that search evolves, and the task at the start of a search may not be the same task at the end (Bates, 1989). Some of the searches went off-topic and whether they are a new task or part of the same task is then debatable (although again this could perhaps have been resolved in an interview study).

As with phase 1, in terms of providing a parsimonious description of the task that is the search for information, the description of the assigned task is mostly the same as the description of any sub-tasks. While information use and search goal could change from the assigned task that was given, all other elements remained the same. As such the operationalisation employed in phase 1 could be used in phase 2 with only minor adjustments to the wording used in the representation scheme.

7.2.5   Determining the role of the work task

Identifying work tasks as such was not problematic. Children are taught in units of work, "a coherent body of teaching" (Dictionary of Education, 2016) and as these units are "separable parts of a person's duties" (Byström & Hansen, 2005, p. 1053) they can also be thought of as work tasks. That topics are used to unite work tasks (see 7.1.2.2) does matter when describing the search task as a search task can fulfil information requirements in more than one work task, and it will occur in different stages for the different work tasks. Arguably, all options should be described (all work tasks related to the search task, and the stage in the motivating work task and overall topic) when describing the search task. However, this would make the representation scheme unwieldy and the point of the scheme is to describe only what is important. In lieu of further research and with a desire not to overburden the scheme with too many descriptions, a decision needed to be made as to when the search task should be described in relation to the motivating work task and when to the uniting topic. It was thought likely that the nature (Q1) of the motivating work task is most important, as it is the motivating work task that determines how the information will be used. However, it is the stage (Q10) of the uniting topic that is most important as it is topic knowledge that will influence relevance judgements and dictate what query terms are available.

7.3   Answering the research questions

In this thesis, what is shaping primary school children's search activities is considered and primary school children's real-life search tasks are described. It is thought likely that if primary school children are a distinct group what is influencing the search activity is likely to be particular to that group and this will also be reflected in the search tasks.

7.3.1   RQ1: What is shaping primary school children's search activities?

A key concern of the field has been can primary school children can be considered a distinct group. The findings of this thesis suggest they are. This distinction is not simply due to age but

to the IUE. While age is influencing primary school children's search it is not the only influence. There are multiple influences which combine (see Figure 11) to shape the search activity. Many of the influences can be mapped onto Taylor's (1991) concept of an IUE, and the concept of an IUE provides a fuller explanation of children's search activities. While it does not fully explain what is occurring in primary schools it does go some way to "taming the unruly beast" that is context (Dervin, 1997).

7.3.2   RQ2: What are primary school children's real-life search tasks?

By asking teachers to describe the different ways search technologies are used and by employing the representation scheme to document these uses, the range of search tasks within a single primary school are scrutinised. This results in a much more holistic depiction of children's search, although it is recognised that to gain a full picture further research in other schools and other environments is needed. Nonetheless, this study does highlight the diversity of children's search tasks, and that children are not just using search technologies for research assignments. For a full list of all the search tasks in this study see Appendix P.

8   CONCLUSION

This chapter reports the contributions made and how the contributions can be used. The limitations of the study are given and future work is outlined.

8.1   Key contributions

In many prior studies children have been considered a distinct user group because of their age and cognitive development with a few other studies indicating that the environment within which children are searching for information influences search activities. It is important to know what is influencing search because if primary school children are a distinct user group support both in terms of providing guidance and developing systems should be tailored to this group. However, what support is needed will also depend on the way search tasks have been constructed (Hackman, 1969, p.97) but there is little knowledge of the range of search tasks that children might do in school and descriptions of search tasks are poor. In this study, a holistic approach has been taken to understanding what is shaping children's search activities and search tasks. This study leads to new insights on the influence of the information use environment on search activities and into the range and variety of search tasks within the primary school environment.

An interesting result of this study is that primary school children can be thought of as a distinct group but to understand how and why children search for information it is important to look beyond age and to also understand the setting within which the information is used. The findings of this study suggest that primary schools are an IUE but the set and the setting extends beyond children and school.

- Sets of people: To an extent primary school children can be thought of as a set of people as although ages range from 4 -11, information use is similar across the different ages. Age did impact on search activities as teacher's designed activities to take account of children's age particularly the need to keep children safe and their developing search skills. Linked to this primary school children's search tasks were also conducted by teachers and in conjunction with teachers. This makes it difficult to consider primary school children's search tasks as belonging to a single set. As children and teachers are both doers and originators of children's search it is difficult to conceive of search as an individual activity. As in much research children are often examined as individuals when using search technologies, the ecological validity of these studies is a concern.
- Problems: In primary schools search technologies are mostly used to resolve information needs that stem from the curriculum that has been imposed on the setting. Although teachers did describe how children were using search technologies to do research assignments, they were also used to solve a range of information problems. As well as using search to realise long term projects it is also often used in an everyday way to solve impromptu information needs. Topics are used to unite disparate work tasks in primary schools and so a search can fulfil information requirements for what are essentially very different work tasks.
- Setting: That the setting is a highly regulated learning environment influences what information is used for and search activities. However, it is not the only setting that is influencing search in primary schools and notably the home environment is also

influencing children's search. Furthermore, access to information varies in primary school settings.

- Resolution of problems: Information problems are resolved with 11 different information uses. The particular set of information use is linked to the setting being a learning environment and the age of primary school children. That information can be used either directly to increase knowledge of a subject area or indirectly to support learning of a subject area has not been reported before. That information may only indirectly connect to the task at hand may also be indicative of the IUE.

A further contribution of this thesis is a novel representation scheme of search tasks developed from a review of the literature and two phases of research. This scheme can be used to describe search tasks as they materialise within the primary school information use environment. The scheme will be further validated in future work.

8.2   How contributions can be used

The contributions from this thesis can be used to inform theory, system design, research design, and classroom practice.

Theory

Very little research examines the connections between search task, work task and task environment (Toms, 2011, pp. 48–51) and this study extends understanding of the relationship between these concepts. Notably what have hitherto been generally agreed upon conceptualisations of work task and search task could not be applied wholesale in this study. It was not possible to distinguish different levels of tasks, and search tasks for different work tasks were often united by topic across multiple distinct work tasks. Whether the mismatch is connected to the research method, an idiosyncrasy of the information use environment or the conceptualisations need updating for the more general field, requires further consideration.

Research design

The representation scheme (Table 22) and list of real-life search tasks (Appendix P) could be used by researchers wanting to test systems. The search tasks collected in this study could be used by researchers wanting to design studies based on real-life tasks. For those wanting to design their own tasks, the representation scheme could be used to design search tasks that are realistic and based on what children do.

The evidence bases (Appendix A and Appendix B) in conjunction with the representation scheme (Table 22) could also be used to guide researchers on what the gaps there are in the research literature and what would be fruitful elements to study.

System design

The insights from this study can be used to help inform system design. It is through developing an understanding of task, that IR systems can be improved as they will be better able to support the searcher in finding the information they need (Ingwersen & Järvelin, 2005; Vakkari, 2003, p. 413). The findings could also be used to support the design of child-friendly systems. However, the value of these systems is questionable as children show little inclination

to use them and in tests the use does not lead to better performance (Jochmann-mannak et al., 2010). The findings of this study indicate that a task-based system may be more beneficial.

Inform classroom practice

While there is some guidance for teachers on developing digital literacy skills this tends to be for technology in general (Hague & Payton, 2010) or when considering search technologies for research assignments (Nesset, 2014). This representation scheme in particular and the findings in general, provide a greater understanding of the variation in primary school search tasks. This understanding could be used as a basis for providing guidance to teachers on what children need to know about search technologies.

8.3 Limitations

How the study was designed does have implications for the quality of the research. Furthermore, how long the findings may be current should be considered.

8.3.1 Using teachers to inform on children

Phase 1 uses teachers to inform on children. This could be considered problematic for two reasons. Firstly, a child's perspective is missing from this research. The phase 1 study is entirely from the perspective of teachers and phase 2 is based on observations. There is a danger that using adults to inform on children makes children the object of the research rather than subject (James et al., 1998). However, the approach taken here is thought to be acceptable for the purpose of this study as it is teachers who decide whether the search activity takes place and only an objective description of search tasks is sought. Nonetheless, this study should be complemented by further research that considers search from the perspective of children.

Secondly, it is possible that some search tasks were missed. In phase 1, teachers were able to report on how the search tasks they gave children evolved. They could do this because this is a collaborative environment where teachers and children were sharing information with each other. However, it is quite possible that many changes of search task were missed, as children may not have or may not have been able to express all their information requirements (Belkin, Oddy, & Brooks, 1982; Hackman, 1969; Taylor, 1968). Furthermore, as observed in phase 2 children also did search tasks "under the desk" (Maybin, 2007).

8.3.2 Short engagement with few participants

Studying real-life is difficult and gaining access to primary school classrooms in this study was hard. As such the length of time spent in the schools was short. Furthermore, only 10 teachers were interviewed in phase 1. However, this was a sampling decision and these teachers were purposefully selected so as to gain as much variation in the sample as possible. Whether more interviews were necessary was considered but it was thought that no new insights would be generated.

Only two schools participated in this study and this has implications for the transferability of the findings. Whether the findings are transferable should be tested in further research. If primary schools are an IUE then it is thought likely that many of the findings will be transferable to other primary schools as aspects of the environment identified as influencing

search are likely to be similar across all primary schools. However, as noted in section 7.1.3.3 settings do differ, and what impact this has on the IUE does require further investigation.

8.3.3   Re-using data

In phase 2 data was re-used from earlier observations. This has some advantages in that the data collection was not influenced by phase 1 but also had the disadvantage that the data collection was not designed for the purpose of phase 2. That the interviews for the West Sheffield observations were largely not relevant and there were no interviews for the East Sheffield observation is particularly problematic. Had the observations been collected for the purpose of the study, interviews could have helped to validate the representation scheme and provide a more complete description of the search tasks. Some of the difficulties encountered in operationalising levels of tasks may have been alleviated.

8.3.4   Use of existing research and theory

Where possible existing research and theory was used to support this study. However, in places this use was not straightforward.

It was difficult to apply conceptualisations of search task and work task as defined in the more general literature to the data collected in phases 1 and 2. This could be linked to a weakness in the study design as only teachers were interviewed. Had there been interviews with children to accompany the observation data it may have been possible to have identified different task levels.

The representation scheme was initially developed from the research literature based on what the field consider important properties of task. The scheme was then amended to reflect the search tasks as they occur in primary schools. Whether the scheme does actually describe properties of the task that are important to search has not been tested and should be in future research. Furthermore, the representation scheme is at its strongest where existing categorisations could be built on. Where categorisation schemes could not be found they had to be built from the data. Notably the categorisation of outputs is weak, and could be improved with further research.

8.3.5   Stability of the primary school IUE

The stability of the primary school IUE and how long the findings will be current needs consideration. While many of primary school problems may be typical they are not immutable and what constitutes resolution of problem also changes. Notably, the curriculum (theme 1), best practice (theme 2) and what resources are available (theme 5) have changed over time and will likely continue to change. This could account for some of the discrepancies in the findings of this study compared with prior work. How long the findings of this study will continue to be relevant also needs to be considered.

That best practice (theme 2) and resources available (theme 5) have changed in recent years in primary schools could account for differences with Gross's (2006) study. It used to be that the curriculum was taught by teacher's delivering all information requirements. A change in ethos (theme 2), where children are now expected to lead their own learning, coupled with easy access to information via the Internet (Kuhlthau et al., 2007) has changed how and why

information is searched for in the classroom. So although, Gross (2006) found that teachers already know the answers to the search tasks that they assign children, in this study teachers reported that because lessons evolve they were searching for information in class that they did not know.

What influences search activities in primary schools may continue to change and in future work differences will be found with this study too. Notably, government initiatives such as the move towards schools becoming academies (Cook, 2016) whereby schools are no longer required to follow a national curriculum (though most state schools still do, Department for Education, 2017), and the current funding crisis threatening many primary schools (Coughlan, 2017) and the impact that could have on resource, could change the information use environment. Furthermore, a new curriculum had been introduced the year of the West Sheffield interviews. The challenge teachers faced implementing the new curriculum could have impacted on search activities in ways that might not be seen in future years when the curriculum is more embedded.

8.4   Future work

The aim of this thesis was to gain a greater understanding of children's search with a focus on primary school children. This aim was achieved by investigating in two schools what is shaping search activities and the search tasks that are conducted therein. This work could now be extended by considering other primary schools, comparing with other IUE, and a more in-depth analysis of some of the search task elements. The following are plans for future work:

1) Investigate further how the information use environment impacts on search by looking at
   a) other primary schools and seeing what aspects of the environment are the same and what are different. Then whether, and how, these aspects impact on search activities
   b) the similarities and differences of with those of other IUE.
2) Survey primary schools to see how transferable the representation scheme is to other schools, and to see how search tasks change across year groups.
3) More detailed study to get greater understanding of how elements change search:
   a) A greater understanding of how search tasks get their cost structure given that there are both motivating work tasks and uniting topics. Furthermore, should stage of task be considered for the uniting topic or motivating work task, if indeed it should be considered at all?
   b) Does origination affect task success. Are children more successful when they have a choice of topic or when they do or do not have a framework? What are the differences between teacher generated and child generated search tasks?
   c) Extend the representation scheme to include a subjective categorisation of task. This could then be used to understand the different ways individuals within a class setting environment perceive the assigned task.

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Appendix A Evidence Base A: Descriptions of children's search tasks

Documented here are all the studies where children's search tasks have been described. For each study, how the search has been described, the age of the participants, who designed the task, how the task is used in the study, and the overall purpose of the study is documented.

Conventions used

- Where possible the task descriptions are categorised in bold according to the representation scheme used in this thesis. If different terminology is used in the original study, the original categorisation is given in brackets. For example, Bilal (2002a) uses the term "type" rather than "goal" to categorise open and closed search tasks. This is displayed here as "**Goal** (Type): Open, Closed"
- Where a study also appears in Appendix B: Evidence Base B this is indicated by *** in front of the authors' name.

Authors	Task description	Participants	Task design	Task in study	Purpose of study
Agosto & Hughes-Hassel (2005)	**People**: Friends/family, School employees, Mentors, Customer service staff, Librarians, Passers-by **Media**: Telephones, Television, Computers, Radio, Newspapers, Product packaging, Personal communication systems,Printed school materials, Product catalogs, Printed ephemera, Books, Magazines, Phonebooks **Topics**: Schoolwork, Time/date, Social life/leisure activities, Weather, Daily life routine, Popular culture, Current events, Transportation, Personal finances, Consumer information, Personal improvement, Job information	Age: 14-17	Self-generated or assigned by teacher	Elements identified during course of study	To find out what young adults search for in everyday life, the media and the sources they use.
Agosto (2002)	**Origination**: Preselected websites / Free surfing. Also refers to Gross (1999) Self-generated / Imposed	Age: 14-16	Searching for the purposes of the research, but they are (mostly) free to search	Examination of element(s)	Uses the searches to establish website evaluation criteria, and finds that evaluations differ between imposed and self-generated searches.

Authors	Task description	Participants	Task design	Task in study	Purpose of study
			on their own interests.		
Bilal (2000)	**Goal:** Fact-based	Grade: 7-9 (US)	Researcher / Teacher	Examination of element(s)	Can, and how, children find the answer to fact-based question
Bilal (2001)	**Origination**: Assigned **Goal**: Research	Grade: 7-9 (US)	Researcher / Teacher	Examination of element(s)	Whether there are differences in behaviour / success for fact-based and research based tasks.
Bilal & Kirby (2002)	**Goal**: Fact-based	Age: 12-15 & university students	Researcher	Examination of element(s)	Children and adults' cognitive, affective and physical behaviours in a fact-based task. It is not clear why the fact-based task was selected.
Bilal (2002a)	**Goal** (Type): Open, Closed **Complexity** (Nature): Complex, Simple **Origination** (Administration): Fully assigned, Semi assigned, Fully self-generated	Age:12-13	Self-generated but for the purpose of the research	Examination of element(s)	Differences in search behaviour for self-generated and assigned information tasks.
Bilal (2002b). Data collected in Bilal (2000, 2001, 2002a)	**Goal**: Research-based (Open-ended), Fact-based **Complexity**: Complex, Simple **Origination**: Fully assigned, Semi self-generated, Fully self-generated	Age: 7-12	Researcher / teacher	Examination of element(s)	Children's cognitive, physical and affective behaviours for different information tasks.
Bilal, Sarangthem & Bachir (2008)	**Origination**: Assigned, Semi-assigned, Fully self-generated	Age: 6-10	Researcher	Examination of element(s)	To produce an empirical model of Arabic children's information seeking in ICDL.
Bilal & Sarangthem (2008)	**Origination**: Assigned, Self-generated **Goal**: Fact-based, Open ended **Complexity**: Complex	Age: 6-10	Researcher	Examination of element(s)	To identify models of behaviour based on task type
Bilal & Gwizdka (2016), Gwizdka & Bilal (2017)	**Origination**: Assigned, Self-Generated **Goal**: Factual, Research / Information	Age: 11-13	Researcher	Examination of element(s)	How task type and grade influences query formulation and result selection.
Borgman et al. (1995)	**Topic**: Topics not pre-classified but the results suggest that task difficulty is related to topic vocabulary and prior knowledge.	Age: 9-12	Researcher, based on science curricula	Identification of elements	How children use online catalogues, and if there are differences depending on the search topic.

