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Learning Through Collaborative Information Seeking

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Abstract

This chapter discusses Collaborative Information Seeking (CIS) from an educational perspective. Our core claim is that CIS has the potential to bring together rich collaborative, and multimodal, contexts in which important learning processes may take place. We thus see CIS as more than just an activity with potential to ‘speed up’ information seeking, or contribute to effective division of labour. This claim is independent of the particular classroom subject, or the form of technological mediation; rather, the chapter provides a focus on some key considerations in collaborative learning that should be of interest to both educators and those interested in the ‘benefits’ of CIS. This chapter first outlines our broad educational interest in elements of CIS, connecting that to the focal points of CIS research. We go on to highlight the importance of dialogue as a tool for learning, before discussing the complexities of understanding ‘success’ in CIS tasks, and then specifically the role that dialogue has played so far in CIS research. We conclude with a call to researchers in both CIS and education to explore the nature of learning in CIS contexts, making use of a rich understanding of the importance of dialogue to create meaning together.

Introduction

Our interest in this chapter is in discussing how CIS might be thought of in the context of education, as an educationally productive activity in its own right. That is, we are interested in the ways in which CIS goes beyond the ‘C’ of collaboration, and the ‘IS’ of information seeking; we are interested in how CIS is ‘greater than the sum of its parts’. A common perspective on both information seeking and collaboration is that they involve the transfer of knowledge from one person, or document, to another. That is, that the focus or ‘success measure’ is centered on finding answers (whether in individual documents – precision oriented

measures – or across them in recall oriented measures). Yet, in our view, this is an incomplete perspective on the educational, and indeed wider, potential of collaboration, and information seeking technologies to support higher order thinking and the co-construction of knowledge.

Our perspective arises from theoretical and empirical research exploring the ways in which language is used to both share, and create, knowledge. In particular our perspective is grounded in a sociocultural perspective which holds that the building of ‘common knowledge’, through our use of language, is fundamental to the educational endeavor at all ages (Edwards & Mercer, 1987; Littleton & Mercer, 2013). Such a perspective rejects the view that the use of language to learn primarily regards the sharing or transmission of tokens of knowledge. Instead, it suggests that through sustained and mutually engaged dialogue learners engage in the co-constructive process of building knowledge in talk, making use of their shared context of a background ‘common knowledge’ – the cultural and social knowledge in which we are embedded.

In explicating this perspective, we first outline contemporary definitions of ‘literacy’, as being inclusive of multiple-document evaluation skills, and contextualised within a technological landscape. Such a view has been recently developed to note the value of interaction between document-literacies, and dialogue. It is in this combination, and in particular, this combination alongside high quality exploratory or accountable dialogue, that we argue the most significant educational gains may be observed. Yet, presently, very little CIS research has explored such a perspective – instead favouring outcome measures and relatively simpler analysis of trace data over analysis of the dialogue as a mode of thinking-together. The chapter ends with an exemplification of our view, drawing upon examples of its classroom application, and significance for understanding ‘success’ in CIS tasks, both as educators and as researchers.

Educational context

Despite the prevalence of internet use, many students, across a broad age range, experience difficulties in their web based information-seeking activities (Bartlett & Miller, 2011; Hargittai, Fullerton, Menchen-Trevino, & Thomas, 2010; Livingstone, Bober, & Helsper, 2005; Walraven, Brand-Gruwel, & Boshuizen, 2008; Williams & Rowlands, 2007). This is not simply a concern regarding students’ technological capabilities; the searching, selecting, and processing of complex documents and multi-media on the web can be seen as a component of literacy (OECD, 2013) and be related to the ways in which students source, corroborate, and integrate claims – key facets of literacy for mature internet use (Rouet, 2006, p. 177). There is thus a growing interest in the learning sciences around how students find information, and how they treat the information that they do find (Barzilai & Zohar, 2009, 2012; Bråten & Samuelstuen, 2007; Bråten & Strømsø, 2006; Chiu, Liang, & Tsai, 2013; Ferguson, Bråten, Strømsø, &

Anmarkrud, 2013; Hofer, 2004; C.-Y. Hsu, Tsai, Hou, & Tsai, 2013; L. Hsu, 2014; Lin & Tsai, 2008; Singh, Hsu, & Moon, 2013; Tsai, Hsu, & Tsai, 2012).

