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How the information use environment influences search activities: a case of English primary schools

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Structured abstract

Purpose: The information use environment (IUE) - the context within which the search activity takes place - is critical to understanding the search process as this will affect how the value of information is determined. This study investigates what factors influence search in English primary schools (children age 4-11) and how information found is subsequently used.

Design/methodology/approach: Ten teachers, selected using maximal variation sampling, describe search related activities within the classroom. The resulting interview data were analysed thematically for the influence of the environment on search and different information uses. The findings were then validated against three classroom observations.

Findings: Eleven categories of information use were identified, and five aspects of the environment (the national curriculum, best practice, different skills of children and teachers, keeping children safe, and limited time and resource) combine to influence and shape search in this setting.

Research limitations/implications: Findings support the argument that it is the IUE that is the key influence of search activity. What makes children a distinct user group is linked to the environment within which they use information rather than age, as advocated in previous studies.

Practical implications: The features of search systems and practical guidance for teachers and children should be designed to support information use within the IUE.

Originality/value: As far as we are aware, this is the first study to consider the influence of the IUE on how search is enacted within primary schools.

Introduction

Many studies of children using search systems have concluded that children are a distinct user group because of their age (e.g. Walter, 1994; Large, Nesset and Beheshti, 2008; Gossen, Hempel and Nürnberger, 2013; Duarte Torres, Weber and Hiemstra, 2014). However, in a study of the professions, Taylor (1991) argues that as the value given to information is dependent upon the environment in which it is used, it is environment that is of crucial importance. Taylor (1991) does not consider demographics (including age) to be a key factor. Instead, Taylor (1991) argues that a person operating in one information use environment (IUE) will value information in a different way from someone operating in another. This suggests that to understand how children search and use information a good understanding is needed of the environments within which they do so. This paper investigates whether the (IUE), not simply age, is the key influence on children's search.

There have been some indications that setting influences children's search (Limberg, 2007; Lundh, 2011). However, a broad study of the English primary school (with children starting school in Foundation age 4 and leaving in Year 6 age 11) information use environment, and especially children's information use in primary schools, has not until now been undertaken and forms the focus of this paper. We address the following research questions: [RQ1] What is shaping primary school children's search? and [RQ2] What do primary school children use information for? The remainder of this paper is structured as follows: first related work on studies of how children find and use information is reviewed, structured around Taylor's (1991) information use environment. Then the approach taken to collect and analyse data is described, followed by the results. Finally the results are discussed in light of prior work.

Related work

Taylor (1991, p. 221) describes an IUE 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". These four elements are used as a framework to review the research literature to reveal how a primary school setting may be influencing children's search. Then the relationship between tasks, activities and the IUE is considered.

1. Sets of people

Taylor (1991) argues that sets of people should not be defined by demographic variables (e.g. gender) or non-demographic variables (e.g. twitter users). Rather sets are those that society have already 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). Primary school children too are a group defined by society and thus can be considered a set of people. However, whether children can be considered a single set or should be subdivided is debatable as many studies of children have found age to be an important factor (e.g. Marchionini, 1989; Duarte Torres, Weber and Hiemstra, 2014). As Taylor's (1991) conceptualisation is based on analysis of "the professions" primary school children could be an exception, and it could be children's role of student (Leckie, Pettigrew and Sylvain, 1996) within the primary school setting that is of prime importance.

2. Problems

Taylor (1991) suggests three areas to contemplate when considering information problems: whether problems change over time, characteristics of typical problems within the setting (particularly, whether problems are familiar, well-structured, complex, or dependent on agreed assumptions), and responses to problems.

With the adoption of new technologies in schools, there has been considerable change in the information environment. Increasing access to the Internet has coincided with a move away from rote learning towards children finding information for themselves (Kuhlthau, Maniotes and Caspari, 2007). Nevertheless, given many schools follow a national curriculum "so children learn the same things" (Department for Education, 2016b), it is likely that there are typical problems. However, whether children in different year groups share information problems needs further consideration as children's information needs change with age (Shenton and Dixon, 2004; Duarte Torres, Weber and Hiemstra, 2014).

Whether children's problems are familiar is unclear from the research literature but it is reasonable to think that as problems stem from a recommended program (in the form of a curriculum) they will likely follow similar patterns for many schools. Although there has been considerable investigation of how children's search behaviour depends on the structure and complexity of problems (e.g. Schacter, Chung and Dorr, 1998; Bilal, 2002), in these studies the problem has been designed by the researcher; the search tasks are used to respond to research questions rather than reflect children's actual search tasks. A consequence is that the structure and complexity of children's real-life tasks are not known. That there are agreed-upon assumptions that influence children's search has been established: notably Limberg (2007, p. n.p.) found 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".

3. Setting

Taylor (1991) describes four key components of a setting: organisational influence, the domain, information access, and time and experience.

The influence of the organisation is manifest in the extent the organisation imposes on the set of people. Primary schools are a highly regulated space and imposition is high. Although there may be a degree of choice in what children search for, school work should always be viewed as externally-assigned as work is assessed, there are intended learning outcomes, and it is the teacher who decides whether the search has been successful (Gross, 2006; Limberg, 2007). Furthermore, teachers are likely assigning tasks from a curriculum that has also been imposed on them (Gross, 2006).

Education is the domain in which primary schools are interested. To make learning meaningful, school work is often designed to relate to the real world; the work is not truly real-life but neither is it simulated (Gordon, 1999). Another idiosyncrasy common to the educational context is that the same work is assigned to the whole class. However, each individual may experience the work differently (Limberg, 2007).