Authors	Task description	Participants	Task design	Task in study	Purpose of study
Borlund (2016)	**Goal** (Information need): Verificative, Conscious & Muddled **Origination**: Simulated Work Task, Personal self-prepared	Age: 14-17, teachers	Researcher	Examination of element(s)	Whether there will be differences of behaviour for the different types of information need
Branch (2003), Study 1	**Origination**: Researcher, Children with teacher, Self-generated personal **Complexity**: Domain knowledge	Grade: 9 (US)	Researcher / teacher	Examination of element(s)	To see what help children need when using search technologies.
Coiro & Dobler (2007)	**Content: Locate, Synthesis**	Grade: 6 (US)	Researcher	Tasks to stimulate different search behaviour	Reading strategies used to search and locate information
*** Cooper (2002)	**Source**: Computer encyclopaedia, Library book shelves	Age: 7	Researcher who is also the school librarian.	Elements investigated	Interested in search strategies and the differences between CD and book behaviour.
Crow (2011)	**Goal** (Task type): Open-ended, Closed **Complexity** (Task nature): Complex, Simple **Origination** (Task administration): Fully assigned, Semi-assigned, Fully self-generated **Doer** (Task relationship): Group, Individual **Topic**: Looks at topic but does not relate back to tasks. Uses Bilal (2002a) taxonomy but adds task relationships. Categorises children's self-generated tasks	Grade: 5 (US)	Examination of real-life tasks.	Elements investigated	What leads to an intrinsic motivation to seek information.
*** de Vries, van der Meij & Lazonder (2008)	**Origination**: Self-generated questions (from an assigned work task). **Nature**: Factual, Reasoning	Grade: 5 -6 (Dutch)	Researcher	Task to test participants. From a real-life study	Testing of a portal designed to promote reflective web searching.
Dinet, Bastien & Kitajima (2010)	**Topic**: High domain knowledge, Low domain knowledge.	Age: 10-17	Researcher	Tasks to stimulate different search behaviour	Do children use typographical cues or prior domain knowledge when examining search results?

Authors	Task description	Participants	Task design	Task in study	Purpose of study
Druin et al. (2009)	**Complexity**: Simple, Multi-step search	Age: 7-11	Researcher	Task to test system	How children search in keyword interfaces. Complex multi-step search task used to determine limits of children's abilities
Duarte Torres, Hiemstra & Serdyukov (2010a)	**Topic**: Cue clusters **Query intent**: Informational, Navigational, Transactional (using Broder, 2002) **Query type**: Question, Phrasal	-	AOL transaction log	Elements investigated	Analysis of transaction logs to understand children's search behaviour.
Duarte Torres, Weber & Hiemstra (2014)	**Topic:** According to Yahoo category structures **Query intent:** Navigational, Non-navigational	-	Yahoo transaction log	Elements investigated	Analysis of transaction logs to understand children's search behaviour.
Eickhoff, Dekker & Wiskunde (2012)	**Goal:** Factual questions, Open-ended questions: **Complexity:** Multi-step questions	Age: 8-12	Researcher	Task to test system	Design of an automatic classifier to identify struggling searchers. Using Druin et al. (2009) they classify behaviour in search sessions as stemming from 1 of 7 roles. But does not analyse the data according to task type.
Enyon (2009)	**Topic**: Look for information on a topic that interests you, Researching products you would like, Keep up with the news, Look for info on careers, Buying products online	Age: 8-19	?	Elements identified during course of study	How technology is used outside of formal education. These are the tasks in the survey. It is not clear how the tasks have been derived.
Foss et al. (2012), (see also Druin et al., 2009; Foss et al., 2013; Foss & Druin, 2014)	**Origination**: Self-generated, Imposed **Complexity**: One step, Multi-step	Age: 7-11	Researcher but 2 tasks are self-generated.	Tasks to stimulate different search behaviour	To identify and group different types of search behaviour. Goal – to view natural use. Complexity – to establish general computer and searching ability. Multi-step – to discover upper threshold of ability. Only multi-step (complex) search is analysed as a task.
*** Francke, Sundin, Limberg (2011)	**Sources:** Different social and technical characteristics	Upper secondary school	Researcher with teacher	Investigation of elements	How credibility of sources is assessed.
Gossen, Low & Nürnberger (2011)	**Query intent**: Informational, Navigational, Transactional (using Broder, 2002)	Children & adults	Transaction log analysis	Investigation of elements	Whether differences between adults and children can be determined in log files.
Gossen, Höbel & Nürnberger (2014)	**Query intent**: Informational, Navigational (using Broder, 2002)	Age: 8-11, 22-59	Researcher	Tasks to stimulate search behaviour	Differences in the way adults and children scan search results.

Authors	Task description	Participants	Task design	Task in study	Purpose of study
Gross (1999)	**Origination:** Self-generated, Imposed **Nature of imposition:** Imposed, Gift, Double imposed **Imposers:** Teachers, Parents, Children **Location:** Home, Class, School library media centre	Grade: Early childhood, Primary, Middle, Upper	Analysis of library transactions and interview study	Elements identified during course of study	Examination of the imposed nature of children's information tasks.
Gross (2001)	**Origination:** Self-generated, Imposed **User:** Imposer, Agent **Location:** Public library, School library media centre	Age: 4-11 and adults	Observation and interview of real-life use of libraries	Investigation of elements	Who is imposing and who is doing information tasks in public libraries and school libraries.
Gross, Dresang & Holt (2004)	**Origination** (Purpose): Self generated, Play, Imposed **Doer:** Number of users at computer **Computer use:** Library catalog, Library web page, E-mail, Games (Internet / CD), Online subscription, Search engine, Chat room, Other website, Educational software (CD), Word processing **Timeframe:** Repeat use, First time	Grade: 4-8 (US) Gender Ethnicity	Observation and interview of real-life computer use	Elements identified during course of study	What children are using public library computers for. Finds that use varies according to grade, gender and ethnicity.
Guinee, Eagleton & Hall (2003)	**Goal:** Scavenger hunt, Research project	Grade: 8 (US)	Researcher	Tasks to stimulate search behaviour	Adolescents' search strategies
Hirsh (1997)	**Topic:** Science and technology topics selected from Dewey Decimal Classification. Links to prior knowledge (used attainment to determine children's domain knowledge). **Complexity:** Browsing -match to directory headings, Keyword – based on number of results	Grade: 5 (US)	Researcher	Investigation of elements	How children find information for different types of information tasks. From literature review determined that prior knowledge, amount of information required, and structure of the library catalogue could impact on children's information seeking.
Hutchinson et al, (2007)	**Goal:** Browsing, Searching **Time:** Loosely timed, Timed	Age: 6-7 and 10-11	Researcher	Investigation of elements	To determine whether children will find it easier to search with flat or hierarchical categories. Tasks used to evaluate search interfaces.
Jochman-mannak, Huibers & Sanders (2010)	**Goal:** Fact-based **Topic:** Non-school related, different domains (Animals, Sport, Art & Music, Health) **Complexity:** Multi-step **Difficulty:** Level of abstraction	Age: 8-12	Researcher	Tasks to test system	Do bespoke search engines support children's search better than Google

Authors	Task description	Participants	Task design	Task in study	Purpose of study
Kammerer & Bohnacker (2012)	**Goal** (Complexity): Fact-based, Research task	Age: 8-10	Researcher	Task to test system	Whether children are more successful in finding information when using natural language queries?
Knight & Mercer (2014, 2017),	**Origination**: Assigned/Directed, Self-directed. **Goal**: Closed, Open	Age: 11-12	Researcher with teacher	Investigation of elements	Differences in talk between groups conducting information tasks. Although it is anticipated that talk will differ depending on information task type this is not actually discussed.
Kuiper, Volman & Terwel (2008)	**Complexity:** Simple and straightforward, Phrasing and difficulty of finding answer	Age: 10	Researcher	Tasks to test participants	Evaluation skills when using the web for information.
Madden et al. (2006)	**Ambiguity**: Lack of specificity in task statement **Difficulty** Repeat previous failed searches Also ask participants to repeat most recent search.	Age: 11-12, 14-15	Researcher	Tasks to stimulate different search behaviour	Strategies used in information seeking. Particularly, how children use the Internet for information tasks that they "typically perform".
Marchionini (1989)	**Origination:** Assigned: **Search task goal:** Open-ended, Closed **Facets:** Person, Place, Activity, Time	**Age:** 8-12	Researcher	Investigation of elements	Can novices use full-text systems. Predicts that it will depend on the task.
Meyers (2010; 2011)	**Inquiry tasks**: Descriptive, Explanatory, Evaluative	Age: 13-14	Researcher with input from teacher	Tasks to encourage different search behaviour	Processes and outcomes of group work.
Naidu (2005)	Uncategorised	Age: 7-11	Researcher	Tasks to test systems	Usability of educational websites
Nielsen (2010)	**Goal**: Directed tasks, Web-wide tasks	Age: 3-12	Researcher	Tasks to test systems	Usability of children's websites
***Oliver & Oliver (1997)	**Problem type**: Context, Social element	Age**:** 11-12	Researcher	Investigation of elements	What learning occurs during information seeking activities and whether this varies according to the context of theinformation problem and social elements.
Rouet & Coutelet (2008)	**Content**: Locate, Compare	Age: 9-13	Researcher	Tasks to stimulate	Children's document search strategies

Authors	Task description	Participants	Task design	Task in study	Purpose of study
				different search behaviour	
Schacter, Chung & Dorr (1998)	**Goal**: Well-defined finding, Ill-defined searching.	Age: 10-12	Researcher	Investigation of element(s)	Impact of search task structure on search behaviour. Task types derived from a review of the literature.
Scott & O'Sullivan (2005)	**Goal**: Locate specific information	Grade: 9 (US)	Researcher / Librarian (action research)		To observe information literacy skills.
Shenton & Dixon (2003)	**Information need**: Advice, Response to problems, Personal information, Affective support, Empathetic understanding, Support for skill development, School-related subject information, Interest-driven information, Consumer information, Self-development information, Preparatory information and supplementations, Verificational information	Age: 4-18	Focus group and interview study	Elements identified during course of study	Develop a typology of information needs.
*** Shenton & Dixon (2004a)	**Flexibility**: Open / Closed continuum based on (1) Topic (2) Focus	Age: 4-18	Teacher	Elements identified during course of study	The way in which ownership is afforded to children's tasks, and how children select topics.
Silverstein (2005)	**Topic**: Career planning, Health & Welfare, Death & Anxiety **Focus**: My life, My stuff, Other people, The world, The Universe, Abstract thought	Grade: k-12 (US)	Log study	Elements identified during course of study	What are the informal questions children are submitting to reference services?
Slone, 2003	**Use** (Broad, Situational Goal): Recreational, Personal, Educational, Job **Topic** (Specific Goal): Historical / Background, Known Person, Current, Supplemental, Fiction **Format**: Detailed text, Brief text, Non-textual data, Email	Age: 7-63	Real-life study	Elements identified during course of study	Impact of age and goals on search.
*** Solomon (1993, 1994)	**Goal**: Locating materials, Fact retrieval, Exploration **Information use**: Personal interest, Structured assignments, Open assignments **Complexity**: The tasks were not categorised according to complexity but the children's queries were.	Age: 6-12	Teacher	Elements identified during course of study	Real-life study: to understand what leads to search success/breakdown

Authors	Task description	Participants	Task design	Task in study	Purpose of study
Tu, Shih & Tsai (2008). See also Hwang et al. (2008)	**Goal**: Open-ended, Close-ended	Age: 14	Researcher	Investigation of element(s)	How performance varies according to type of task, experience and epistemology.
Vanderschantz, Hine & Cunningham (2014)	**Origination**: Student initiated, Teacher initiated **Flexibility**: Own choice of sub topic **Topic**: My culture, Kitchen chemistry, Historical events, Celebrities, Human rights **Location**: Home, School classroom, School library, Public library **Outputs**:Speeches, Essays, Slideshows / PowerPoint, Posters, Dioramas, Writing in homework books, Book **Sources**: Google, Wikipedia, Print sources	**Age:** 9-11	Teacher	Elements identified during course of study	Investigation into children's search strategies, and differences when using books / internet. Describes individual elements of school tasks. Does not integrate the elements and does not analyse strategies in relation to task types.
Walraven, Brand-Gruwel & Boshuizen (2008a)	**Subject areas**: Physics, Geography, Language, Culture **Type of Information requested**: Persons, Amounts, Goals, Cause, Effect, Evidence, Opinion, Explanation, Equivalence, Difference **Type of Match**: Locate, Generate **Plausibility of distractors** Based on Mosenthal (1998)	Age: 14	Teacher under researcher instruction	Investigation of element(s)	How information and sources are evaluated for a particular types of information tasks.
Walter (1994)	**Origination**: Adults **Topic** (Need): Self-actualization, Esteem, Love and Belonging, Safety, Physiological	Teachers reporting on behalf of children	Interview study	Elements identified during course of study	To determine what children's information needs are.
Wu & Cai (2016)	**Goal**: Semi-open ended, Closed-ended, Research oriented (Open-ended)	Grade: 7-12 (China) Cognitive style:	Researcher	Investigation of element(s)	Whether search behaviour varies according to type of task. Also the influence of grade and cognitive style.

Appendix B Evidence Base B: Descriptions of children's work tasks where search occurs

Documented here are all studies of children's work tasks where a search activity has occurred. For each study, the description of the work task, the age of the participants, the extent to which the search task is considered in the study, and who designed the work task are documented.

Conventions used

- Where possible work task descriptions are categorised (in bold) according to this study's representation scheme (e.g. **Location**, **Output** and so on).
- Where a study also appears in Appendix A: Evidence Base A this is indicated by *** in front of the authors' name.

Authors	Work task	Task description	Participants	Purpose of study
Abbas (2005)	Not known	**Origination**: Work task assigned by teacher. Researcher dictates how to use bespoke search system (Artemis). **Flexibility**: Task assigned by teacher but the questions are devised by the children and mediated by the teacher **Doer**: Children work in small groups **Location**: School **Timeframe**: Only multi-session searches included in study.	Age: 11-13	A study of the relationship between children's questions and search terms used, and document representation.
Alexandersson & Limberg (2003)	Assignment	**Origination**: Teacher **Flexibility**:Own choice of sub-topic e.g. Pirates, Titanic **Topic**: The sea **Doer**: Start by searching collaboratively but work on texts individually. **Location:** School library, Public library, Classroom, Home	Age: 11	How meaning is constructed through information objects in the school library

Authors	Work task	Task description	Participants	Purpose of study
		Timeframe: "a number of sessions" (p.20) **Output**: Final product is a booklet		
Asselin & Moayeri (2008)	Homework assignments	**Location**: Home **Timeframe**: 2 weeks Lists information tasks but does not categorise.	Age: 12 & 15	Investigation of children's Internet literacies.
Branch (2003), Study 2	Inquiry-based learning activity	**Origination**: Teacher and School librarian / Researcher **Flexibility**: Research project of child's choosing **Doer**: Individual but also group work **Location**: School **Timeframe**: Two months / 18 classes **Output**: PowerPoint presentation	Grade: 9 (US)	Think together and think after used to determine what help children need when using search technologies.
Bowler (2008, 2010)	Inquiry-based project	**Origination**: Teacher **Flexibility**: Choice of sub topic **Topic**: Continuity and change in Western civilisation **Doer**: Individual **Location**: School **Timeframe**: 4 months **Output**: Argumentative essay	Age: 16-18	Information seeking activity not observed. Uses journals and interviews to identify the role of metacognitive knowledge during inquiry-based projects.
Chu, Tse & Chow (2011)	Inquiry project-based learning in General Studies	**Origination**: Researcher with teacher **Flexibility:** Own choice of sub-topic **Topics:** The Earth, History of Hong Kong or China **Doer:** Groups of 5-6 **Location:** School **Timeframe:** 9-10 weeks **Output:** Written report, Presentation	Primary: 4 (Hong Kong), equivalent to grade 4 (US)	Developing primary school children's information literacy skills
Chung & Kim (2007)	Research in Literature	**Origination**: Teacher **Flexibility**: Choice of author	Grade: 11(US) Ability: Low level	To design information literacy instruction for low-level students,

Authors	Work task	Task description	Participants	Purpose of study
		Topic: American literature authors **Doer**: Individual School library **Output**: 2 page paper and PowerPoint presentation		
Chung & Neuman (2007)	Class project in persuasive speech class	**Origination**: Teacher **Flexibility**: Self-chosen topic **Doer**: Individual **Location**: School library, Home **Timeframe**: Two weeks **Output**: 5-7 minute speech. Also written outline and note cards **Goal**: In-depth **Source**: Online, Offline	Grade: 11 (US) Attainment: honours students	How information is found and used for a school persuasive speech class. Examines search process for learning task.
Cole et al. (2013)	Research project in History	**Origination**: Teacher **Flexibility**: Topic of group's choice **Doer**: Group **Timeframe**: 3 ½ months **Output**: Written proposal, Final presentations (Documentary video, Hstorical newscast, Performance skit, Art exhibit, Historical re-enactment)	Grade: 8 (Canada)	Can implicit knowledge identified in proposals be used to predict instructor marks? The searches themselves were not discussed.
*** Cooper (2002)	Project about spiders	**Origination**: Teacher assigned work task. Information task assigned by School librarian / Researcher **Flexibility**: None **Doer**: Pairs, Groups **Location**: School library **Timeframe**: 3 occasions **Output**: Notes **Source**: Computer encyclopaedia, Library book shelves	Age: 7	Interested in search strategies and the differences between CD and book behaviour.