First impressions suggest that, such a perspective on literacy, and information seeking, is rather individualistic – individuals read texts, and the benefits of such reading are conferred on those individuals. To put it another way, we seek information because we (as individuals) wish to know something. Indeed, there is a very obvious sense in which this is true. However, as the verbal question-answering scenario analogue indicates, there are at least two ways in which information seeking goes beyond individuals. First, much information seeking can be seen in the context of larger discussions that extend beyond simple question and answer exchanges (and of course, information-flows are often bi-directional in such exchanges). Secondly, in seeking information – particularly on the internet – we engage with a network of linked documents with a rich set of intertextual ties; in a very real sense, reading much of the web involves a direct interaction with the thoughts of others, in the form of blogs, micro-blogs, and rich multimedia all of which ‘readers’ may comment on. Recognising this, sociocultural perspectives on information behaviour have emerged (see, for example, Lloyd, 2007; Sundin & Francke, 2009; Sundin & Johannisson, 2005a) in which the seeking of information is seen in the social and cultural context in which it occurs.

In parallel, an increasing body of research is recognising the interaction between document literacies, and dialogue (see for example, Snow, 2002). Here, the effective use of language is seen as an important cultural tool, with technologies (including books) affording grounding for the resourcing of that dialogue. Thus, through the use of technology, we are able to draw on the voices of others across time and location (Wegerif, 2013). As such, the kind of ‘transmissive’ view of learning – in which even the richer kinds of document evaluation discussed above would be seen as a transfer of knowledge from a knower (in the form of a written text) to a learner – represents, in our view, an impoverished perspective on the potential of language through collaboration for learning (Knight & Littleton, Forthcoming). Given this, we take a sociocultural perspective on information seeking, and in particular on collaborative information seeking, and consider salient existing educational research in the sociocultural tradition and its application to CIS. To begin such a consideration, it is worth noting Wegerif’s (2007; 2010) claim that, technologies and the kinds of representational tools that they afford, might be thought of as constituting what has been called a ‘dialogic space’ in which different ideas, perspectives and understandings can be collectively explored, and material can be modified to record the development of a discussion and capture emerging ideas. Wegerif’s (2010) claim is that, to promote the kind of ‘dialogic’ use of technology we are interested in, we should consider:

1. Opening dialogic spaces (e.g. by adding comments to blogs), but also explicitly teaching learners how to do this (e.g. through the use of ground rules for talk, and other approaches such as philosophy for children);

2. Widening dialogic spaces – understanding more points of view, and the background behind them, for example through WebQuest activities in which different perspectives – and their assumptions – are explored;
3. Deepening dialogic spaces – increasing reflection on assumptions made in arguments by students and others, using shared awareness tools to make explicit the arguments being made (and their structures) can support such deepening;
4. Teaching content through induction into fields of dialogue – Wegerif notes “interactivity makes it easy for software to simulate multiple points of view in a dialogue, thus allowing learners to be inducted into a field of dialogue rather than into fixed ‘truths’” (Wegerif, 2010, p. 350) noting that, the internet can be a cacophony of voices, rather than a dialogue, but through designed spaces – such as WebQuests, and the emailing of links between geographically distant groups – presence and dialogue can be mediated to encourage reflection and learning.

This final point is not only a claim about collaborative dialogue, but one about the very nature – the unstructured, messy nature – of the internet, and its use for developing spaces to explore multiple viewpoints. It is specifically in this space that our educational interests sit, rather than in the kind of fact-retrieval tasks that a more limited perspective on both online and offline information seeking might align with. Given this target, it is important to note then that the collaborative task context is as important as collaborative tool design (Rick & Guzdial, 2006), particularly given concerns regarding the pedagogic effectiveness of some classroom collaborative activities and in the context of computer mediated collaboration the potential to enhance problems; “for example, due a lack of social presence or limited nonverbal cues such as gestures and facial expressions (Daft & Lengel, 1986; Kreijns, Kirschner, & Jochems, 2003; Short, Williams, & Christie, 1976)” (Janssen & Bodemer, 2013, p. 40).