Like much of Europe and North America, UK schools have invested heavily in technology, ensuring that all pupils have access to computers in schools, and hence to the Internet. However, there is potential for variation in how technology is used in the home (van Deursen and van Dijk, 2014). Whether difficult tasks become routine over time and with experience in primary schools is unclear from the research literature.

4. Resolution of problems

Taylor (1991) describes two aspects to information problems: information traits and information use. There is some indication that particular information traits ("traits inherent in information beyond subject matter" (Taylor, 1991, p.231)) are common in primary schools as it has been observed that in school children look for factual information and single solutions (Limberg, 1999; Chung and Neuman, 2007).

There have been few studies of children's information use in primary schools. Nesset (2007) found that children search for text and images because it is difficult to make use of multi-media in paper-based writing projects. Lundh & Limberg (2012) found that there are four ways pictures can be used to support text (decorating, illustrating, explaining and narrating), and in a study of secondary school children Limberg (1999) found that information use depends on how a task is perceived and that different members of a class will perceive the same assignment differently.

Relationship between information use environment, activity and task

Within Information Science the term activity has been used as a synonym for task (e.g. Li and 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, no date, p. n.p.). This concept of an activity is in keeping with how search is enacted in primary schools (Figure i), where lessons may be structured around a search activity. During a search activity (an activity structured around using search systems) multiple search tasks (responding to distinct needs for information) may be conducted. These search tasks can be used to fulfil separate units of work: "a coherent body of teaching / learning material usually focused on one specific topic or subject" (Dictionary of Education, 2016) that could be for one or more lesson. These units of work are conceptually similar to work tasks: the "separable parts of a person's duties to her/his employer" (Byström and Hansen, 2005, p. 1053).

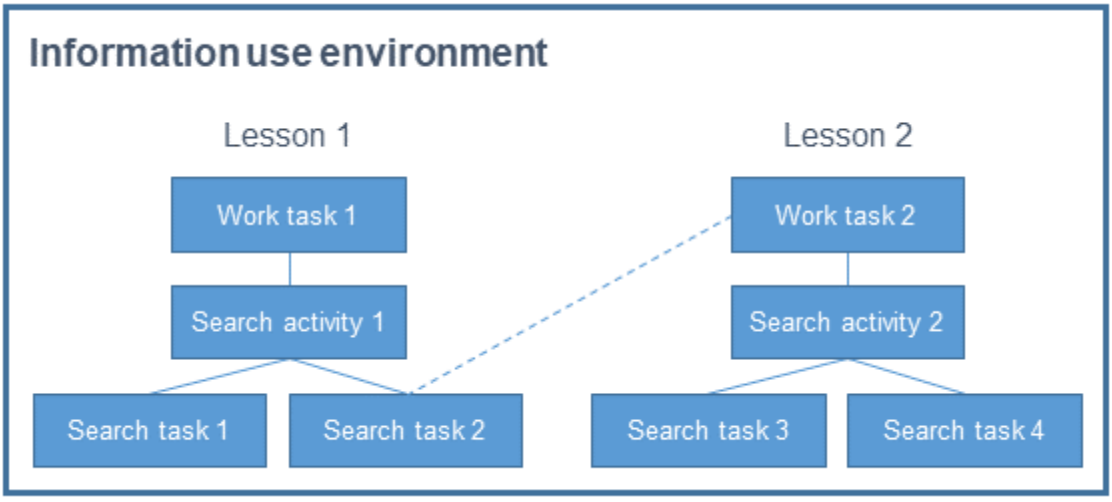

Figure i: Relationship between information use environment, activity and task

Summary

Whether due to their age children are a distinct user group is central to much work examining how children seek information (e.g. Walter, 1994; Large, Nesset and Beheshti, 2008; Gossen, Hempel and Nürnberger, 2013; Duarte Torres, Weber and Hiemstra, 2014). In the more general field, Taylor (1991) puts forward a compelling argument for IUEs, whereby it is the environment within which information is used that has the most influence. Reviewing studies of children, using Taylor's (1991)

model as a framework, gives indications that the IUE influences children's search, but it is difficult to draw a definitive conclusion; to determine what is influencing children's search requires further examination.

Research design

The research was conducted in two phases and summarised in Table 1. The two phases are described next.

Table 1: Overview of research design

Research phase	Phase objectives	Data source & collection	Data analysis
Phase 1	To identify what is influencing search in a primary school (RQ1) To identify different uses of information in a primary school (RQ2)	A priori maximal variation sample (1 school, 10 teachers) Semi-structured interviews	Step 1: Inductive thematic analysis (Braun and Clarke, 2006) and deductive analysis using Taylor's (1991) classes of information use
Phase 2	To verify what is influencing search in primary schools (RQ1) To verify different uses of information in primary schools (RQ2)	Re-use of existing datasets (2 schools, 3 classes) Classroom observations	Step 2: Rich descriptions of the lessons and search activities Step 3: Descriptive analysis compared with phase 1 analysis

Phase 1: Identifying influences and information use

To uncover variation, a priori maximal variation sampling was employed whereby participants were selected for heterogeneity (Patton, 2015). Two teachers who specialised in computing and eight teachers from different year groups were purposively recruited from a single primary school. During each interview, teachers were asked to reflect back over the academic year (September 2014 to July 2015) and to think about situations in which children searched for information. To collect as wide a range of responses as possible, teachers were free to describe situations as they wished, for example

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.