Authors	Work task	Task description	Participants	Purpose of study
*** de Vries, van der Meij & Lazonder (2008)	Biology:	**Origination**:Teacher **Flexibility** Self-generated questions (from an assigned work task). **Topic**: "Design of a community of bees or ants" **Nature**: Factual, Reasoning **Doer**: Mostly pairs **Location**: School **Timeframe**: 6 lessons **Output**: Concept maps, Drawings, Explanations, Final presentation	Grade: 5-6 (Dutch)	Testing search portals designed to help children incorporate new information into existing knowledge structures.
Fidel et al. (1999)	Homework assignments	**Origination**:Teacher assigned **Topic**: Horticulture **Doer**: Individual **Location**: School library. Research participants used computers in a separate room. **Timeframe**: Weekly assignment	Grade: 11-12 (US)	High school students searching behaviour.
*** Francke, Sundin, Limberg (2011)	Class project work	**Originator:** Teacher with researcher **Doer:** Groups **Topic:** Nuclear power **Timeframe:** 7 weeks **Output:** Presentation	Upper secondary school	How credibility of sources is assessed.
Heinström (2006)	Guided inquiry projects in Humanities, Social studies, Chemistry, Biology	**Stage**: Initiation, Formulation, Conclusion	Grade: 6-12 (US)	How motivation changes search behaviour
Herring (2009)	Discursive essay on a topical issue, English	**Origination:** Teacher with some input from Researcher **Flexibility:** Own topic **Doer:** Class brainstorming, Individual **Output:** Mind mapping	Year: 8 (UK) Attainment: Mostly high achievers	

Authors	Work task	Task description	Participants	Purpose of study
		Sources: Various		
Herring (2010a, 2010b, 2011)	Research based tasks in History, Science, Modern languages	**Origination**: Teacher **Flexibility**: Select own choice of an area of a topic **Doer**: Individual **Timeframe**: A term **Output**: Diary, Holiday brochure, Multimedia presentation, Visual and narrative depcitions **Sources**: A range	Age: 11-12	Study of information literacy practices. Including how children formulate their own questions for curricula assignments
Hirsh (1999)	Research paper	**Origination**: Teacher **Flexibility**: Own choice of sport person **Topic**: Sports figure **Doer**: Individual Location: School library **Timeframe**: 4 weeks **Output**: Written report (4 pages minimum including cover, pictures, timeline, map, and acrostic poem), Presentation.	Grade: 5 (US)	The purpose of the study is to determine information seeking behaviour and relevance criteria for school topic searches.
Hoffman, Wu, Krajcik, Soloway (2003)	Online inquiry – in Science	**Origination**: Teacher **Flexibility**: Children's questions on curricula science topic **Doer**: Pairs **Location**: School computer rooms **Output**: Activity sheets, Posters, Journals, and Reports	Grade: 6 (US)	How students learn using the web.
Julien & Barker (2009)	Science assignment	**Origination**: Teacher **Doer**: Pairs **Topic**: Major world biomes **Location**: Mostly school library **Output**: Report	Grade: 11 & 12 (Canada)	Information literacy skills used during class assignment.
Kuiper Volman &	Collaborative inquiry	**Origination:** Researcher / Teacher	Age: 10	Whether information literacy skills can be developed through collaborative inquiry

Authors	Work task	Task description	Participants	Purpose of study
Terwel (2009)		**Flexibility:** Free to follow own interests on topic **Topic:** Healthy Food **Doer:** Pairs **Timeframe:** 10 weeks **Output:** Brochure		
Large, Beheshti & Rahman (2002) and Large & Beheshti (2000)	Research topic	**Origination:** Researcher / Teacher **Flexibility:** Choice of aspect of topic **Topic:** Winter Olympics **Doer:** Small groups **Location:** Classroom **Timeframe:** 78 half hous sessions **Output:** Poster **Source:** Web, CD-Rom, Print	Age: 12 Gender: Male, Female	Whether search behaviour varies according to gender. Also children's experiences of using the web.
Li & Lim (2008)	Historical inquiry	**Origination:** Researcher with teacher **Doer:** Pairs **Search goal:** Open-ended **Output:** Presentation slides	Age: 12-14	The use of scaffolds in online inquiry
Limberg (1999)	Learning assignment	**Origination:** Teacher **Topic:** Swedish EU membership **Doer:** Groups **Location:** School, Site visit **Timeframe:** 4 months **Output:** 20 page paper	Age: 18-19	Link between conceptions of information seeking and learning outcomes
Lundh & Alexandersson (2012), Lundh (2010)	Research	**Origination:** Teacher **Flexibility:** Topic of own interest **Doer:** Individuals, Pairs **Location:** Classroom, School library, School computer room **Timeframe:** 5 weeks **Output:** Mind maps, Presentation,	Age: 9-10	How children's choice of topic is negotiated with the teacher. How children search for and use images

Authors	Work task	Task description	Participants	Purpose of study
		Booklet		
Madden, Ford & Miller (2007)	Homework assignments	**Origination:** Teacher **Location:** School, Home **Sources:** Books, CD/DVD, Friends outside of school, Librarian, Newspapers & Magazines, Relatives, Schoolmates, Teachers, The Internet, TV & Radio **Subject areas:** Art, D&T, English, History, Maths, Science	Age: 11-16	The information resources used for homework.
Mistler-Jackson & Songer (2000). Songer, Lee & Kam (2002).	Inquiry-based Science project:	**Origination**: Researcher **Doer**: Group, Individual **Topic**: Weather **Location**: Classroom **Timeframe**: 8 weeks	Grade: 6 (US)	What motivates children to search for information for a science project. Investigates barriers to using technology for inquiry based science learning .
Moore (1995)	Research assignments	**Origination**: Researcher **Doer**: Individual **Topic**: Birds **Location**:School library **Timeframe**: One time **Output**: Booklet	Age: 11	Cognitive and metacognitive demands of finding information for typical school assignments, and the difficulties children face.
Nesset (2005, 2007, 2011)	Class project	**Origination:** Teacher **Doer:** Pairs **Topic:** How animals survive winter **Location:** Classroom, Home **Timeframe:** 1 term **Output:** Posters, Presentations	Age: 8-9	How children find information for the project, and the difficulties they face.
***Oliver & Oliver (1997)	Inquiry tasks	**Originator**: Researcher **Doer**: Pairs **Topic**: Global warming, Ozone layer **Problem type**: Context, Social element **Location**: School **Timeframe**: 10 weeks	Age: 11-12	Two information tasks: testing whether information activities that have contextual and social elements lead to increased learning.

Authors	Work task	Task description	Participants	Purpose of study
		Output: Booklet		
Oliver & Perzylo (1994)	Inquiry activity	**Origination**: Researcher with teacher **Flexibility**: Children's questions on topic **Topic**: Mammals **Location**: School library **Doer**: Pairs, Individual **Timeframe**: 4 weeks **Output**: Written report including pictures	Age: 12	During the inquiry process, can children extract meaningful information from non-text based sources.
Power (2012)	Inquiry-based learning: research in Biology	**Origination**: Teacher **Topic**: Dietry related diseases **Doer**: Pairs **Location**: School, Home **Timeframe**: 3 weeks **Output**: Presentation, PowerPoint	Grade: 8 (Australia)	Information activity not observed. Uses questionnaires to determine information literacy skills when engaged in inquiry-based projects.
*** Shenton & Dixon (2004a)	Homework assignments	**Origination**: Teacher **Flexibility**: Open / Closed continuum based on (1) Topic (2) Focus **Doer**: Collaboration, Individual	Age: 4-18	The way in which ownership is afforded to children's tasks, and how children select topics.
Solomon (1993, 1994)	Any use of OPAC during school year	**Origination**: Teacher, Child **Doer**: Small groups, Whole class **Information use**: Personal interest, Structured assignments, and Open assignments. **Location**: School library **Goal**: Locating materials, Fact retrieval, Exploration **Complexity**: The tasks were not categorised according to complexity but the children's queries were.	Age: 6-12	To understand what leads to search success/breakdown
Sormunen, Alamettälä & Heinström (2013),	Literature and history assignments	**Origination**: Researcher / Teacher **Topic**: Historical period, Fiction novel **Doer**: Groups	Upper secondary	Focus is on stages of guided inquiry, information literacy instruction and student collaboration.

Authors	Work task	Task description	Participants	Purpose of study
Sormunen & Alamettälä (2014)		**Location**: Classroom, Public library **Timeframe**: 8 weeks **Output**: Articles for Finnish Wikipedia and school wiki		
Spavold (1990)	History topic.	**Origination**: Teacher with researcher **Topic**: Census **Location**: School **Timeframe**: One year	Age: 9-10	The children were learning how to construct and search databases within a history topic. Would children understand search better if they construct the database, and do children prefer menus to commands.
Spink, Danby, Mallan & Butler (2010)	Class project	**Origination**: Teacher **Flexibility**: Own choice of sub topic **Topic**: Environmental issues **Doer**: Informal groupings **Location**: School **Timeframe**: 3 days **Output**: Posters	Age: 5-6	How young children search for information. How children search is discussed in detail but this is not explicitly related back to the work task.
Todd (2006)	A range of inquiry-based projects	**Origination:** Researcher / Librarian **Location**: School library	Grade: 6-12 (US)	How students' knowledge change as a result of the information found during inquiry based learning. Information tasks not discussed.
Wallace, Kupperman, Krajcik & Soloway (2000)	Inquiry-based project	**Origination**: Children's questions on class topic **Topic**: Ecology **Doer**: Pairs **Location**: School **Timeframe**: 6 weeks. Information activity 6 days. **Output**: Written journal for information activity	Grade: 6th (US)	How childrren carry out an inquiry-based project.
Walraven, Brand-Gruwel & Boshuizen (2010)	History class	**Origination**: Researcher with teacher **Doer**: Individual but group discussions **Topic**: World War 1 **Location**: School	Age: 14-15	Whether evaluation skills taught for one search task are transferred. Evaluation skills are taught during the work task, and whether the skills are transferred is deduced using different information tasks pre- and post- work task. Two different transferal methods are tested.

Authors	Work task	Task description	Participants	Purpose of study
		Timeframe: Over 15 lessons, each lesson on different sub topic **Output**: Fill in process worksheet.		

Appendix C   Definitions of search goal

The following table includes examples of how search goal has been defined in the literature on children's search. The different definitions are organised under Toms' (2011) categorisation of search goal into two types: specific item and general topical.

Table 24: Definitions of search goal

Study	Specific item		General topical	
	Term used	Definition / Description	Term used	Definition / Description
Bilal (2000, p. 648)	Fact-based	"Requires a single, straight-forward answer. It is data-based, usually uncomplicated, and may not require research to find the answer."		
Bilal (2001, p. 123)			Research	"More complex than the fact-based task … the topic of the task had multiple facets"
Bilal (2002a, p. 1171)	Closed	"(Also known as fact-based) are simple, well-defined and have structured problems"	Open-ended	"(Also known as research-based) are complex in nature. They have ill-structured problems where the information required for accomplishment cannot be determined in advance"
Bilal & Kirby (2002, p. 656)	Fact-based / Fact-finding	"Usually simple, certain, and uncomplicated in nature. Such tasks have a target answer that may be a date, a location of an address, a lifespan of an animal, and the like"		
Borlund (2016, p. 315)	Verificative information need	"Concerns the searching for a specific piece of information (fact-oriented)"	Conscious topical information need	"The is about finding information on a topic the test participant is familiar with"
			Muddled topical information need	"Is about the exploration of a topic that is unknown, but of interest to the test participant"
Crow (2011)	Closed	Uses Bilal (2002a)	Opened	Uses Bilal (2002a)
Eickhoff, Dekker & Wiskunde (2012, p. 133)	Factual questions	"Can be answered with a single sentence. Tasks like this can typically be answered with a single query."	Open-ended questions	"Express exploratory information needs that aim towards acquiring broad knowledge about a given topic"
Guinee, Eagleton & Hall (2003)	Scavenger Hunt	Example task: "How many actors have played James Bond?"	Research project	"used the Web to research a self-selected island- or nautical-themed topic"
Hutchinson et al, (2007, p. 1623)	Searching	"A question of the form "How many X books are there?,""	Browsing	"To try out the program to find some books"
Jochman-mannak, Huibers & Sanders (2010)	Fact-based	-		
Kammerer & Bohnacker (2012, p. 185)	Fact-based	"With a yes/no answer"	Reearch	"Requiring a more sophisticated explanation"

Knight & Mercer (2017, p. 38)	Closed	For example "how many women have won a Nobel Prize"	Open	For example "why Marie Curie (Q1) and Nelson Mandela (Q3) are considered good role models"
Marchionini (1989, p. 57)	Closed	"Find a fact"	Open	"Many possible names and associated facts to retrieve"
Nielsen (2010, p. np)	Directed	"Tasks that we'd prepared for each site … find a horseback riding game"	Web-wide	"Asking users a general question and letting them find the answer on a site of their choosing"
Schacter, Chung & Dorr (1998, pp. 843–4)	Well-defined finding	"A clearly defined goal end state"	Ill-defined searching:	"(a) Vague goals, (b) a large number of open constraints requiring resolution, (c) many possible solutions, and (d) no clear directions for when to stop solving the problem"
Scott & O'Sullivan (2005, p. 24)	Locate specific information	"Find an example of a winning poster from the "Worldwide Poster Contest" organised by UNESCO, for the UN Year of Tolerance"		
Solomon (1993, p. 253)	Locating materials	"Goal-oriented"	Exploration	Younger children " pressing keys and sometimes watching to see what happened. Older children directly explored the interaction of technology and the structure of information"
	Fact retrieval	"Just as purposeful and goal-oriented"		
Tu, Shih & Tsai (2008, p. 1146)	Close-ended	(1) "Standardized answers" (2) "Particular answers"	Open-ended	"Students needed to search web resources, analyze and critically evaluate web materials, and put personal thoughts into answers to complete that task. Since the question asked students ''what do you think'' and ''why'', it may require their high-level cognitive skills such as reasoning and decision-making abilities such as doing judgment or strategies"
Wu & Cai (2016, pp. 438–439)	Semi-open ended	Not defined as such but task entails finding more than one specific website	Research oriented (open-ended)	Not defined as such but task entails formulating an opinion on a topic
	Closed-ended	Not defined as such but task entails finding specific information a topic		

Appendix D Multi-dimensional schemes compared to representation scheme

In Table 25 the elements of the representation scheme are compared to similar elements in other multi-dimensional schemes. Then for each multi-dimensional scheme what elements have been included in the representation scheme is documented in Tables 26-29.

Table 25: Representation scheme compared to multi-dimensional schemes

This study	Xie (2009)	Li & Belkin (2008)	Kim & Soergel (2006)	Pharo & Järvelin (2004)
Q1:What is the nature of the motivating task: Routine, Typical, Nature.	**Nature of work task**: Routine, Typical, Unusual.	**Time - Frequency**: Unique, Intermittent, Routine	**Abstract characteristics**: Routineness.	
Q2: From whom does the search task originate: Child, Teacher, Class, Teacher with class.	**Origination**: Self-generated, Assigned.	**Source of task**: Internally generated, Collaboration, Externally assigned.	**Origin**: Internal, External.	**Actor**
Q3: If the search task originates from a teacher, how flexible is it: Own framework and no topic, Own topic and framework, Own area of interest and no framework, Own area of interest and framework, Topic specified any true, Topic specified and framework, Choice of specific question, Semi-specific information, Specific information.	**Flexibility**: Very flexible, Flexible, Inflexible.		**Locus**: Degree of Local decision making.	
Q4: Who does the search task: **(1) Doer**: Teacher, Individual child in class setting, Pairs of children in class setting, Small groups of children in class setting, Nominally child. **(2) Optionality**: Compulsory, Compulsory some, Optional, Elective.		**Task doer**: Individual, Individual in Group. **Group: Interdependence**: High, Moderate, Low.	**Individual**. **Group**: Cooperating mixed groups, Group dynamics, Division of labour, Group contribution pattern.	**Actor**
Q5: Is the search task planned: Planned, Unplanned				
Q6: What is the location of the search tasks: In class, outside of class, Both calss and outside of class, Either class or outside of class.				
Q7: What subject area is the search task for: National curriculum subject areas, Topic, Generic, Events, Non-school work.				
Q8: How is information used: Direct, Indirect				

This study	Xie (2009)	Li & Belkin (2008)	Kim & Soergel (2006)	Pharo & Järvelin (2004)
Q9: What is information used for: To orient, To extend, To make sense, To illustrate, To decorate, To verify, To navigate, To define, To get instruction, As precise data				
Q10: What stage in the uniting topic is the search task: All, Start, Near start, Mid, End.	**Stage of task**: Pre-focus, Focus, Post-focus.	**Time - Stage**: Beginning, Middle, End.	**Structure**: Sub-task structure.	**Stage**
Q11: Other than people what resources are used? Any resource, A general resource, A specific resource				**Search task, Resources**
Q12: What are outputs: Articulate, Construction, Formal writing, Illustration, Notes, Spreadsheet, Vocalise.		**Product**: Physical (WT), Intellectual (WT/ST), Decision / Solution (WT), Factual (ST), Image (ST), Mix Product (ST).	**Product**: Physical, Intellectual, Decision / Solution.	
Q13: What is the overall search goal: General topical, Specific item.	**Search task type**: Update information, Look for specific information, Look for known item, Look for items with common characteristics.	**Goal - Quality**: Specific goal, Amorphous goal, Mixed goal **Goal - Quantity**: Multi-goal, Single-goal **Product**: Physical (WT), Intellectual (WT/ST), Decision / Solution (WT), Factual (ST), Image (ST), Mix Product (ST).	**Structure**: Degree of structure. Multiplicity. **Product**: Physical, Intellectual, Decision / Solution.	**Goal**

Table 26: Xie's (2009) "Dimension of tasks" compared to representation scheme

"Dimension of tasks" (Xie, 2009)		Similarities and differences in this study
Dimension	**Dimension type**	
Work task		
Nature of task	Routine	Covered as by Xie in nature of motivating task (Q1).
	Typical	
	Unusual	
Stage of task	Pre-focus	Covered with amendments in stage (Q10): Stage is considered in relation to time of occurrence in uniting topic rather than focus. Focus is subjective and from an individual's perspective.
	Focus	
	Post focus	
Timeframe	Extremely urgent	Not covered – differences not found in dataset. Reconceived as planning (Q5) and location (Q6).
	Urgent	
	Non-urgent	
Search tasks		
Origination	Self-generated	Covered with amendments in origination (Q2). Origination is considered in relation to who the originator is rather than how the origination is for an individual.
	Assigned	
Search task type	Update information	Covered with amendments in search goal (Q13). Search goal based on Toms (2011) categorisation of goal.
	Look for specific information	
	Look for a known item	
	Look for items with common characteristics	
Flexibility	Very flexible	Covered with amendments in flexibility (Q3). Flexibility of search activties based on Shenton & Dixon (2004a).
	Flexible	
	Inflexible	

Table 27: Li & Belkin's (2008) "A faceted classification of task" compared to representation scheme

"A faceted classification of task" (Li & Belkin, 2008, p.1834)			Similarities and differences in this study	
Generic facet of task (work task, information seeking task and search task)				
Facets	**Sub-facets**	**Values**	**Work task**	**Information task**
Source of task		Internally generated	Not covered here. Teachers described designing lessons individiually, collaboratively with other year group teachers and using third party lesson plans. Nothing in thematic analysis & dataset to suggest that there were differences in information tasks depending upon the source of the lesson.	Covered with amendments in origination (Q2). Origination is considered in relation to who the originator is rather than how the origination is for an individual.
		Collaboration		
		Externally assigned		
Task doer		Individual	Not covered separately from doer of the information task here.	Covered with amendments in doer (Q4). As well as whether the doer is an individual or in a group, doer is considered in relation to who does the search and whether there is a choice to do this.
		Individual in a group		
		Group		
Time	Frequency	Unique	Covered with amendments in nature of motivating task (Q1). Equivalent to Xie's (2009) Nature of task which was used in preference.	Not covered here. Could be considered in further studies.
		Intermittent		
		Routine		
	Length	Short-term	Not considered here.	Reconsidered as planning (Q5) and location (Q6).
		Long-term		
	Stage	Beginning	Covered with amendments in stage (Q10). The relationship between uniting topic and search task is described.	
		Middle		
		End		
Product		Physical (WT)		

		Intellectual (WT/ST)	Covered with major amendments in outputs (Q12) and goal (Q13). Outputs considered distinct from cognitive outcomes. Cognitive outcomes not considered as cognition is individual and therefore subjective.	
		Decision / Solution (WT)		
		Factual (ST)		
		Image (ST)		
		Mix product (ST)		
Process		One-time task	Not covered.	Not considered as such but is covered to some extent in nature of motivating task (Q1)
		Multi-time task		
Goal	Quality	Specific goal	Not covered.	Covered with amendments in outputs (Q12).
		Amorphous goal		
		Mixed goal		
	Quantity	Multi-goal		
		Single-goal		
Common attributes of task				
Task characteristics	Objective task complexity	High complexity	Subjective characteristics not considered.	Subjective characteristics not considered.
		Moderate		
		Low complexity		
	Inter-dependence	High	Not covered here. Likely that all units are of high interdependence.	Covered with amendments in doer (Q4).
		Moderate		
		Low		
User's perception of task	Salience of task	High	Subjective characteristics not considered.	Subjective characteristics not considered.
		Medium		
		Low		
	Urgency	Immediate		
		Moderate		
		Delayed		
	Difficulty	High		
		Medium		
		Low		
	Subjective task complexity	High		
		Medium		
		Low		
	Knowledge of task topic	High		
		Moderate		
		Low		
	Knowledge of task procedure	High		
		Moderate		
		Low		

Table 28: Kim & Soergel's (2006) "A list of task characteristics" compared to representation scheme

"A list of task characteristics" (Kim & Soergel, 2006)		Similarities and differences in this study
Intrinsic task characteristics		
Overall type	List of different task types identified in literature review.	Not covered as different types hard to identify.
Abstract characteristics	Complexity / simplicity	Routineness of work task covered with amendments in nature of motivating task (Q1). Routineness equivalent to Xie's (2009) Nature of task which was used in preference. Routineness of search task not covered. This could be addressed in further studies. Other abstract characteristics not considered.
	Difficulty	
	Analyzability	
	Determinancy, variety, variability	
	Adapatability	
	Routineness	
	Abstractness	
	Domain specificity	
	Traceability	
Product	Physical	Covered with major amendments in outputs (Q12). Outputs considered distinct from cognitive outcomes. Cognitive outcomes not considered as cognition is individual and therefore subjective.
	Intellectual	
	Decision / solution	
Scope	Local	Not considered as not relevant to primary school IUE.
	Global	
Requirement and process	Task	Not considered as is mostly subjective and about the user.
	Ability	
	Behaviour	
	Material	
	Feedback	
Extrinsic task characteristics		
Locus	Degree of local decision making on task	Considered with ammendments in flexibility (Q3).
Origin	Internal	Covered with amendments in origination (Q2). Origination is considered in relation to who the originator is rather than how the origination is for an individual.
	External	
Autonomy	Unity of control	Not covered.
	Closeness of supervision	
	Closeness of control	
Importance		Subjective characteristics not considered.
Urgency		Subjective characteristics not considered.
Frequency	Quantiative	Not covered but could be considered in further studies.
	Qualitative	
Risk		Subjective characteristics not considered.
Reward		Subjective characteristics not considered.
Constraints		Covered in planning (Q5) and location (Q6).

Goal	Satisficing vs optimizing	Not covered.
	Quantiative vs qualitative	
Structure	Degree of structure	Considered as part of search goal (Q13)
	Clarity	Not covered.
	Solution clarity	
	Certainty & predictability	
	Diffuseness	
	Multiplicity	Considered as part of search goal (Q13)
	Subtask structure	Considered as part of stage (Q10)
Task performer		
Individual		Different task performers considered under doer (Q4) but make-up of group not considered
Group	Cooperating / mixed motive groups	
	Group dynamics	
	Division of labour	
	Group contribution pattern	
Interaction of task performers	Interdependence	Not covered.
	Direction of interaction	
	Group integration	
	Friendship opportunities	
Relationship between task and performer		
Familiarity / novelty		Not covered.
Manageability		
Identity		
Intrinsic interest		
Significance to performer		
Salience		
Motivation		
Goal acceptance		
Belief in success		

Table 29: Pharo & Järvelin's (2004) "Categories/attributes", extracted from "The conceptual framework – the domain of method schema", compared to representation scheme

"Categories/attributes" (Pharo & Järvelin, 2004, p.648)	Similarities and differences in this study
Work task	
Goal	Not covered.
Complexity	Not considered. Complexity is an abstract construct.
Resources	Covered in resources (Q11).
Size	Not covered.
Stage	Covered in stage (Q10).
Searcher	
Task knowledge	User characteristics not considered.
Search knowledge	
Search system knowledge	
Education	
Motivation	
Tenacity	
Uncertainty	
Attention	
Search task	
Goal	Covered in search goal (Q13)
Complexity	Not considered. Complexity is an abstract construct.
Resources	Covered in Q11 (resource)
Size	Not covered
Stage	Covered in Q10 (stage)
Strategies	User behaviour not considered.
Soc. / Org. environment	
Actors	Covered in Q2 (orgination) and Q4 (doer)
Domain	The scheme is for a particular domain (IUE)
Goal strategies	User behaviour not considered.

Appendix E   Information sheet given to headmaster, phase1

[Note, the name of the school, name of headmaster, names of my children, and my phone number have been redacted.]

<div align="right">

Information School, University of Sheffield

Regents Court

12 March 2015

</div>

[School name] Primary

Dear [headmaster name]

In 2012, [school name] participated in our research on how children search the Internet. We wish to expand the study and are wondering if [school name] would be willing once again to grant us access to conduct research in the school. The overall purpose of the research is to gain a better understanding of the digital skills children require to search for the information they need.

I am in the second year of a PhD program at the University of Sheffield, exploring how primary-age children are using the Internet to search for information for their school work at school or as part of their homework. The PhD is supervised by Professor Paul Clough (p.d.clough@sheffield.ac.uk) and Professor Elaine Toms (e.toms@sheffield.ac.uk).

To date we have conducted two studies. Firstly, the research conducted at [school name] in 2012, where we observed and recorded a Y4 ICT lesson. Secondly, we have observed Y6 children in another primary school in east Sheffield. As such, we now have two detailed studies of how children are using the Internet when they search for information in class. Now we need to complement this with a broader study of what children at both KS1 and KS2 might search for within a given school year. In particular, we are interested in what children are searching for

- formally in class either as part of an ICT lesson or for another subject,
- informally in class, for example "why don't you check that at home on Google"
- as part of their homework
- any other ways the Internet is used to search for information

To collect this information, we need to interview teachers from different year groups and view copies of homework information sheets, where the children could use the Internet.

A bespoke report of the findings will be made available to any school that participates. The findings of this research will be presented at conferences, and published, as well as contained in my PhD thesis. The University of Sheffield requires that all research be reviewed for ethics. All data and participants including the school will be anonymised and participants will not be identifiable in any of the research outputs.

Please note, that in addition to the research we conducted in 2012, I am also familiar with the school as a parent as both my children attend [name of school]; [name of child] in Y6 and [name of child] in Y4.

If [name of school] would be interested in participating in this research I can be contacted on sarutter1@sheffield.ac.uk or [mobile phone number].

Regards, Sophie Rutter

Appendix F   Information sheet given to teachers, phase 1

Note, the name of the school, names of my children, and my phone number have been redacted.

Information School, University of Sheffield

Regents Court

29 April 2015

Dear [name of school] Primary teacher,

I am in the second year of a PhD program at the University of Sheffield, exploring how primary-age children are using the Internet to search for information for their school work at school or as part of their homework. The PhD is supervised by Professor Paul Clough (p.d.clough@sheffield.ac.uk) and Professor Elaine Toms (e.toms@sheffield.ac.uk).

The overall purpose of the research is to gain a better understanding of the digital skills children require to search for the information they need. The project is split into 3 phases, and in this second phase we would like to study what children at both KS1 and KS2 might search for within a given school year. In particular, we are interested in what children are searching for

- formally in class either as part of an ICT lesson or for another subject
- informally in class, for example "why don't you check that at home on Google"
- as part of their homework
- in any other ways the Internet is used to search for information.

To collect this information, we would like to firstly interview teachers from different year groups and secondly view copies of homework information sheets, where the children could use the Internet to find information for assignments.

If you would be interested in participating in this research, I can be contacted on sarutter1@sheffield.ac.uk or [my phone number]. Alternatively, I am often in the playground at school pickup and drop off as my children [child's name] (Y6T) and [child's name] (Y4S) attend the school.

Regards, Sophie Rutter

Appendix G   Early thematic analysis, phase 1

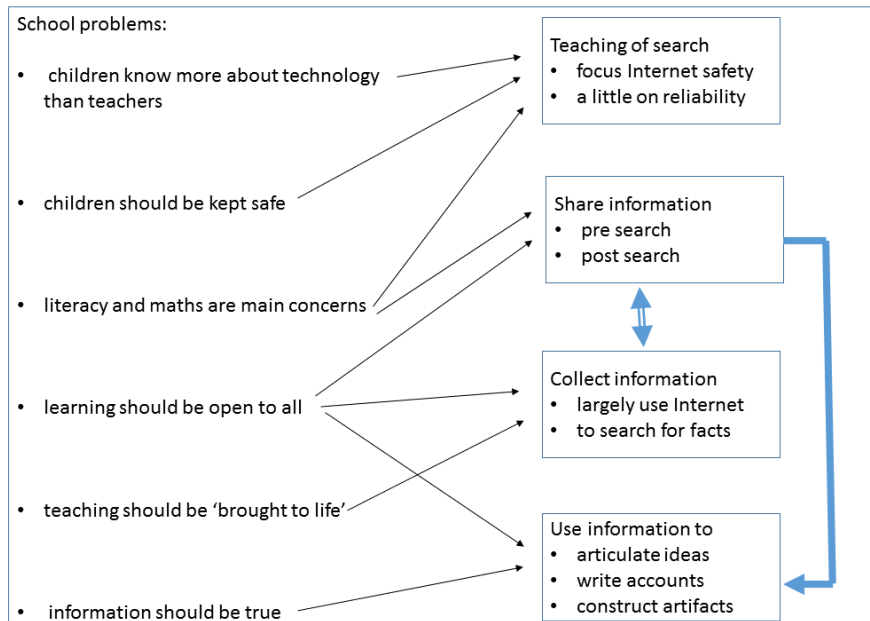Early attempts at thematic analysis are depicted in Figure 15 and Figure 16.

Figure 15: Identification of themes and influence on search activities, first attempt
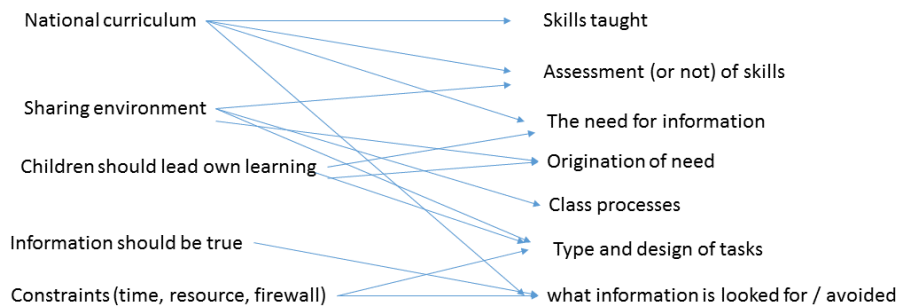
Figure 16: Identification of themes and influence on search activities, second attempt

Appendix H   Adaptation of Shenton and Dixon's (2004a) continuum

Shenton & Dixon's (2004a) continuum is used in this thesis as a basis for determining the flexibility of search tasks but was adapted three ways. Firstly, the term framework was used in preference to foci as this was the term the teachers used. Secondly, in the adapted scheme the elements are no longer on a continuum. This is because without further study of how children conduct searches it is not clear to what extent frameworks and choice of topic make a task more open or more closed, hence combining these aspects on a continuum is problematic. Thirdly, Shenton & Dixon's (2004a) continuum developed from an analysis of homework assignments. These search tasks all have general topical goals (and this fits with the findings of this study where homework assignments are broad and open). However, in this study, some of the search tasks conducted in class and given to children to do at home ad hoc, had specific goals. For this reason, the continuum needed to be adapted so that it also included search tasks with specific goals.

Table 30: Flexibility of search tasks compared to Shenton & Dixon's (2004a) open / closed continuum

If the search task originates from a teacher, how flexible is it?	"The "open"/ "closed" continuum for information needed for assignments" (Shenton & Dixon, 2004a, p. 23)
Own topic and no framework	"Information on own topic with own focus/foci; no specified areas included"
Own topic and framework	"Information on own topic pertaining to the appropriate curriculum area with focus/foci specified"
Own area of interest and no framework	"Information on own topic drawn from a category with own focus/foci, no specified areas to be included"
Own area of interest and framework	"Information on own topic; drawn from a category, with own focus/foci; specified areas to be included"
Topic specified, any true	"Information on specified topic with own focus/foci; no specified areas to be included"
Topic specified and framework	"Information on specified topic with own focus/foci specified"
Choice of specific question	-
Semi-specific information	-
Specific information	-

Appendix I   Determining outputs

No pre-existing scheme was found to base the outputs on. The outputs were categorised according to the descriptions teachers gave as documented in Table 31.