For RQ1, the data were analysed inductively using thematic analysis. Employing open coding the lead researcher coded the data for how and why search occurs in primary school. A semantic approach was taken whereby it is the "the explicit or surface meanings of the data" that is coded (Braun and Clarke, 2006, p. 13). The open codes were then aggregated into different themes (see Appendix, Table 3) and checked by the second and third researchers. The codes were then applied to the interview data by the lead researcher. The codes were further tested and validated in phase 2.

To analyse the data for RQ2, the interview transcripts were initially examined deductively for examples of "what information does to or for the recipient and his or her problem or situation" (Taylor, 1991, p. 221), using definitions of information use from the research literature (see Table 2). Previous definitions were refined inductively to reflect the information uses described in this study, and some new uses were also identified inductively. We report these definitions alongside illustrative quotes in the results. The information uses and definitions were further tested in phase 2.

Phase 2: Verifying the results of Phase 1

The phase 1 findings were verified and tested by triangulating the phase 1 findings using three classroom observations from two previous studies (Rutter, Ford & Clough, 2015; Rutter, Clough & Toms, accepted pending revision). In the observations, children worked individually or in pairs while completing a search activity within a lesson. This was observed in situ and audio recorded. Some computers had screen capture activated depending on the limitations of the school network. Children made notes of their searches either on paper or on a portable whiteboard and copies were taken of all notes.

The first pair of observations were from the same phase 1 school (referred to as West School). Data were collected on 26th June 2012, during two consecutive Computing lessons. Data from the second school (referred to as East School) were collected on 12th June 2014. Both schools are large primaries located in the north of England and are considered "good" by Ofsted, the English school inspector (www.gov.uk/government/organisations/ofsted). However, the catchment areas are diverse: West School is located in an affluent neighbourhood and East School in an area of high deprivation.

Approval for the two studies was obtained from the school leadership teams, who helped recruit classes. Children in these classes were informed of the study and asked if they wanted to participate. In all studies, more children wanted to participate than we could accommodate. In West School, the two class teachers each drew six children's names from a hat. In East School, the first eight children to collect a computer in the classroom were selected.

In step 1 (phase 1), the interview data were coded thematically for information use and the influence of the environment. In phase 2 the data were analysed with two more steps. In step 2, classroom observations were used to build rich descriptions of lessons (the instructions and support the teacher gave, how the children were assigned the task, the time given to the search activity and the actual search tasks) and children's searches (how the search unfolded for each child/pair) from the audio recordings and screen captures. In step 3, phase 1 codes and definitions were verified and tested by examining the rich descriptions for these codes. The findings for each step are reported in the results, and the combined findings of phase 1 and 2 are considered with respect to the two research questions.

Research quality and limitations

Several techniques were employed to ensure research quality (Lincoln and Guba, 1985). For credibility, both within and multiple method triangulation was used: data were collected at different times from two diverse schools using both teachers and children as information sources; both semi-structured interviews and observation were used as research instruments; and data were analysed both inductively and deductively. To help ensure transferability the settings were richly described

and findings were linked to the research literature, notably to Taylor's (1991) concept of an IUE. To confer dependability and confirmability, processes were audited and care was taken to ensure consistency across the two phases. After the study was completed a report was sent back to each participating teacher.

Although care has been taken to ensure research quality there remain limitations. The observations only partially validate the findings of the interviews. On reflection to observe all that is described in the interviews is likely unfeasible. Furthermore, the study involves two schools and this may impact how far findings can be generalised. Further research is required to determine whether there are different influences in other primary schools, and the similarities and differences with schools from other countries.

Ethics

After a full ethics review permission was received to carry out the research from the University Ethics Committee. To ensure confidentiality neither the school, teachers or children are personally identifiable. Informed consent was obtained from all who participated in the studies and it was made clear to all participants that they could withdraw at any time.

Results

These results report first how and why search is occurring in primary school as identified in phase 1 (data analysis step 1), and then from phase 2 the descriptions of the three lessons and search activities in two schools (step 2). Phase 2 is then compared with phase 1 (step 3) and the combined findings used to ascertain what factors shape primary school children's search (RQ1) and their different information uses (RQ2).

Environmental influences (Step 1: RQ1)

The phase 1 teacher interviews were analysed thematically for how and why search is occurring in primary school. Five themes were identified, described in the following sections.

Supporting the curriculum (theme 1)

Search systems are used to support the curriculum as it is the curriculum that drives the need for information. Even when teachers state that they are not searching for information for the curriculum, they are using it to go beyond the curriculum.

> "Some kids might be actually wanting to do [Maths] that is not in our curriculum." (Y4 Teacher)

Information is used to support the curriculum in two ways. Firstly, information is used directly to increase knowledge of a curricular subject. For example, in History children search for information on Ancient Egypt. Secondly, information is used indirectly to support learning of a curricular subject. For example, in Literacy when learning about non-chronological reports (a non-fiction report that is not ordered by time) children search for information on nocturnal animals. It is through writing about nocturnal animals that children learn about Literacy (non-chronological reports) but the information searched for (nocturnal animals) is not about Literacy.