Table 31: Categorisation of outputs

Output	Example output
Articulation	Share information found on Ancient Egypt. (Y4)
Construction	Make a habitat using a shoe box. (Y4)
Formal writing	Write a non-chronological report. (Y2)
Illustration	Draw images of creatures. (Y3)
Notes	Notes for producing a booklet on Victorian Sheffield. (Y3)
Spreadsheet	Spreadsheet modelling – plan a party. (Y6)
Vocalisation	Pronounce words in a different language. (Foundation)

Appendix J   Information use definitions

Table 32: Comparison of definitions of information use

Information use	Definition
To orient	To orient to a topic by seeking a broad and general understanding
Enlightenment	"The desire for context information or ideas in order to make sense of a situation" (Taylor, 1991, p. 230).
Learn about	"Trying to learn about an unfamiliar topic: seeking general orientation and an understanding of concepts" (Freund, 2008, p. 86).
To extend	To find out about a particular aspect of a topic.
Problem understanding	"More specific than enlightenment, better comprehension of particular topic" (Taylor, 1991, p. 230).
Understand	"Use of the web to help a respondent understand some topic" (Morrison et al., 2001, p.164).
Find a solution	"Trying to solve a problem or fix a malfunction; finding information on similar scenarios, problems, bugs and solutions" (Freund, 2008, p. 86).
To make sense	To bridge a gap in understanding.
Sense-making	"The principal information activity is to resolve the *equivocality* of information about the organisation's environment" (Choo, 2006, p. 5) (italics in original)
Make sense	"Find or use information to better understand or make sense. … Relates to times when the group had commented that they did not understand something. … Information tasks related to "make sense" involved looking for more general, broad information rather than a specific fact." (Toze, 2014, p. 330).
To illustrate	To explain or represent an object or concept
Explaining	"To explain a point made in the text or where the text can only be seen as explanatory when combined with a picture, or when the text is understood more easily with the help of the pictures" (Lundh & Limberg, 2012, n.p.).
Narrating	"The important story is told through the use of images" (Lundh & Limberg, 2012, n.p.).
To decorate	To visually enhance presentation of an information object
Decorating	"Pictures whose main function seem to be to make the booklets look nice" (Lundh & Limberg, 2012, n.p.).
Illustrating	"[Pictures] illustrate visually something mentioned in the text" (Lundh & Limberg, 2012, n.p.).
To verify	To confirm information already known
Confirmational	"The need to verify a piece of information" (Taylor, 1991, p. 230).
Confirm	"Information is found and used to verify another piece of information" (Toze, 2014, p. 330).
To navigate	"To reach a particular site" (Broder, 2002, p. 5)
Navigational	"The immediate intent is to reach a particular site" (Broder, 2002, p. 5)
Re-find	"Information needs to be re-found, as it has been lost" (Toze, 2014, p. 330).
To define	To find out the meaning, spelling, synonym and translation of words.
To get instruction	To find out "what to do and how to do something" (Taylor, 1991, p. 230).
Instrumental	"Finding out what to do and how to do something" (Taylor, 1991, p. 230).

Information use	Definition
How to	"Trying to find out how to do something – a procedure or work plan identifying the steps to take and issues involved" (Freund, 2008, p. 86).
How to	"Information is found and used to answer questions such as How do we? Or what do we need to do?" (Toze, 2014, p. 330).
To entertain	To amuse.
Entertainment	"Actively looking for and watching information for fun, to entertain group members" (Toze, 2014, p. 330).
As precise data	To use data (such as price or location data) as specific unambiguous units of information.
Factual	"The need for and consequent provision of precise data" (Taylor, 1991, p. 230)
Find	"Use the web to download information / get a fact / get a document / find out about a product" (Morrison et al., 2001, p.164).
Find facts	"Trying to find specific factual information about products or technologies, for example: parameter values or supported software" (Freund, 2008, p. 86).
Fact-finding	"Information is found and used to determine the facts of a phenomenon or event, to describe reality" (Toze, 2014, p. 330).
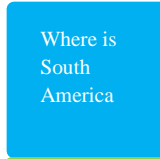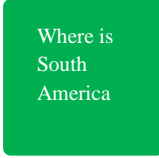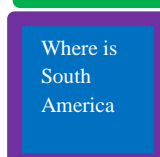
Appendix K   Elements of connected search tasks

Connected task	Origination	Doer	Planning	Location	How information is used	What Information is used for	Resources	Goal
Registration	Teacher with class	Teacher	Planned	School	Directly	To define & As precise data & To extend	Internet	Specific & General
Animals	Children & Teacher	Children & Teacher	Planned & Unplanned	School		To orient & To extend & To verify & To navigate & To make sense	Internet & Particular site & Library	Specific & General
Africa	Teacher & Children	Children & Teacher	Planned	Outside of school & School		To illustrate & To extend	Any & Internet	Specific & General
Poetry	Teacher & Class	Teacher	Planned	Outside of school & School	Directly	To extend	Internet & Particular site	General
Non-chronological reports	Teacher	Teacher	Planned	Outside of school & School	Indirectly	To orient & To extend	Any & Internet	General
Climate and weather	Teacher	Children & Teacher	Planned	Outside of school & School	Directly	To orient & To extend & To get instruction	Any & Internet	General & Specific
Victorian Shefffield	Teacher	Children	Planned	Outside of school	Directly	To extend	Any	General
Present perfect	Teacher	Teacher	Planned	Outside of school & School	Directly	To verify & To navigate	Internet	Specific
Rainforest animals	Teacher & Children	Children	Planned	School		To orient & As precise data & To extend	Any & Internet	General & Specific
Ancient Egypt	Teacher	Children	Planned	School		To orient & As precise data	Any & Internet	General & Specific
Biography of a scientist	Teacher	Children & Teacher	Planned	Outside of school & School	Directly	To orient & To decorate & To navigate	Any & Internet	General & Specific
Lifecycles	Teacher	Children	Planned	Outside of school & School	Directly	To extend	Internet	Specific
South America	Teacher	Children	Planned	School		To orient & As precise data	Any & Internet	General & Specific
Enterprise	Children	Children	Planned	School	Indirectly	To get instruction & As precise data	Any	Specific
Ancient Greece	Teacher	Children	Planned	Outside of school & School	Directly, Indirectly	To orient & to extend	Any & Internet	General
Biography	Teacher	Children	Planned	Outside of school	Indirectly	To orient & To decorate	Internet	General & Specific

Appendix L   Connections between search tasks, phase 1

Where search tasks were connected the different elements of the search tasks are illustrated.

Key to illustrations

Search task			Each box is labelled with a brief description of the information requirement
Doer / Location	Where is South America	Where is South America	The fill colour of the box denotes the doer and the location. The fill colour is • dark blue if done by a child in class • light blue if done by a child outside of class • dark green if done by a teacher in class • light green if done by a teacher outside of class
	Where is South America	Where is South America	
Origination	Where is South America	Where is South America	The outline colour of the box denotes origination. If the doer and originator are the same the box will be a solid block of colour. The outline colour is • blue if origination is from a child • green if origination is from the teacher • orange if origination is from the class • purple if origination is teacher with class
	Where is South America	Where is South America	
Occurrence in time	Where is South America	Where is South America	Search tasks that occur in different classes and homework are shown in horizontal alignment.
	Where is South America		Search tasks that occur in the same class / homework are shown in horizontal alignment.
	Where is South America		
Information use	Verification		Information use is in red text
Goal	Specific		Search goal is in pink text

216

Registration / Celebrating all cultures, Foundation

Time

| Greeting in "x" language | To define Specific | Greeting in "x" language | To define Specific | Greeting in "x" language | To define Specific |

| "x" country on map | Precise data Specific | "x" country on map | Precise data Specific | "x" country on map | Precise data Specific |

| More about "x" country | To extend General | More about "x" country | To extend General | More about "x" country | To extend General |

Animals, Foundation

Time

To orient	To orient	To extend	To verify	To navigate	To make sense
Answers to class question	Browse Simple City	In-depth info	Info about wolf spiders	Info about an aye-aye	Videos to answer questions
General	General	Specific	Specific	Specific	Specific

Africa, Y1

Time

To illustrate	To extend	To extend	To extend
Evidence about Africa	Facts about Africa	African animals	Program African animals
Specific	General	Specific	Specific

Poetry (Literacy), Y1

Time →

To extend

Poem about animals

General

To orient

Browse poetry website

General

Non-chronological reports (Literacy), Y2

Time →

To orient

Research a nocturnal animal

General

To extend

More research on nocturnal animal

Specific

Weather and climate (Geography), Y3

Time ↓

To extend

Do one together: set framework

To orient

Weather related research

General

To extend

Different types of weather

General

To extend

Weather different countries

General

To extend

Difference climate & weather

General

To extend

Climate change

General

To get instruction

Different types of weather

Specific

Victorian Sheffield (History), Y3

Time →

To extend

Transport Victorian Sheffield

General

To extend

An aspect Victorian Sheffield

General

To extend

An aspect Victorian Sheffield

General

To extend

An aspect Victorian Sheffield

General

To extend

An aspect Victorian Sheffield

General

Present perfect (Literacy), Y3

Time

To verify

Websites for use in lesson

Specific

To navigate

Re-find website

Specific

Rainforest animals, Y4

Time

To orient

A rainforest animal

General

As precise data

Amazon rainforest on a map

Specific

To extend

Rainforest videos

Specific

Latin names

As precise data   Specific

Ancient Egypt, Y4

Time

Research Ancient Egypt

To orient   General

Sphynx on Google Maps

As precise data   Specific

Biography of a scientist, Y5

Time

To orient   General

Research a scientist

To illustrate   To navigate

Websites for lesson

Navigate to scientist website

General   Specific

Lifecycles, Y5

Time

To extend   To extend   To extend

Lifecycle of an insect

Lifecycle of an amphibian

Incomplete metamor-phosis

Specific   Specific   Specific

South America, Y5

Time

A country in South America

To orient   General

Where is South America

As precise data   Specific

Enterprise, Y5

Time

To get instruction   As precise data

How to make lemonade

Where to buy ingredient

Specific   Specific

Ancient Greece (History / Computing), Y5

Time

To orient

To extend

Research Ancient Greece

Information on Ancient Greece

General

General
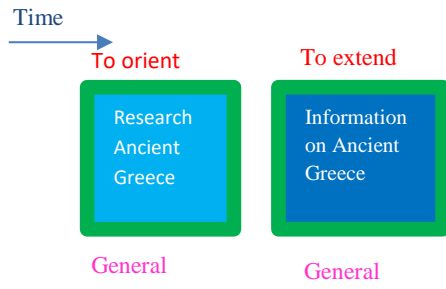
Biographies (Literacy), Y6

Time

To orient

To decorate

Research a person

Picture of a person

General

Specific
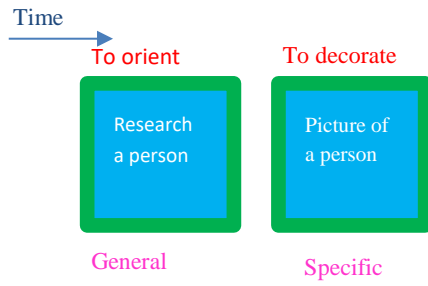
Appendix M   Search tasks and queries, phase 2

Table 33: Search tasks and queries, phase 2

Doer	Search task	Queries
West Sheffield observation study		
Pair A	What is the longest bone	wikipedia
		what is the longest bone in the skeilton
		what is the largest bone in the skeleton
		what is largest bone is skeleton
		google
		kids wikipedia
		what is the longest bone in the skeleton
		what is the largest bone in the skeleton
	What is bone made out of	what is a bone made of
		+
Pair B	What is the longest bone	wikipedia
		human skeliton
		human skeleton
		what is the longest bone
		Bing
		human skeleton for kids
		human skeleton
		human skeleton facts
		human skeleton facts
Pair C	What is the longest bone	human body facts
Pair D	How long is the spine in an average human adult?	how long is the spine in the average human body
		a human spine
		human
Pair E	How many bones are in your foot?	how many bones in a human babys foot
		How many bones in a human babies foot
		how many bones in a human babys foot
Pair F	How long is the spine in an average human adult?	how long is the average human spine
		Bing
		how long is the spine in an average adult
		how long is the spinal cord in an average human adult
	How many bones are in your foot?	how many bones in a mans average fot
		how many bones in a mans average foot
East Sheffield observation study		
C1T1	Tour de France	tour of france jerseys
	World Cup and Spain	spain and the world cup
		spain and the world cup
	Tour de France	tour de france
		tour de france
		tour de france
	World Cup and Spain	spain and the world table
		spain and the world cup
C2T1	Tour de France	tour de france

Doer	Search task	Queries
		tour de france
		tour de franc
	Personal interest	ferrit
	World Cup and Spain	spain
	Personal interest	pool cat
	World Cup and Spain	spain
	Personal interest	pole cat
	World Cup and Spain	spain football
	Personal interest	doberman
	Tour de France	tour de france jerseys
	Personal interest	big pole cat
		pole cat
	Tour de France	tour de france jerseys
	World Cup and Spain	spain city
		spain football team
C3T1	Tour de France	tour be france
		tour de france
		tour be france
	Personal interest	poole cat
		poole cat
	Tour de France	what colour jersey does the rider in the lead win
		what colour jersey does the rider in the lead win
	Personal interest	the dig is pole cat
		the dog is polecat
C4T1	Tour de France	tour de france
		tour de france
		what dose the green gersy mean
		what does the green jersey mean
	Personal interest	worlds biggest pole cat
		worlds biggest pole cat
C5T1	Tour de France	tour de france
		tour de france GREEN
		tour de france GREEN
		tour de france
	World Cup and Spain	fifa world cup spain
		world cup spain
		world cup spain information
	Tour de France	tour de france what is the white jersey
C6T1	Tour de France	in LE DOUR DE FRANCE what colour jersey do they wear
		in LE TOUR DE FRANCE what colour jersey do they wear
		in LE TOUR DE FRANCE what colour jersey do they wear
	World Cup and Spain	how many times did spain won the world cup
		how many times did spain won the world cup?
C7T1	Tour de France	what colour jersey tour de france

Doer	Search task	Queries
		what colour jersey white means
		what colour jersey tour de france
	World Cup and Spain	information about spain world cup
	Tour de France	tour de france 101 what do different colour jersey
C8T1	Tour de France	what colour jersey tour de france
		what colour jersey tour de france
	World Cup and Spain	the world cup and spain 2014
		the world cup and spain 2014
		the world cup and spain 2014
	Tour de France	what colour jersey tour de france
		what colour jersey wiit
		what colour jersey green mean
C9T2	Tour de France	tehere are different colour jerseys in le Tour de France what do they mean
		tour de france jerseys meaning
	World Cup and Spain	spain football
		spain football wiki
C10T2	Tour de France	tour de france
		tour de france
		tour de france
		colour jerseys le tour de france
		le tour de france jerseys
		le tour de france jersey meanings
	World Cup and Spain	spanish world cup players 2014
	Tour de France	la tor de france jersey meanings
		la tor de france jersey yellow
		la tor de france jersey yellow
		la tor de france yellow jersey meaning
		la tor de france jersey yellow
		green jersey meaning tour de france
C11T2	Tour de France	la tour de france
		la tore de france
		la tour de france wiki
		wiki
		le tour de france jersys
		le tour de france jerseys
		jersey colours for tour de france
		jersey colours for tour de france what do they mean
		jersey colours for tour de france
C12T2	Tour de France	what do the diffrent coulour jersys mjean
		what do the different colour jerseys mean
		what does the green jersey mean
		what does the green jersey mean
		what does the red jersey mean
C13T2	Tour de France	theres a different coloured jersey that the riders can win what are they for
		what do the coloured jerseys in the tour de france mean