> "Literacy has to have some kind of content. There has to be some context to the learning … 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)

Search systems are used to support the curriculum with five intended outcomes:

(1) to gain factual content about a topic / curricular subject

> "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)

(2) to gain research skills

> "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)

(3) to gain an understanding of concepts, either through the information found or the act of searching

> "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 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)

(4) to acquire operational skills

> "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)

(5) to gain a better learning experience through following good classroom practice (see theme 2 below)

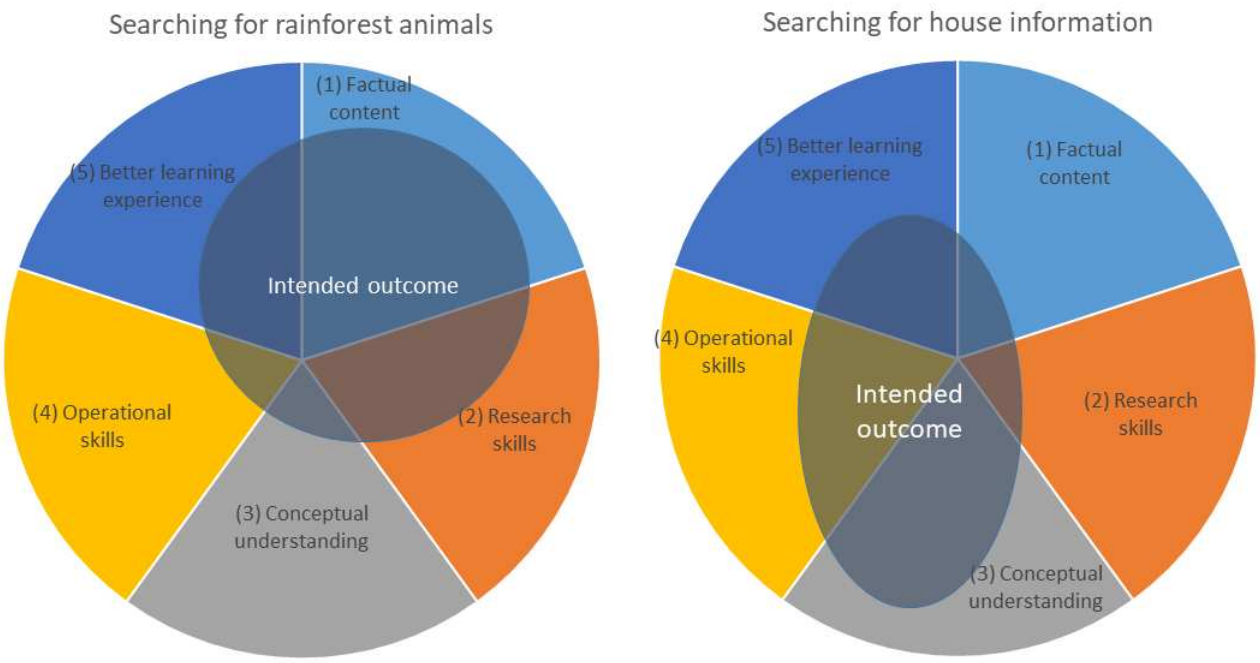

Figure ii: Combinations of intended outcomes

Each intended outcome is not discrete and each search may fulfil a different combination of intended outcomes. Figure ii illustrates how when children are searching for Rainforest animals the primary purpose 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 2) and using the Internet means that children are not constrained by the books available in the classroom (intended outcome 5). By contrast, when children search Rightmove (www.rightmove.co.uk) for house information, the primary purpose is that they gain a conceptual understanding of data files (intended outcome 3), but also that they gain an operational understanding (intended outcome 4) and by using a real-life example find data files easier to understand (intended outcome 5).

Good classroom practice (theme 2)

Throughout the interviews teachers described search in relation to good practice. Before a planned search activity, teachers typically discuss with a class what they already know and after the search activity is complete children are encouraged to articulate and discuss what they have found.

> "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." (Y3 Teacher)

Children may have a choice in what to research so that lessons can be child-led.

> "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, 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)

To make learning feel more real, images of unfamiliar places and objects may be searched for. Conversely, children may search for local information to understand unfamiliar concepts.

> "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)

Teachers also think it important that children search for information.

> "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)

Teachers also use search systems in class because children enjoy using the Internet and because the Internet provides access to information in appealing formats.

> "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)

Supporting children (theme 3)

To ensure information is available for everyone in the class, children are encouraged to support each other by working in pairs and occasionally in small groups. Teachers may also provide alternative resources. Particularly in the younger year groups, teachers search for information on behalf of the class. This was reported as a shared activity with the teacher simply acting as the operator.

> "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 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." (Y4 Teacher)

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

However, teachers believe that it is not necessary to teach some skills.

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

Information access (theme 4)

To keep children safe, the school limits what information children can access using a firewall, but sometimes innocuous content is restricted. Teachers are also careful when searching in front of the class.

> "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)

> "I wouldn't use it [Google Images] 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." (Foundation Teacher)

Environmental constraints (theme 5)

Constraints in the environment influence search system use. So that work can be completed in the time available teachers may support children in their searches. Some searches are given as homework where teachers believe children will have more time.

> "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." (Y6 Teacher)

> "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" (Y4 Teacher)

In each classroom there is only one computer. If teachers want the whole class to conduct searches they must book equipment in advance. There is also not enough equipment for each child to use on their own.

> "The biggest problem is that we don't have equipment in every classroom at all times. […] 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)

> "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." (Y5 Teacher)

However, search systems are used in response to shortcomings of other resources.

> "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)

Classes of information use (Step 1: RQ2)

In phase 1, teachers described 10 ways in which information is used. In addition, for some searches there was no use of information:

(1) *To orient:* Information is used to orient to a new topic by seeking a broad and general understanding.

> "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)

(2) *To extend:* Information is used to find out about a particular aspect of a topic.

> "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 School and they had to go home and research it." (Y3 Teacher)

(3) *To make sense:* Information is used to bridge a gap in understanding (Dervin, 1983). These searches originate from the questions that children ask when they need more information to make sense of what they are learning.

> "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)

(4) *To illustrate:* Information (text or image) is used to explain or represent an information object or concept.

> "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." (Y1 Teacher)

(5) *To decorate:* Information is used to visually 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)

(6) *To verify:* Information is used to confirm. This may occur when the teacher is uncertain of the veracity of the information and children may be encouraged to check information they find.

> "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)

(7) *To navigate:* Information is used "to reach a particular site" (Broder, 2002, p. 5). Teachers and children may want to re-find information or a site that they have used before or teachers may instruct the class to find a particular website.

> "We were looking at present perfect in SPAG [Spelling, Punctuation and Grammar]. 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)

(8) *To get instruction:* Information is used to find out "what to do and how to do something" (Taylor, 1991, p. 230).

> "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)

(9) To define: Information is used to find out the meaning and spelling of words, and to find synonyms and translation.

> "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)

(10) *As precise data:* To use data (such as price or location data) as specific unambiguous units of information.

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

No clear use: The information searched for is not used. For example, as described above when searching Rightmove children are doing this to gain a conceptual understanding of data files, they do not use the house data.

Lesson descriptions (Step 2: RQ1 and RQ2)

The rich descriptions of the lessons and search activities from the phase 2 observation sessions are described next.

West School

Two Computing classes that ran consecutively were observed in West School. In each class there were approximately 30 children (aged 8 and 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 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 and were free to choose their partner (although for this study the screen recording children needed to work together).

The search tasks were:

- Class 1:
    - What is the longest bone?
    - What is the shortest bone?
    - What is bone made out of?
- Class 2:
    - 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]?

During the search activity, the Computing teacher moved around the class observing the children, offering help when needed. Of the six pairs observed in this study, four pairs searched on two questions, two pairs on one. While searching three pairs only entered queries which were variations of the task statement, while the other three pairs navigated to specific sites (Google, Wikipedia, Bing) before and after querying variations of the task statement. One pair also checked that the information they have found is correct by searching again in a different search engine.

Altogether the children were given around twenty minutes to complete their search activity. Network connection problems meant that some children had considerably less time. At the end of the class the children sat on the carpet at the front of the class while the teacher asked what they had found out.

East School

In this class, twenty-four children sat at three tables with eight children on each. At the start of the lesson all the children sat on the carpet at the front of the class while the teacher explained that they would use the Internet to find out more about the Tour de France, which had been discussed in the school assembly that morning. The teacher displayed on the interactive whiteboard the assembly PowerPoint presentation and asked the children to search on one of the questions that had not yet been answered. 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 to complete if they had finished the first task. Both search tasks were based on current events that the children had been learning about in other lessons.

The search tasks 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.

Of the eight children observed using screen recording software, two children navigated to a specific site (Wikipedia). One child searched for how to spell "cycling". Two children (unknown to the teacher) also conducted searches on polecats for their own entertainment. While each child had a

computer they shared information and answers, and thus often worked collaboratively. This was particularly the case for the Word Cup task.

The class spent approximately seventeen minutes using the Internet. 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.

Verification of environmental influences and information use (Step 3: RQ1)

The phase 1 themes are now revisited with the phase 2 observations.

Supporting the curriculum (theme 1)

In West School, children searched on their Science topic during a Computing class thus confirming that information is used to indirectly support learning of a subject. Similarly, in East School, although children searched on current events they used this information to support their learning in the curriculum.

Good classroom practice (theme 2)

All observations indicated that search activities were shaped by what are considered good classroom practices. In West School, 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 School, the teacher set a broad task so that children could pursue their own interests within this topic. In both schools, although the teachers supported the children they encouraged them to find this information independently. Again, in both schools, before and after search activities information was discussed and shared.

Supporting children (theme 3)

In West School children worked in pairs partly because of a lack of resources but also so that they could support each other. In East School each child had their own computer, but the children sat together at tables and supported each other anyway. In both schools, the teacher helped children who were struggling and search tasks were completed together. It is very difficult to view the search activities in any of the observations as independent solo activities for any child.

Information access (theme 4)

In all observations children selected links to blocked websites. In all cases the websites were innocuous (checked later by the researcher on a university campus) and children were noticeably frustrated by their inability to access the desired information. In West School, the teacher started each class by talking about how to search safely.

Environmental constraints (theme 5)

The time given to the search activity in all three observations was short at around 17 to 20 minutes, and was dictated by the length of the lesson and the need to share and discuss information before and after the search activity. In both schools, computers were brought into the class to use. In West School, children needed to share computers because there was not enough for one each. However, there was considerably more resource in East School and each child used a separate computer.

Summary

Five themes were identified in the phase 1 interview study. Many aspects of these themes were validated in the phase 2 class observations. Apart from the East School having access to greater resource (but still only one computer in the classroom) search occurred similarly in both schools.

Comparison of information use and lesson descriptions (Step 3: RQ2)

The information uses identified in phase 1 are now revisited with the phase 2 observations.

The West School search tasks assigned by the teacher all had "to extend" information uses; the topic had already been discussed in class and information was used to find out about a particular aspect of a topic. To find this information three children went "to navigate" to particular sites. One pair did new searches "to verify" their findings.