Doer	Search task	Queries
		what does the green jersey mean in cycling
		what does the red jersey mean in cycling
	World Cup and Spain	what do the spain flag colours mean
C14T2	Tour de France	coloured jerseys what do they mean
C15T2	Tour de France	what colour jersey does the rider in the lead where
		what do the different coloured jerseys mean
	World Cup and Spain	history about spains football club
		history about spain's football club
C16T2	Tour de France	wikipedia
		Cycling
		la tour de france
		la tour de france jerseys
		info on la tour de france jerseys
	World Cup and Spain	world cup fixtures
		world cup f
		world cup spain
		world cup spain 1982
		world cup spain squad 2014
		world cup 2006 spain squad
		spain football squad
		spain football
		spain football world cup squad
		spain football world cup wins
C17T3	Tour de France	wikipedia
		tour de france jesyies
		tour de france jesies
		tour de france jersey colours
		jersy coulers
		jersey colors
		jersey colors 1-10
		jersey colors wikipedia
		cycle jerseys
		1st to 10 thcycle jerseys
		1st to 10th cycle jerseys
		tour de france cycling jersey
		tour de france cycling jersey
		tour de france jerseys colours
	World Cup and Spain	wikipedia
		spain world cup
		spain football national team
		spain football team
		spain football
		spain
	Tour de France	tour de france colour jerseys
	Personal interest	callum stephen disney
C18T3	Tour de France	tour de france colour jerseys
	World Cup and Spain	spain world cup 2014
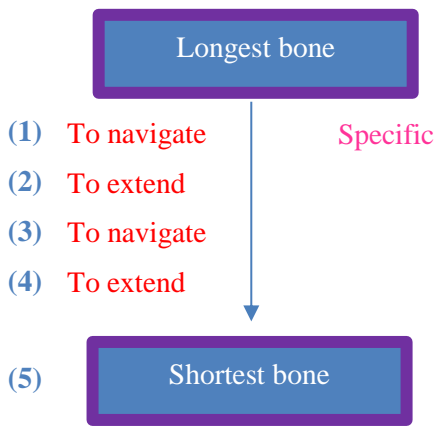
Doer	Search task	Queries
		andreas iniesta
		spain world cup 2014
		most expensive spanish player
		most expensive spanish football player
		most expensive football player
		most expensive football players
		Spain's Most expensive football player
C19T3	Tour de France	what coulers do the tour de france people mean
		what colors do the tour de france people mean
		what colours do the tour de france people wear
		tour de france colour jerseys
	World Cup and Spain	spain world cup 2014
		spain facts
C20T3	Tour de France	what coloured jersy do the riders win
		what colour jersey do the riders win
		tor de france colour jerseys
		tour de france coloured jersys
		tor de france 101
		what do coloured jersys
	World Cup and Spain	world cup 2014
		world cup 2014
		spain facts
		spain world cup 2014
		spain world cup 2014
		spain world cup 2010
	Tour de France	tor de france 101
C21T3	Tour de France	tour de france jerseys
	World Cup and Spain	spain squad
		Iniesta
		In
		south africa world cup spain goal
		south africa world cup spain goal
		spain facts
		most expensive spain player
		most expensive player in spain
		most expensive spanish player
	Tour de France	white jersey tour de france
C22T3 (arrives at end of class)	Personal interest	what are the jersey shore cast worth
		ronaldo
		ronaldo's girlfriend
C23T3	Tour de France	tour de france
		tour de france facts
		tour de france colour jerseys
	World Cup and Spain	spain
		spain facts
		world cup facts
		world cup history
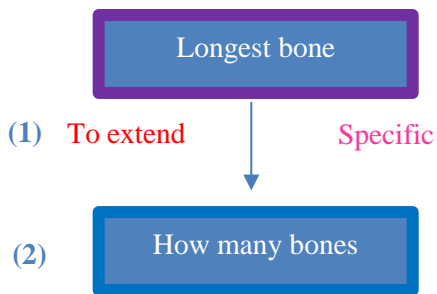
Doer	Search task	Queries
		world cup history facts
		world cup facts
		world cup facts
	Tour de France	tour de france
		tour de france facts
		tour de france colour jerseys
C24T3	Tour de France	*missing data*
	World Cup and Spain	ronaldos boots
		iniesta
		iniesta
		history of spain in world cup
		history of spain in world cup
		most expensive player in spain
		spains most expensive player
		history of spain in world cup
	Tour de France	tour de france coulered jerseys
	World Cup and Spain	spains most expensive player
		spain's most expensive player
C25T3	Tour de France	tour de france colored jerseys meanings
	World Cup and Spain	spain world cup history
C26T3	Tour de France	tour de france colourd jersys
		tour de france colour jerseys
	not known	wikipedia
	World Cup and Spain	most expensive player in spain

Appendix N   Vignettes of search activities, phase 2

The elements for each child / pair's search activity is illustrated and described. The illustrations are based on the scheme developed in phase 1. See Appendix L for key to illustration.

Pair A	
Longest bone **(1)** To navigate Specific **(2)** To extend **(3)** To navigate **(4)** To navigate **(5)** To extend **Bone made of** **(6)** To extend Specific **(7)** To navigate	(1) Pair A start by entering "wikipedia" into the Google search box. Before searching for any information specific to the task they determine "that is easy that. It's just the spine. That answer is the spine". They also think that they might know the answer to the 3rd task, "I know what a bone is made of … it starts with A". (2) In Wikipedia they search for "what is the longest bone in the skeilton" and correct the query using "did you mean". When seeing that the first result is for dinosaur they start to edit the query because "we need to write human skeleton" but then decide to swap to a different IRS. (3-4) In the Bing tool bar search box they query "Google". After selecting Google from the results they then search for "Kids Wikipedia". (5) They inadvertently go back to Wikipedia and again search for "what is the longest bone in the skeliton", also correcting the query. When they cannot find the answer they decide that spine must be the right answer and record this in a Word document. (6) Pair A then move onto task 3. Staying in Wikipedia they query "what is a bone made of". (7) When they cannot find the information they are looking for they enter "+" in the Bing toolbar search box.
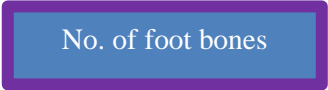
Pair B	
Longest bone **(1)** To navigate Specific **(2)** To extend **(3)** To navigate **(4)** To extend **(5)** Shortest bone	(1) Pair B start by entering "wikipedia" into the Google search box. (2) In Wikipedia they search for "human skeliton", correcting the query using "did you mean". When they cannot find relevant results, they search for "what is the longest bone". (3) The pair tell the researcher that "'what is the longest bone' is not working?". As instructed by the ICT teacher, the researcher tells the pair to use another search engine. The pair enter "Bing" in the Bing toolbar search box. (4) Pair B then search Bing for "human skeleton for kids", "human skeleton" and "human skeleton facts". After the researcher has hinted that the answer can be found on the site they were viewing, they found the answer for task 1. (5) The pair find the answer to task 2, the shortest bone at the same time: "what is the longest bone! We found it! Femur. Thigh bone. Smallest bone! We've found the answers" and so do no searches for this task.

Pair C	
Longest bone **(1)** To extend Specific **(2)** How many bones	(1) Pair C start by searching for the answer to the first task "what is the longest bone" and enter just one query "human body facts". They view x sites. (2) After 6 minutes when they cannot find the answer to their question they make up a new question (how many bones does an adult have)[10] to fit the information they have found.

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[10] coincidently this is a search task in the next class

Pair D	
(1) **Spine length** To extend Specific	(1) Pair D start by entering into Google "how long is the spine in the average human body". They select a medical dictionary from the results and search within the site for "a human spine" and "human". They are unable to conduct any further searches because of network connection failures.

Pair E	
(1) **No. of foot bones** To extend Specific	(1) Pair E type Google directly into the URL address bar. They then search for "how many bones in a human babys foot", and accept the "did you mean" suggestion of "How many bones in a human babies foot". Later they return to Google reverting back to the original query. After 5 minutes of searching they found the correct answer, "52 foot bones", but interpret it wrongly to be for each foot. The rest of the time they spend formatting a document in which to present their answers.

Pair F	
Spine (1) To extend Specific (2) To navigate (3) To verify ↓ **No. of foot bones** (4) To extend Specific	(1) Pair F start by entering "how long is the average human spine" into Google. They quickly find the answer to the length of the spinal cord. (They are unaware that the spine is not the same as the spinal cord.) (2) They decide to check the answer in Bing. The pair enter "Bing" in the Bing toolbar search box. (3) They then verify answer by searching for "how long is the spine in an average adult" and "how long is the spinal cord in an average human adult". (4) After finding the same answer again, the pair move onto the second task and search for "how many bones in a mans average fot", and then correct the query.

C2T1

(1) Tour de France

To extend — Specific

↓

(2) Personal interest

To entertain — General

↓

(3) World Cup & Spain

To orient — General

↓

(4) Tour de France

To extend — Specific

↓

(5) World Cup & Spain

To orient — General

↓

(6) Personal interest

To entertain — General

↓

(7) World Cup & Spain

To orient — General

↓

(8) Personal interest

To entertain — General

↓

(9) World Cup & Spain

To orient — General

↓

(10) Tour de France

To extend — Specific

↓

(11) Personal interest

To entertain — General

(1) C2T1 enters the query "tour de france" that he has overheard another child suggest to the teacher would be a good query. Then at teacher's suggestion C2T1 swaps from Web search to Google Images. From the images C2T1 is able to identify the different colour jerseys but is unable to move on to the next facet of the task and find out the meaning behind the different jerseys.

(2) The teacher stops the class from searching to discuss what they have found so far. C2T1 immediately starts searching on a topic of personal interest and searches for "ferrit".
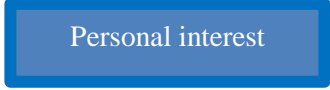
(3) The teacher briefs the class on the second task. Despite not completing the first task C2T1 begins this new task and enters "spain" in the search box.

(4) The teacher directs C2T1 back to the first task.
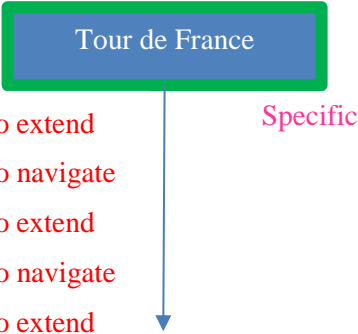
(5-9) C2T1 claims to neighbour "I know them in my head" and then iterates between searching for task 2 ("spain", "spain football team", "spain football") and searching for personal interest ("pool cat", "pole cat", "doberman"). C2T1 discusses the results of the searches with a neighbour, particularly the results of the personal interest searches.
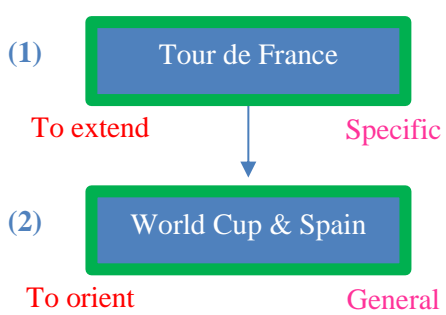
(10) The teacher notices that C2T1 has not completed task 1 and helps C2T1 by typing in a query ("tour de france jerseys") and selecting a search result. The meaning of the jerseys is available in the website selected but C2T1 only extracts the name of the jerseys.
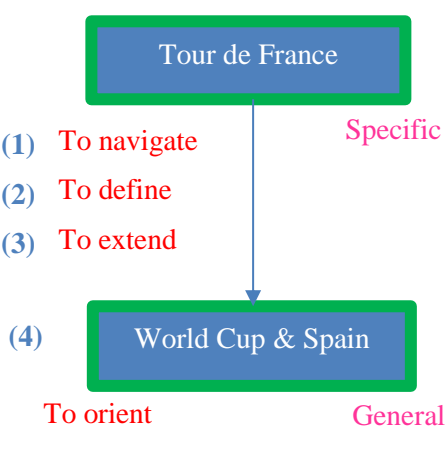
(11) After writing some answers to task 1 on a whiteboard, C2T1 returns to searching for personal interest ("pole cat, "big pole cat").

C4T1 **(1)** Tour de France To orient — Specific **(2)** Personal interest To entertain — General	(1) C4T1 asks the teacher what he should type in. something … He starts by typing "what colours" but inadvertently clicks on Google banner and goes to the World Cup page. After closing this window C4T1 goes back to the query box and enters "tour de france" a suggestion he has overheard. Then also overhearing the teacher's discussion with another child, C4T1 goes to Google Images. From the images search results C4T1 is able to identify different colour jerseys but also identifies jerseys that are not one of the four key colours. C4T1 then searches for the meaning of the green jersey. C4T1 tells the teacher he has found the different colour jerseys and suggests to the teacher that the jerseys are awarded for first, second and third place. The teacher helps C4T1 identify that green is the sprinter's jersey and explains to C4T1 what sprinting means. In between helping other children, the teacher helps C4T1 identify the other meanings. (2) After declaring "I've done it" C4T1 joins in C2T1's search for personal interest, and enters the query "worlds biggest pole cat".
C5T1 **(1)** Tour de France To extend — Specific **(2)** World Cup & Spain To orient — General **(3)** Tour de France To extend — Specific	(1) C5T1 is uncertain how to begin and asks the teacher whether to enter "tour de france and then the question". C5T1 does not submit a query until after the teacher has agreed that the phrase Tour de France could be used as a query. C5T1 swaps to image search at the teacher's suggestion. C5T1 clicks on two images and works out from this that the winner wears a yellow jersey. C5T1 tells the teacher that he has found the answer, and the teacher tells C5T1 to continue looking for the other colours. C5T1 iterates between Web and Image search, for the query "tour de france GREEN". C5T1 finds an image of the green jersey and calls the teacher over. The teacher says "he's wearing it but why has he got it.", and works with C5T1 to determine the meaning of the green jersey. (2-3) Without fully completing task 1, C5T1 goes onto task 2. Near the end of the lesson C5T1 goes back to task 1.

C11T2	
Tour de France **(1)** To extend Specific **(2)** To navigate **(3)** To extend **(4)** To navigate **(5)** To extend	(1) C11T2 starts by typing in Google "la tore de france" but does not select any results. (2) C11T2 then edits the query to "la tore de france wiki". The results load but cannot be selected (user error or connection failure?). C11T2 then enters the query "wiki" and selects Wikipedia from the results. (3) In Wikipedia, C11T2 searches for "le Tour de France" and "le tour de france jersys" (4) When unable to find information for task 1, C11T2 types "Google" in the URL address bar. (5) C11T2 then enters "jersey colours for tour de france" in the query box. C11T2 finds out about the different jersey colours but declares "I don't know what any of them means". C11T2 continues to enter new queries. Overhearing the teacher tell another child about Google Images, C11T2 swaps from Web Search to Image Search.

C14T2	
(1) **Tour de France** To extend Specific	(1) C14T2 enters one query "coloured jerseys what do they mean" and selects the first search result. The website has the answers to the first task and C14T2 spends the rest of the time copying down the answers onto the whiteboard.

C15T2	
(1) Tour de France To extend Specific **(2)** World Cup & Spain To orient General	(1) Ch15T2 starts by entering "what colour jersey does the rider in the lead where" into Google and selects the Wikipedia entry, the first search result. Not finding the information, C15T2 then returns to Google and enters "what do the coloured jerseys mean". C15T2 selects the first search result and finds information related to the task. C15T2 writes "yellow jerseys" on the whiteboard. (2) C15T2 then moves onto the second task, entering "history about spains football club" in Google. C15T2 discusses with a neighbour information found about the World Cup, and writes down the name of players on the whiteboard. The teacher notices that task 1 is not complete. C15T2 is told to return to this task. However, there is no time left to do so.

C16T2	
Tour de France **(1)** To navigate Specific **(2)** To define **(3)** To extend **(4)** World Cup & Spain To orient General	(1) C16T2 starts by typing "wi" into Google and selecting "Wikipedia" from autocomplete. (2-3) C16T2 wishes to type "cycle" into the query box but is unable to spell the word and asks the researcher for help. After submitting the query "Cycling" C16T2 views the Wikipedia Cycling page. C16T2 then using the back button returns to Google and continues searching on "la tour de france", "la tour de france jerseys" and "info on la tour de france jerseys". C16T2 determines that yellow is for the leader and concludes the other jerseys are also for positions, and writes the answers on a whiteboard. (4) C16T2 uses autocomplete to suggest queries for the second task. C16T2 finds out that Spain have previously won the World Cup and immediately reports this to the researcher. The teacher suggests to C16T2 "you might be thinking about current players. What's their world ranking right now." and C16T2 carries on searching.

C23T3

```
(1)   ┌─────────────────────┐
      │   Tour de France    │
      └─────────────────────┘
To extend              Specific
              │
              ▼
(2)   ┌─────────────────────┐
      │  World Cup & Spain  │
      └─────────────────────┘
To orient              General
              │
              ▼
(3)   ┌─────────────────────┐
      │   Tour de France    │
      └─────────────────────┘
To extend              Specific
```

(1) C23T3 starts task 1 by submitting "tour de france" in the Google. C23T3 quickly scans the results and twice edits the query ("tour de france facts". "tour de france colour jerseys"). Then selects two websites. The other children at the table are discussing the answers. C23T3 joins in as does the teacher. Then particularly those sitting at table 3, ask the teacher what they should do now as they have finished the task. The teacher stops the class and briefs the class on the second task.

(2) Before the teacher has finished briefing the second task, C23T3 enters "spain" in the search box. C23T3 reads out loud the time of Spain's next match. C23T3 edits the query to "spain facts". C23T3 examines a website from the search results. C23T3 then submits the query "world cup facts". Other children at the table are discussing the World Cup and adjusting their searches to the discussion. C23T3 does not join in. C23T3 examines two websites from the search results. C23T3 tells the teacher "I found Spain facts and World Cup facts". The teacher does not respond. The teacher complains that some children have found out about jersey colours and names but not the meaning of the colours. C23T3 tells the teacher the meaning of the sprint jersey. C23T3 goes back to a World Cup website, and then discusses match times with a neighbour. At the same time C23T3 flicks between different World Cup and Spain websites.

(3) Just before the teacher tells the class they have "30 seconds" Child 23T3 repeats the earlier three Tour de France queries.