The first search task assigned by the East School teacher used information "to extend" as again this topic had already been discussed in class and information was used to find out about a particular aspect of a topic. The second search task assigned by the teacher was very open and non-specific. The teacher asked children to gain general information on the broad topic. While completing the first search task, two children went "to navigate" to particular sites. One child needed "to define" spellings. Two children also conducted searches "to entertain".

As such five of the ten information uses found in phase 1 are confirmed in the observations: to orient, to extend, to navigate, to define and to verify. One new information use of "to entertain" was identified. Although "to entertain" was not described as an information use in the West School interviews, one of the reasons teachers gave for using search technologies was that children enjoyed using them. This information use is now added to the classes of information use.

(11) To entertain: Information is used for amusement.

Summary

Across phase 1 and phase 2, it was found that the curriculum influences how search is taught, what search technologies are used for, and why they are used (theme 1). Search is aligned with what is considered good classroom practice and this affects when and why search occurs (theme 2). Teachers need to support children but also children support each other because within a class there are different skill sets (theme 3). To keep children safe, what and how information is accessed is restricted (theme 4). Both time and resource influence who searches and the design of search activities (theme 5). Using these findings, we conclude that five aspects of the primary school environment combine to shape children's search (RQ1), namely that primary schools are in a learning environment

1. that is guided by an external curriculum
2. where teaching is guided by best practice
3. where people have different skills
4. where children must be kept safe
5. where time and resource are limited.

We also identified eleven uses of information across phase 1 and 2: to orient, to extend, to make sense, to illustrate, to decorate, to verify, to navigate, to define, to get instruction, as precise data, to entertain, and also that for some searches there was no use of information

Discussion

Five aspects of the primary school environment were found to influence children's search: curriculum, best practice, skill differences, safety, and time and resource. These different aspects approximate to Taylor's (1991) model of an IUE: the set of people (skill differences, safety), the problems of the setting (curriculum), what is considered resolution of the problem (best practice) and the setting itself (time and resource). These findings are now summarised in relation to Taylor's (1991) model.

- Sets of people: Taylor (1991) argues that it is the set of people as defined by society that influences information-seeking. The findings of this study support this but role is also influential. However, within a setting some tasks are shared by people with different roles.
- Information problems: Taylor (1991) argues that there can be different responses to problems depending on their characteristics. Problem characteristics were not investigated in this study but it was found that how information problems are resolved is influenced by all aspects of the IUE.
- Setting: Taylor (1991) argues that information problems are linked to the setting. This is supported by the findings of this study but it was also found that more than one setting influences search and that variations within IUE settings have some influence on the search activity.
- Resolution of problems: Taylor (1991) argues that there are eight general classes of information use not limited to any particular user group or information system. Eleven different uses of information were found in this study and for some searches there is no clear use of information. The information uses are generic but it is likely that the combination of information use is particular to the IUE. How information is used is also linked to the IUE. Furthermore, search systems can be used to fulfil multiple outcomes simultaneously.

The findings are described in more detail.

A unique "role" for students

In studies of children, age is considered a key determinant of search behaviour (e.g. Marchionini, 1989; Duarte Torres, Weber and Hiemstra, 2014). In this study, that the set of people is young differentiated two expected aspects of the environment: different skills and keeping safe. However, this study suggests that age is not the only critical factor; rather, it is the multiple interacting aspects of the environment that influence children's search.

While many studies have shown that children's information needs change with age with regards to the topics they look for (e.g. Shenton and Dixon, 2004; Duarte Torres, Weber and Hiemstra, 2014), the same classes of information use were described by teachers in all the primary school year groups: further suggesting that it is the environment rather than simply age that is influencing search. This finding supports the argument that information use is particular to the people within a setting (Taylor, 1991), and defines a "role" status of student to the set of primary school children.

The concept of primary school student as representing a discrete "set of people" (Taylor, 1991), a unique role that may have its own characteristics, needs further clarification. Although teachers did have some additional information needs (for example, finding teaching resources) they also did the same searches as children because they searched with children when children lacked skill (aspect 3), and sometimes on behalf of children when resources and time were limited (aspect 5). Searching was often reported as a shared activity. 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, Pettigrew and Sylvain, 1996) only partially accounts for differences in search tasks between teachers and children.

How information problems are resolved is influenced by all aspects of the IUE

Search systems are mostly used to resolve information needs that arise from the curriculum. Teachers described three ways problems are resolved: what information is used for, how information is used, and the intended outcomes of use. As illustrated in Figure iii, all aspects of the IUE influence problem resolution: in brief, information is needed for subjects in the curriculum (the setting's information problem). In response to what is considered best practice and depending on time and resource (the constraints of the setting), search systems may be used to fulfil information requirements. The design of the search activity is then influenced by the IUE (what is considered best practice, the searchers' skill, the constraints of the setting, and the desire to search safely). To meet curriculum requirements, 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, an understanding of concepts, operational skills, analytical skills, and a better learning experience. Information found is then used either directly to increase knowledge of a curricular subject or indirectly to support learning of a curricular subject. This in turn fulfils the requirements of the curriculum (the problems stemming from the setting).

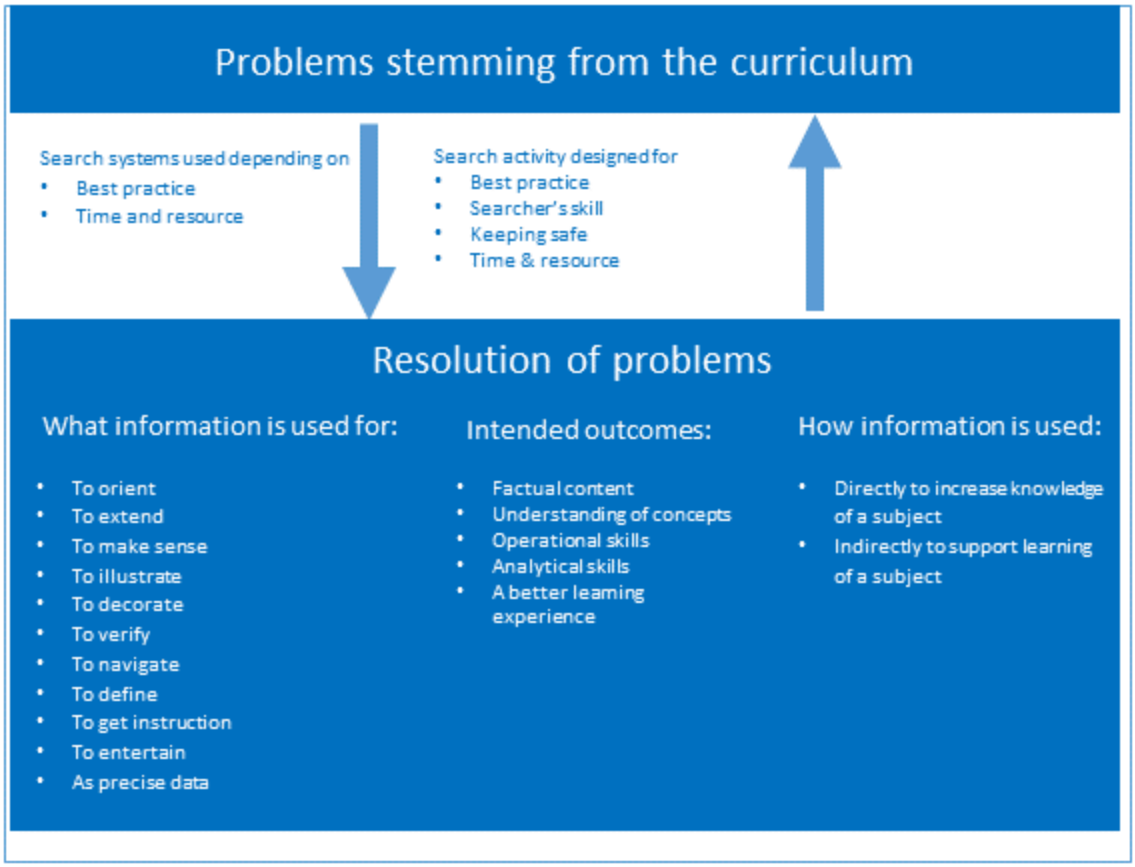

Figure iii: Resolution of problems in primary schools and the influence of the IUE

Likely that the combination of information uses is distinct to the IUE

The types of information use are generic; indeed, the types identified here may also be found in various adult environments or within various work-place roles (see Table 2). However, the combination of information uses depends upon the IUE. That for some searches there was no clear use of information is also perhaps indicative of the IUE where learning to search is an important end in itself, regardless of whether useful information is found. Some information uses such as "to define" maybe more prevalent in primary schools, and has yet to be reported in any study, as children will be learning to read, write and learn new words at primary school. Interestingly, Madden et al. (2018) found that secondary school children's information behaviour differs depending on whether they are trying to acquire subject tools (e.g. in primary school this could be learning new words in French) or trying to apply those tools (e.g. understanding of French culture through analysing a text), and as such it seems likely that different information behaviours would be observed for a "*to define*" information use than for example a "*to extend*" information use.

Four information uses were not seen in this study (projective, motivational, personal/political, and keep track). This is not surprising given the IUE. Children may do projective, motivational and personal/political searches (Taylor, 1991) outside of school, but this is less likely for school work. Similarly, teachers did not report children keeping track or monitoring information (Toze, 2014), possibly because in primary school new topics are taught every half-term (about 6 weeks). While children did use information to make decisions, unlike other studies (Morrison, Pirolli and Card,

2001; Freund, 2008; Toze, 2014) we do not consider this to be a distinct information use as information-seeking is always part of a larger process of decision making (Rouse and Rouse, 1984). For example, while deciding which charity to raise money for, children did this by looking up charities they already knew to find additional information about them; this is considered a "to extend" information use.

Table 2: Information use in different environments

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					

How information is used is distinct to the IUE

In primary school information is used both directly (e.g. Ancient Egypt in History) and indirectly to increase knowledge (e.g. nocturnal animals in Literacy) of a curricular subject. It is difficult to find parallels in the more general research literature. The nearest equivalent is Bartlett & Toms' (2013) interpretation ("information used to aid understanding of a phenomenon") and input ("information is entered into another process"). There are, though, two key differences between input and indirect use. Firstly, input is not used to gain understanding of a phenomenon: while this was the case for some children's search tasks (e.g. there was no attempt to understand pricing of local attractions when learning about spreadsheet modelling) the same cannot be said for all searches (e.g. when in their Literacy lesson children search on nocturnal animals it would be difficult to see how they could write a report if they did not gain an understanding). Secondly, for input, information is directly relevant to the task at hand whereas in this study the information is unrelated. That information may only indirectly connect to the work task is almost certainly associated with the IUE as school tasks are somewhat artificial in that they do not resolve real-life problems, although real-life problems may be given (Gordon, 1999).