Appendix O Summary of findings sent to participating teachers

Information School

The University of Sheffield

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211 Portobello

Sheffield

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April 2017

Dear [name of teacher]

You kindly took part in an interview study about how search technologies are used in school.

Thank you for taking part in this study. We very much appreciate the time you gave explaining how search technologies are used in the classroom. Attached is a summary of the key findings of the project. These made apparent the wide range of subjects that use Internet search; the many reasons why search technologies are used in the classroom; the different factors that shape search activities (and that constrain them); and the many things children gain from taking part in them. If you have any feedback about this report – for example, about whether you think it is an accurate account of the ways search is used – we would be very interested to hear.

We are using this research to further academic understanding of children's search activities, and the findings of this research will be presented at conferences, and published, as well as contained in my PhD thesis. We would also like this research to be of practical use to teachers. Using these findings, we plan to develop guidance on how best to support children when using search technologies: in particular, what search skills are needed for the different information uses (to orient, to extend etc.) and how best to design search tasks that support different learning objectives. If there is particular support that you would like, please let us know.

Once again, thank you very much for taking part in this study.

Sophie Rutter

(Parent of [name of child])

Sophie Rutter, University of Sheffield, sarutter1@sheffield.ac.uk

A study of primary school children's search activities

Introduction

This report is based on a study of primary school children's search activities conducted at two schools in Sheffield. This report is largely derived from interviews with 10 teachers at a West Sheffield school conducted between May 2015 and July 2015. Prior to the interviews, two Y4 classes had been observed at the West Sheffield school on 26th June 2012 and one Y6 class had been observed at an East Sheffield school on 12th June, 2014. These observations are used to support and verify the findings of the interview study.

The overall aim of this research is to develop a greater understanding of primary school children's search tasks. This understanding can then be used to support the design of search systems and provide guidance to teachers and children on using search technologies.

Overview of search in primary school

Search in primary school is illustrated in Figure 1. (Note: terms used here are explained later on in this document.) In brief, information is needed for subjects in the curriculum and search technologies may be used in response to time and other resource constraints or if their use corresponds with best practice. This leads to different uses of search technologies (to orient, to extend and so on). How children search for this information is influenced by factors in the environment and by the different uses. While searching children are gaining factual content, understanding of concepts, operational skills, analytical skills and potentially a better learning experience. The information is then used either directly to increase knowledge of a subject area or indirectly to support learning of a subject area. This in turn fulfils the requirements of the curriculum.
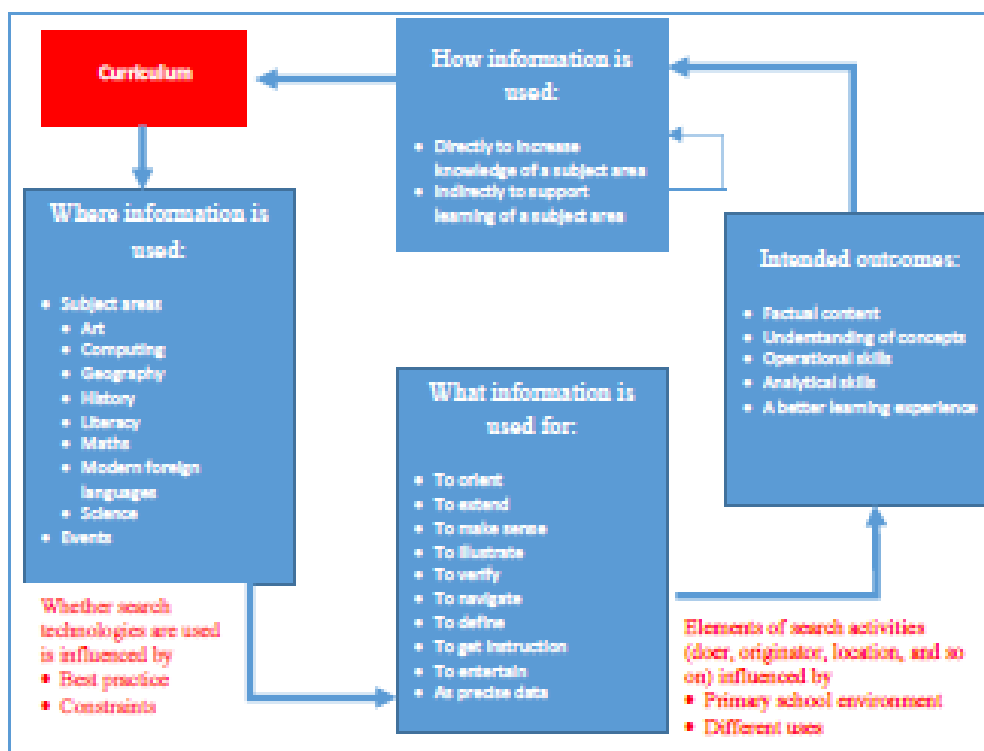
Figure 1: Search in primary school

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Curriculum and why search technologies are used

It is the curriculum that drives the need for information, and search technologies were used across a wide range of subject areas. The few search activities that were not for the curriculum, were for going beyond the curriculum or were for events (which are often related back to the curriculum anyway). Although in the curriculum there is some requirement to do research and to be able to use search technologies effectively, that information should be searched for is mostly not stipulated. The reason information is searched for in class is often in response to what is considered best practice. This is illustrated in the following two examples. The first example is, in Y5 the teacher searched during class for journeys mentioned in the book *Kensuke's Kingdom* because it helps to aid children's understanding and it helps bring the book to life. The second example is, in Y6 when learning about coasts in Geography children search for information on this topic because it is thought that they should be given opportunities to find information by themselves; partly because finding information is considered an important skill and also because it is thought that children learn better this way.

Constraints in the environment also influence search technology use. A concern for time means that teachers use the Internet to find additional information during lessons if they think this information can be found quickly and easily. The Internet is also often used in preference to other resources because there is more flexibility in what information is available (children are not limited to what books the teacher has ordered), the same source can be viewed by multiple children simultaneously, and the Internet is constantly updated (whereas particularly the school dictionaries may be outdated). It should be noted though that the importance of using other resources was stressed and children did not only use the Internet to find information.

What information is used for

10 different uses of information were apparent. Namely, information is used

- *To orient* – to orient by seeking a broad and general understanding, particularly at the start of a new topic.
- *To extend* – to find out about a particular aspect of a topic, usually later in a topic.
- *To make sense* – to bridge a gap in understanding. The search tasks usually result from children's questions during class discussions.
- *To illustrate* – to explain or represent an object or concept. The information can be a text or a picture.
- *To verify* – to confirm other information that children give to the class and also to confirm information found during search activities.
- *To navigate* – to re-find particular websites or to find particular websites as directed by someone else.
- *To define* – to find out the meaning, spelling, synonym and translation of words.
- *To get instruction* – to find out how to make and do things.
- *To entertain* – to amuse (children were observed searching for their own amusement in the East Sheffield school. Although to entertain was not described in West Sheffield, it is thought likely that this information use occurs in both teacher and children originated tasks).
- *As precise data* – as unambiguous units of information such as price data that can then be used in other information tasks. For example, to populate spreadsheets in computing lessons.

The range of use is broad and mostly corresponds with those observed in studies of adults working in different environments. *To keep track* seen in studies of adults was not observed but this may be linked to the primary school environment where new topics are taught every half-term so there is no need to keep abreast of developments. The prevalence of some uses, for example, to define is likely

linked to the educational environment and the age of children.

Elements of search activities

Search activities are made up of different elements such as origination, doer, planning, location, stage and goal. 5 aspects of the primary school environment influence the elements of search activities. Namely, that this is a learning environment

- that is guided by an externally imposed curriculum (aspect 1)
- where teaching is guided by best practice (aspect 2)
- where people have different skills (aspect 3)
- where children must be kept safe (aspect 4)
- where time and resource are limited (aspect 5)

Aspects are likely to be similar across different primary schools although access to resource may vary. The different aspects crossover to influence the different elements. For example, four aspects of the environment influence who does search tasks. Best practice (aspect 2) means that teachers want children to find out for themselves. Keeping children safe (aspect 4) also means that teachers sometimes did the search, particularly for images and video content. As well as this, not all children had the skill (aspect 3) to search. In the younger year groups teachers may do the searches on behalf of children. Children may also search in pairs so they can support each other. Also in West Sheffield there were not enough computers for the children to have one each (aspect 5).

Within a school, the same elements occur across the different year groups with only minor variation. The main difference between the different year groups is who is doing the search task. In Foundation teachers are mainly doing the searches, this tails off in later year groups and as children get older they are more likely to be given search activities to complete at home. Children are also more likely to originate search tasks in older year groups. There is little difference in what search technologies are used for between the year groups. Elements tended to occur in a similar way for each use suggesting that there are distinct ways in which searches are enacted depending on what the use of the technology is.

- Origination – *To orient, to extend, to illustrate* and *as precise data* information uses all originate from teachers. *To define* originate from individual children. *To make sense* originate from the class but which individual child this has originated from often cannot be determined as information requirements emerge from the group.
- Doer – Children are predominantly the doer of *to orient* and *to extend* information uses. It is also mainly children who are the doer of *to define* information use and the doing is predominantly elective, in that children ask the teacher if they can look up words on the class computer. *To make sense* searches are predominantly optional as the teacher may suggest that children find the information at home but there is no requirement to do so.
- Planning – *To orient, to extend, to illustrate* and *as precise data* information uses predominantly occurred in planned search activities, whereas *to make sense* and *to define* information uses predominantly occurred unplanned.
- Location – *As precise data* searches occurred exclusively in school.
- Stage – *To orient* searches tend to occur near the start of a unit. *To make sense* and *to define* could occur at any stage.
- Goal – *As precise data, to navigate, to verify, to make sense* and *to define* are all information uses which have specific search goals where particular information is sought. *To orient* and *to extend* information uses mainly have general goals (no specific information is looked for) but the goals can be specific if the children already have some knowledge of a topic.

Intended outcomes

There are five intended outcomes for using search technologies: gain factual content, aid conceptual understanding, gain operational skills, learn analytical skills and a better learning experience. Each search activity comprised a combination of intended outcomes. No search had a singular purpose and each search activity comprised a combination of different objectives. To illustrate this two examples are given next. The first example, is a search activity where the focus is on gaining factual content. In Y4 the children search for Rainforest animals. The primary purpose here is to gain knowledge of the topic but the teacher also uses this as an opportunity to teach research skills. The second example, is a search activity where the focus is on conceptual understanding. In Y3 children search RightMove (www.rightmove.co.uk) for house information. Children do not need to know about houses but through the act of searching it is hoped that children will gain a conceptual understanding of data files. It is through doing the search, not the search results that Y3 children learn about data files.
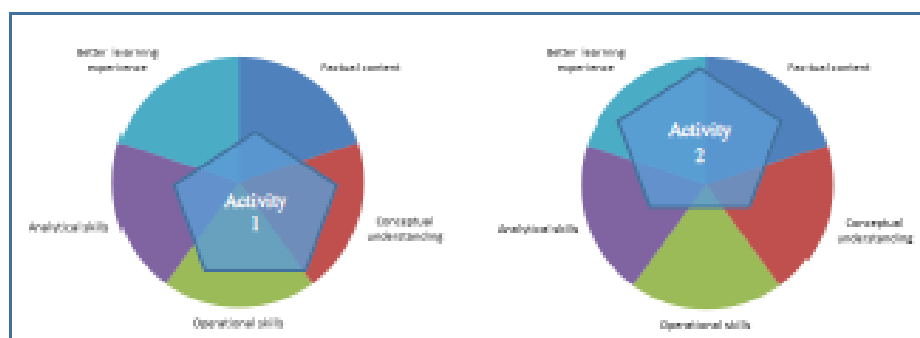
Figure 2: Intended outcomes

How information is used

Information is used in two ways. It may be used directly to increase knowledge of a subject area, or it may be used indirectly to support learning of a subject area.

- Directly to increase knowledge of a subject area – for example, the Y3 class search for information on weather and climate. The information is used to gain a knowledge of Geography.
- Indirectly to support learning of a subject area – for example, when the Y2 children search for information on nocturnal animals, they use this information to write a non-chronological report in their literacy lesson. What is searched for does not directly lead to a knowledge gain in literacy. The information about nocturnal animals is used to learn how to write a non-chronological report.

Appendix P   Primary school children's real-life search tasks

All the phase 1 and phase 2 search tasks are documented in Table 34.

Table 34: Primary school children's real-life search tasks

Age	Search task	Nature	Originator	Flexibility	Doer	Optionality	Planning	Location	Area	How info	What info	Stage	Resource	Output	Goal
4-5	"Greeting" in language "x"	Routine	Teacher with class		Teacher		Planned	Class	MFL	Directly	To define		Particular website	Vocalise	Specific
4-5	"x" country on map	Routine	Teacher with class		Teacher		Planned	Class	Geography	Directly	As precise data		Particular website		Specific
4-5	More about country "x"	Routine	Teacher with class		Teacher		Planned	Class	Geography	Directly	To orient		Internet		General
4-5	Find answers to many questions generated by class	Typical	Class		Small groups in class setting	Compulsory	Planned	Class	Literacy		To orient	Any	Library	Articulate	Specific
4-5	Find answer to a single question for a fiction book	Typical	Teacher	Specific info	Small groups in class setting	Compulsory	Planned	Class	Literacy		To extend		A book	Articulate	Specific
4-5	An image of a real animal	Typical	Teacher	Own area & no framework	Individual in class setting	Compulsory	Planned	Class	Art	Indirectly	To illustrate		Library	Formal writing	General
4-5	Videos to answer children's questions	Typical	Child		Teacher		Unplanned	Class	Topic		To make sense	Any	Particular website		Specific
4-5	Browse Simple City to find more information for class topic	Typical	Teacher	Own area & no framework	Small groups in class setting	Compulsory	Planned	Class	Topic		To extend	Start	An app	Articulate, Illustrate, Notes	General
4-5	Find in-depth information about a particular animal	Typical	Class		Teacher		Planned	Class	Topic		To extend	Mid	Internet	Formal writing	General

Age	Search task	Nature	Originator	Flexibility	Doer	Optionality	Planning	Location	Area	How info	What info	Stage	Resource	Output	Goal
4-5	information about an aye-aye	Typical	Child		Teacher		Planned	Class	Topic		To navigate	Mid	An app		Specific
4-5	Verification that Wolf Spiders are from all over the world, not just England. That some are deadly and poisonous. But not ones found in England.	Typical	Teacher		Teacher		Unplanned	Class	Topic		To verify	Any	Internet		Specific
4-5	Search for images to use in phonics	Typical	Teacher		Teacher		planned	Class	Literacy		To decorate		Internet		Specific
4-5	Video of plant life cycles	Typical	Teacher		Teacher		Planned	Class	Science	Directly	To illustrate	Mid	Particular website		Specific
4-5	What is a rock pool and what does the word coast mean	Typical	Class		Teacher		Unplanned	Class	Topic		To make sense	Start	Particular website		Specific
5-6	Information on African animals	Typical	Teacher	Own area & no framework	Small groups in class setting	Compulsory	Planned	Class	Topic		To orient	Start	Any resource	Formal writing	General
5-6	Facts about Africa	Typical	Teacher	Topic specified, any true	Small groups in class setting	Compulsory	Planned	Class	Topic	Indirectly	To orient	Start	Any resource	Formal writing	General
5-6	Program about animals in Africa e.g. Big cats in Africa	Typical	Class		Teacher		Planned	Class	Topic		To extend	Any	Internet		General
5-6	For evidence that not everybody in Africa lives in a village	Typical	Teacher		Teacher		planned	Class	Topic		To illustrate	Start	Internet		General

Age	Search task	Nature	Originator	Flexibility	Doer	Optionality	Planning	Location	Area	How info	What info	Stage	Resource	Output	Goal
5-6	Investigate charities	Unusual	Teacher with class		Teacher		Planned	Class	Event	Directly	To extend	Start	Internet		General
5-6	Poem about animals	Typical	Teacher		Teacher		planned	Outside of class	Literacy	Indirectly	To extend		Internet		General
5-6	Browse poetry website	Typical	Teacher		Teacher		Planned	Class	Literacy	Directly	To extend		Particular website		General
5-6	Any information on new topic	Typical	Teacher	Own area & no framework	Nominally child	Optional	Planned	Outside of class	Topic		To orient	Start	Any resource		General
6-7	Polar regions topic search. Example questions: questions about Penguins and Polar Bears and how people live there, and what do people eat when they are there and what do people wear? And do children go to school there? Do they have school there? Do people learn to read in the arctic?	Typical	Teacher with class	Choice of specific question	Small groups in class setting	Compulsory	Planned	Class	Literacy	Indirectly	To orient	Start	Any resource	Articulate, Formal writing	Specific
6-7	Additional information about a particular nocturnal animal	Typical	Teacher	Own area & framework	Individual in class setting	Compulsory, some	Planned	Class	Literacy	Indirectly	To extend	Mid	Internet	Formal writing	General
6-7	Meaning of a word	Typical	Child		Individual in class setting	Elective	Unplanned	Class	Generic	Directly	To define	Any	Internet		Specific

Age	Search task	Nature	Originator	Flexibility	Doer	Optionality	Planning	Location	Area	How info	What info	Stage	Resource	Output	Goal
6-7	Spelling of a word	Typical	Child		Individual in class setting	Elective	Unplanned	Class	Generic	Directly	To define	Any	Internet		Specific
6-7	Are there vegetarian spiders?	Typical	Teacher		Teacher		Unplanned	Class	Topic		To make sense	Any	Internet		Specific
6-7	"How are whales like other mammals?" What do they share? Do they feed their babies milk?	Typical	Class	Choice of specific question	Teacher		Unplanned	Class	Topic		To make sense	Any	Internet		Specific
6-7	Find information about any nocturnal animal	Typical	Teacher	Own area & framework	Nominally child	Compulsory	Planned	Outside of class	Literacy	Indirectly	To orient	Start	Internet	Illustrate, Formal writing	General
6-7	Find out about fire engines	Typical	Class		Teacher		Unplanned	Class	Topic		To extend	Mid	Internet		General
6-7	Find out about farm animals e.g. how big does a rabbit get	Typical	Teacher	Own area & no framework	Pairs in class setting	Compulsory	Planned	Class	Topic		To orient		Internet		General
7-8	Look up how to pronounce word in French	Typical	Child		Teacher	Elective	Unplanned	Class	MFL		To define	Any	Internet	Vocalise	Specific
7-8	Differences between climate and weather	Typical	Teacher	Topic specified & framework	Pairs in class setting	Compulsory	Planned	Class	Geography	Directly	To illustrate	Mid	Internet	Articulate	General
7-8	"Find out about different types of weather"	Typical	Teacher	Own area & framework	Pairs in class setting	Compulsory	Planned	Class	Geography	Directly	To extend	Start	Internet	Articulate, Formal writing	General
7-8	Weather in different countries	Typical	Teacher	Own area & framework	Pairs in class setting	Compulsory	Planned	Class	Geography	Directly	To extend	Mid	Internet	Articulate	General

Age	Search task	Nature	Originator	Flexibility	Doer	Optionality	Planning	Location	Area	How info	What info	Stage	Resource	Output	Goal
7-8	Climate change	Typical	Teacher	Topic specified & framework	Pairs in class setting	Compulsory	Planned	Class	Geography	Directly	To illustrate	End	Internet	Articulate	General
7-8	Find a weather related activity (make clouds)	Typical	Teacher		Teacher		planned	Outside of class	Geography	Directly	To get instruction		Internet	Construct	Specific
7-8	"We are going to be doing about weather so do some research at home"	Typical	Teacher	Own area & no framework	Nominally child	Optional	Planned	Outside of class	Geography	Directly	To orient	Any	Internet		General
7-8	Information about a subtopic in Victorian Sheffield e.g transport in Victorian Sheffield	Typical	Teacher	Own area & no framework	Nominally child	Compulsory	Planned	Outside of class	History	Directly	To extend	Any	Any resource	Notes, Formal writing	General
7-8	Use Rightmove to understand data handling	Typical	Teacher		Pairs in class setting	Compulsory	Planned	Class	Computing	Directly			Particular website		Specific
7-8	What is merguez	Typical	Child		Teacher		Unplanned	Class	MFL	Directly	To define	Any	Internet		Specific
7-8	Explanation of present perfect	Typical	Teacher		Teacher		planned	Outside of class	Literacy	Directly	To verify		Internet		Specific
7-8	Re-find explanation of present perfect	Typical	Teacher		Teacher		Planned	Class	Literacy	Directly	To navigate		Internet		Specific
7-8	Answers to children's questions	Typical	Child		Teacher or child	Optional	Unplanned	Either class or outside of class	Generic		To make sense		Internet		Specific
7-8	"Find images of either a land creature, sea creature or flying creature. And find some different	Typical	Teacher	Own area & framework	Nominally child	Compulsory	Planned	Outside of class	Art		To illustrate		Internet	Illustrate	General

Age	Search task	Nature	Originator	Flexibility	Doer	Optionality	Planning	Location	Area	How info	What info	Stage	Resource	Output	Goal
	images to practice drawing it"														
8-9	Research a rainforest animal	Typical	Teacher	Own area & framework	Pairs in class setting	Compulsory	Planned	Class	Literacy	Indirectly	To orient		Any resource	Notes, Formal writing	General
8-9	Latin names for rainforest animals	Typical	Child		Pairs in class setting	Elective	Planned	Class	Literacy	Indirectly	As precise data		Internet	Notes, Formal writing	Specific
8-9	Research a minibeast	Typical	Teacher	Own area & framework	Pairs in class setting	Compulsory	Planned	Class	Literacy	Indirectly	To orient		Any resource	Formal writing	General
8-9	Do apes have better eyesight than humans?	Typical	Child		Nominally child	Optional	Unplanned	Outside of class	Topic		To make sense		Internet		Specific
8-9	Children's maths questions	Typical	Child		Nominally child	Optional	Unplanned	Outside of class	Maths		To make sense	Any	Internet		Specific
8-9	Maths theory or code	Typical	Teacher	Specific info	Nominally child	Optional	Unplanned	Outside of class	Maths	Directly	To extend	Any	Internet	Articulate	Specific
8-9	Research the habitat of a creature	Typical	Teacher	Own area & no framework	Nominally child	Compulsory	Planned	Outside of class	Geography	Directly	To orient	Mid	Internet	Construct	General
8-9	Research Ancient Egypt	Typical	Teacher	Own area & no framework	Nominally child	Compulsory	Planned	Outside of class	History	Directly	To orient	Mid	Any resource	Articulate. Formal writing, Construct	General
8-9	Find facts about the river Nile (this is given as an example of a type of task that could be given to children)	Typical	Teacher	Topic specified, Any true	Pairs in class setting	Compulsory	Planned	Class	History	Directly	To extend		Internet		General
8-9	Look at Sphynx on Google Map	Typical	Teacher	Specific info	Teacher		Planned	Class	History	Directly	As precise data	Mid	Particular website		Specific
8-9	Find Amazon rainforest on a map	Typical	Child		Pairs in class setting	Compulsory	Planned	Class	Topic		As precise data		Particular website		Specific

Age	Search task	Nature	Originator	Flexibility	Doer	Optionality	Planning	Location	Area	How info	What info	Stage	Resource	Output	Goal
8-9	Rainforest videos	Typical	Child		Pairs in class setting	Compulsory	Planned	Class	Geography		To extend		Internet		General
8-9	Research France	Typical	Teacher	Own area & no framework	Nominally child	Compulsory	Planned	Outside of class	Geography		To orient		Any resource	Articulate. Formal writing, Construct	General
9-10	Find as many facts as you can about the moon	Typical	Teacher	Topic specified, any true	Pairs in class setting	Compulsory	Planned	Class	Topic		To extend	Start	Internet	Notes	General
9-10	Biographical information about a particular scientist	Typical	Teacher	Own area & framework	Pairs in class setting	Compulsory	Planned	Class	Science	Directly	To extend		Any resource	Formal writing	General
9-10	Life cycle of an insect	Typical	Teacher	Specific info	Pairs in class setting	Compulsory	Planned	Class	Science	Directly	To illustrate	Start	Internet		Specific
9-10	Life cycle of an amphibian	Typical	Teacher	Specific info	Nominally child	Compulsory	Planned	Outside of class	Science	Directly	To illustrate	Mid	Internet		Specific
9-10	Incomplete metamorphosis	Typical	Teacher	Specific info	Pairs in class setting	Compulsory	Planned	Class	Science	Directly	To illustrate	End	Internet		Specific
9-10	Research a country in South America	Typical	Teacher	Own area & framework	Pairs in class setting	Compulsory	Planned	Class	Literacy		To orient	Start	Any resource	Formal writing	General
9-10	"Shall we quickly Google that"	Typical	Class		Teacher		Unplanned	Class	Generic		To make sense	Any	Internet		
9-10	"Go and have a look"	Typical	Class		Individual in class setting	Elective	Unplanned	Class	Generic		To make sense	Any	Internet		
9-10	Meaning of words selected by the teacher in the Highwayman poem	Typical	Teacher	Specific info	Pairs in class setting	Compulsory	Planned	Class	Literacy	Directly	To define	Any	Internet		Specific

Age	Search task	Nature	Originator	Flexibility	Doer	Optionality	Planning	Location	Area	How info	What info	Stage	Resource	Output	Goal
9-10	Look up meaning of a word	Typical	Child		Small groups in class setting	Elective	Unplanned	Class	Literacy	Directly	To define	Any	Internet		Specific
9-10	How to make lemonade	Unusual	Child		Small groups in class setting	Elective	Planned	Class	Event	Indirectly	To get instruction	Mid	Internet	Construct	Specific
9-10	Cost of ingredients	Unusual	Child		Small groups in class setting	Elective	Planned	Class	Event	Indirectly	As precise data	Mid	Internet	Construct	Specific
9-10	What is the longest python in Australia?	Typical	Teacher	Specific info	Teacher or child	Optional	Unplanned	Both class and outside of class	Art		To illustrate		Internet	Illustrate	Specific
9-10	Research Ancient Greece	Typical	Teacher	Own area & no framework	Nominally child	Compulsory	Planned	Outside of class	History	Directly	To orient		Any resource	Articulate. Formal writing, Construct	General
9-10	Where is South America in the world?	Typical	Teacher		Teacher		Planned	Class	Literacy	Indirectly	As precise data	Start	Particular website		Specific
9-10	Look up journeys in Kensuke's Kingdom	Typical	Class		Teacher		Planned	Class	Literacy	Indirectly	To illustrate	Any	Internet		Specific
7-8	Looking at the local area and comparing different areas	Typical	Teacher		Teacher		Planned	Class	Geography	Directly	As precise data		Particular website		Specific
9-10	Locate two points on a map to measure distance between	Typical	Teacher	Semi-specific info	Pairs in class setting	Compulsory	Planned	Class	Maths	Directly			Particular website		Specific
10-11	What can you find out about the Mayan civilization	Typical	Teacher	Own area & no framework	Pairs in class setting	Compulsory	Planned	Class	History	Directly	To orient	Start	Internet	Articulate	General

Age	Search task	Nature	Originator	Flexibility	Doer	Optionality	Planning	Location	Area	How info	What info	Stage	Resource	Output	Goal
10-11	Questions about coasts e.g. Why do some coasts erode quicker than others	Typical	Teacher with class	Choice of specific question	Pairs in class setting	Compulsory	Planned	Class	Geography	Directly	To orient	Start	Internet	Articulate, Notes	Specific
10-11	Research a person for a biography	Typical	Teacher	Own area & framework	Nominally child	Compulsory	Planned	Outside of class	Literacy	Indirectly	To orient	Mid	Any resource	Notes, Formal writing	General
10-11	Picture to decorate biography	Typical	Teacher	Choice of specific question	Nominally child	Optional	Planned	Outside of class	Literacy	Indirectly	To decorate	End	Internet	Formal writing	Specific
10-11	Picture to decorate a science fiction story	Typical	Teacher	Choice of specific question	Nominally child	Optional	Planned	Outside of class	Literacy	Indirectly	To decorate	End	Internet	Formal writing	Specific
10-11	Get ideas to make box of the inside of the borrowers	Typical	Teacher	Own area & no framework	Nominally child	Optional	Planned	Outside of class	Literacy	Indirectly	To illustrate	Mid	Any resource	Construct	General
10-11	Find content / inspiration to write and decorate a mountain holiday leaflet	Typical	Teacher	Own area & framework	Nominally child	Compulsory	Planned	Outside of class	Literacy	Indirectly	To extend	Mid	Internet	Formal writing	General
10-11	Search on any topic to write an explanation	Typical	Teacher	Own topic & framework	Nominally child	Compulsory	Planned	Outside of class	Literacy	Indirectly	To extend	Mid	Any resource	Formal writing	General
10-11	Any food and any drink prices in Asda or Tesco website	Typical	Teacher	Semi-specific info	Pairs in class setting	Compulsory	Planned	Class	Computing		As precise data	Mid	Internet	Spreadsheet	Specific
10-11	Music for a film	Typical	Teacher	Own area & no framework	Nominally child	Optional	Planned	Outside of class	Computing		To illustrate		Internet	Construct	General
10-11	Search for BBC touch typing program	Typical	Teacher	Specific info	Nominally child	Optional	Planned	Outside of class	Computing		To navigate		Internet		Specific

Age	Search task	Nature	Originator	Flexibility	Doer	Optionality	Planning	Location	Area	How info	What info	Stage	Resource	Output	Goal
10-11	Children's questions for example How fast does light travel?	Typical	Child		Nominally child	Optional	Unplanned	Outside of class	Science	Directly	To make sense	Any	Internet	Articulate	Specific
10-11	Picture and background information Helen Keller	Typical	Teacher		Teacher		Unplanned	Outside of class	Literacy		To illustrate		Internet		Specific
10-11	Picture of Rebecca Turner	Typical	Teacher		Teacher		planned	Outside of class	Event		To illustrate		Internet		Specific
10-11	Spelling of word	Typical	Child		Individual in class setting	Elective	Unplanned	Class	Science	Directly	To define	Any	Internet		Specific
10-11	Synonym for word	Typical	Child		Individual in class setting	Elective	Unplanned	Class	Generic	Directly	To define	Any	Internet		Specific
10-11	Meaning of word	Typical	Child		Individual in class setting	Elective	Unplanned	Class	Science	Directly	To define	Any	Internet		Specific
10-11	Prepare for school trip	Typical	Child		Nominally child	Elective	Unplanned	Outside of class	Event		To orient	Start	Internet		General
9-10	Costs of attractions in Sheffield	Typical	Teacher	Semi-specific info	Pairs in class setting	Compulsory	Planned	Class	Computing	Indirectly	As precise data		Internet	Spreadsheet	Specific
9-10	Cost of a meal at a local restaurant	Typical	Teacher	Semi-specific info	Pairs in class setting	Compulsory	Planned	Class	Computing	Indirectly	As precise data		Internet	Spreadsheet	Specific
7-8	Information about volcanoes	Typical	Teacher	Own area & no framework	Pairs in class setting	Compulsory	Planned	Class	Computing	Indirectly	To extend		Internet	Formal writing	General
6-7	Information (text and images) about Cleethorpes	Typical	Teacher	Own area & framework	Pairs in class setting	Compulsory	Planned	Class	Computing	Indirectly	To extend		Internet	Formal writing	General
5-6	Find Isle of Tune website.	Typical	Teacher	Specific information	Pairs in class setting	Compulsory	Planned	Class	Computing		To navigate		Internet		Specific

Age	Search task	Nature	Originator	Flexibility	Doer	Optionality	Planning	Location	Area	How info	What info	Stage	Resource	Output	Goal
9-10	Information on Ancient Greeks	Typical	Teacher	Own area & no framework	Pairs in class setting	Compulsory	Planned	Class	Computing	Indirectly	To extend		Internet	Formal writing	General
9-10	Navigate/Refind Scientist page	Typical	Teacher	Specific info	Pairs in class setting	Compulsory	Planned	Class	Science		To navigate		Internet		Specific
n/a	Video of two specific Olympic swimmers	Typical	Teacher		Teacher		planned	Outside of class	Event		To illustrate		Particular website		Specific
9-10	Something they ask you at the end of the day	Typical	Child		Nominally child	Optional	Unplanned	Outside of class	Generic		To make sense	Any	Internet		Specific
10-11	Spelling of word	Typical	Child		Individual in class setting	Elective	Unplanned	Class	Geography	Directly	To define	Any	Internet		Specific
10-11	Meaning of word	Typical	Child		Individual in class setting	Elective	Unplanned	Class	Geography		To define	Any	Internet		Specific
8-9	What is the longest bone / What is the shortest bone / What is bone made out of / How long is the spine in an average human adult / How many bones are in your foot / How many bones does a fully grown male / female [have]	Typical	Teacher with class	Choice of specific question	Pairs in class setting	Compulsory	Planned	Class	Computing	Indirectly	To extend, To navigate, To verify	Near start	Internet	Notes	Specific
10-11	There are different colour jerseys that the riders can win [in the Tour de	Typical	Teacher	Specific question	Individual in class setting	Compulsory	Planned	Class	Event	Indirectly	To extend, To navigate	Near start	Internet	Notes	Specific

Age	Search task	Nature	Originator	Flexibility	Doer	Optionality	Planning	Location	Area	How info	What info	Stage	Resource	Output	Goal
	France]. What are they for?														
10-11	Our country for the World Cup is Spain. I would like you to find out as much information about Spain and the World Cup as you can. So I don't want to know about culture, I don't want to know about food, I don't want to know about the tourist industry. I want to know about the World Cup and Spain.	Typical	Teacher	Own area & no framework	Individual in class setting	Compulsory some, Elective	Unplanned planned	Class	Event	Indirectly	To orient / To extend	Mid	Internet	Notes	General
10-11	Ferrets	Typical	Child		Individual in class setting	Elective	Unplanned planned	Class	Non-school work	Indirectly	To entertain		Internet		Specific