Search systems are used to fulfil multiple outcomes simultaneously

In primary school there are five possible intended outcomes when using search systems: to gain factual content, gain research skills, aid conceptual understanding, gain operational skills, and obtain a better learning experience. Perhaps not surprisingly there is a close match to these intended outcomes and what are considered areas of learning in school: "knowledge, concepts, skills and attitudes" (Pritchard, 2014, p. 19). There is some indication that there are differences in the way search systems are used when the main intention is to gain conceptual understanding. For example, when children search Rightmove they do not use the information they find about houses; rather it is through the act of searching that children learn about data files. However, whether there are differences in information behaviour when the main intended outcome is conceptual understanding rather than to gain factual content needs to be investigated further.

Problems are (mostly) linked to the setting

The setting is a highly regulated learning environment that influences what information is used for. As Taylor (1991) suggests, children's information problems in primary school mainly stem from the demands of the setting, and as nearly all the search tasks that teachers described were in response to the curriculum (aspect 1), it is likely that schools following the same curriculum will have similar information problems. However, as observed in the East School, not everything looked for in school has been sanctioned by the teacher. Nonetheless, the imposition on children within primary schools is likely high. As has been found in prior research teachers are the assigners and assessors of children's work (Gross, 2006; Limberg, 2007). Furthermore, it is teachers who decide if a search activity can take place in the classroom. However, contrary to Gross' findings (2006) as a result of best practice (aspect 2) children do originate search tasks, 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. The collaborative nature of primary school children's search (searching both with teachers and with each other) is perhaps linked to the educational setting where children are learning basic skills such as reading and writing as well as learning to search.

More than one setting influences search (and teachers take advantage of this)

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, information is brought in impromptu from home and teachers give children search tasks as homework. Secondly, teachers also plan activities to take advantage of the differences between home and school settings because it is thought that children will have more time to conduct the searches (aspect 5). However, it is also recognised that children's uses of technology in the home might differ (van Deursen and van Dijk, 2014) and so what resources children should use at home is left open.

Variation within settings has some influence on the search activity

Taylor (1991) does not consider the local setting to be a substantial factor. However, there are differences in the settings of the West School and East School that likely impact on search activities. In England, 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 West School had limited resources compared to East School (aspect 5). An obvious effect here is that West School children

had to search in pairs as there was not enough equipment, whereas in East School each child could search on their own.

Conclusion

In many prior studies, children have been considered a distinct user group because of their age (e.g. Walter, 1994; Large, Nesset and Beheshti, 2008; Gossen, Hempel and Nürnberger, 2013; Duarte Torres, Weber and Hiemstra, 2014), with a handful of other studies indicating the influence of the environment (Limberg, 2007; Lundh, 2011). In this study, by investigating what is shaping children's search activities through interviews with teachers and classroom observations it was found that the broader information use environment is influencing primary school children's search, not simply age. Indeed, as an educational setting for young people the primary school is a unique environment. As children are still learning to read and write, for support they search collaboratively, with each other and with their teachers. Information problems stem from a prescribed curriculum so many search tasks are externally-generated. However, as best practice suggests that lessons should also be child-led, children may originate searches. Topics are used to integrate learning across curricular subjects, and therefore the same topic may be searched on for different subject areas. As well, information may be used both directly and indirectly to increase knowledge of a curricular subject, and as children are also learning how to search for some searches there is no clear use of information. Searches for school work are also conducted at home, where the constraints are different and teachers take advantage of this.

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Appendix

Table 3: Code book

Code	Operational definition	Illustrative quote
Theme 1: Supporting the curriculum		
What search systems are used for	Subjects in the curriculum	"I use it all the time. Especially in French."
	Beyond the curriculum	"Some kids might be actually wanting to do [Maths] that is not in our curriculum."
How using search systems supports the curriculum	To gain factual content	"We did a history booklet and each week they did a different topic."
	To gain a conceptual understanding of a topic	"If I want to explain the life cycle of a bean or a plant."
	To gain analytical skills	"We talk about the importance of looking at more than one website."
	To gain operational skills	"We are looking at using a data file."
	To gain a better learning experience through following best practic	(See theme 2)
How information is used to support the currriculum	Directly to increase knowledge of a subject	"We've been doing Geography this half-term and the children have been researching weather in different parts of the world."
	Indirectly to support learning of a subject	"[You know] what you need to include in a biography to be good. […] 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."
Theme 2: Good classroom practice		
Information should be shared	How information is shared and discussed	"Right let's brainstorm. Let's talk about what we know about them already."
Children should search for what interests them	Giving children choices and allowing lessons to evolve according to their interests	"You often know how the lesson is going to go but sometimes they change it."
Bringing learning to life	Finding 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 should 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	Operational definition	Illustrative quote
Learning should be enjoyable	How using search systems is influenced by children's enjoyment	"We just found it and they've just loved it."
Theme 3: Supporting children		
Teachers support children	How teachers support or do not need to support children	"Children are so computer literate these days, they know how to use Google, Bing, or whatever it is."
Children supporting children	How children support each other	"We tend to use mixed ability because then the poorer readers are supported."
Theme 4: Information access		
Information access	Access restrictions	"They are not allowed to use YouTube."
Theme 5: Environmental constraints		
Time	Influence of time restrictions	"You don't want them to spend an hour and not to have answered any of the questions."
Resource	Influence of resource restrictions	"There is not enough computers for one each."