Collaborative Information Seeking

It is in this broad context that we see CIS. Indeed, as we discuss in this section, some existing CIS research speaks to this perspective. Thus far, many studies of CIS explore collaboration *in action* only indirectly, and they thus may ignore important means to support higher quality collaboration and collaborative dialogue. Furthermore, given the importance of such collaborative discourse for educational outcomes it is important to understand how discourse interacts with task properties, including information seeking.

It is interesting, then, to consider the range of focal points for CIS research and their relationship to educational contexts – as

Table 1 briefly does – for example, understanding what sorts of collaboration are likely to be of interest to, or/and of high incidence in, educational settings.

Table 1 - Focal Points for CIS Research

Element	Key Issue	Educational Context
Intent	How explicit is the collaboration?	The task might be shared (but with little explicit collaboration) or – of more interest here – collaborators might share the same goals
Activeness	How willing and aware is the user of the collaboration?	Explicit collaboration and sharing
Concurrency	Is the collaboration occurring at the same time (concurrently) or not?	Either synchronous (e.g. in class) or asynchronous (e.g. homework) within a constrained timeframe
Location	Are the collaborators co-located?	Either co-located or remote
System mediation	What role does the system play in mediating collaboration?	CSCL tools could mediate search, or tasks could be designed to encourage use of mediating tools such as email
Interaction level	How much interaction with the system does the user have?	CSCL and CMC tools could support interactional systems, while email lends itself to more transactional approaches
Usage of information	How does information flow in the system?	Given the evidence around Kuhlthau's (1991) ISP and CIS, indicating a difficulty in delineating stages it is likely CIS will occur at all stages – and various stages may be of direct interest to education researchers.
Awareness	How aware of the collaborators is the user?	Collaborators should be aware
Communication level	How much communication occurs between collaborators?	Communication should be facilitated – this is a key interest to educationalists.
User roles	Do the users have defined roles in the system?	Roles may be useful (e.g. for differentiation in classrooms) but generally open ended systems may be best suited
Strength of connection	How 'connected' are the collaborators socially?	Connection may depend on learning context – e.g. a mooc v. a classroom. May also be task specific (groups constructed for particular purpose), or depend on friendship or ability groups and so

		on.
Balance of benefits	Is the collaboration mutually beneficial?	In most educational contexts it is expected that there will be mutual benefit, even in peer teaching contexts it is assumed there is benefit to both teacher and student.

We are interested in the kinds of activity in which the collaboration is: Oriented towards the same goal of mutual, shared understanding, through explicit collaboration, either synchronously or asynchronously, remotely or co-located, and using any variety of tools, but with an awareness of collaborators, and a level of interaction and communication facilitative of the shared goal. Such episodes might occur at any educational level (or indeed, in informal learning) and with a range of technological mediation.

The cases we are most interested in for our purposes, are those in which collaboration is specifically included as of pedagogic interest – those in which learners are to co-construct together, and – as we discuss below – engage in higher level search tasks of a more ‘exploratory’ nature. In such tasks, success is not just a matter of finding the correct answer, but of working together constructively to build knowledge together to address some problem or talking point.

Productive Educational Dialogue

Partly in response to such considerations, Mercer and colleagues have extensively researched what constitutes effective educational dialogue, including in CSCL contexts. They have developed an intervention strategy called ‘Thinking Together’ designed to explicitly teach, children how to engage in constructive dialogue in classroom contexts through the teaching of particular types of talk, and the use of pedagogic strategies such as generating and establishing ‘ground rules’ for talk designed to foster effective group work¹. The team have highlighted a particular form of productive dialogue which, adapting the term from Douglas Barnes’ (Barnes & Todd, 1977) original broadly individualistic description, they have termed ‘exploratory’. They contrast this with two other types of, typically less educationally productive, talk – disputational, and cumulative, as in Table 2.

Table 2 Mercer and Colleagues’ Typology of Talk*

Type of Talk	Characteristics	Analysis
Disputational	“Characterised by disagreement and individualised decision making. There are few attempts to pool	“short exchanges, consisting of assertions and challenges or

¹ See the Thinking Together materials hosted at the University of Cambridge <http://thinkingtogether.educ.cam.ac.uk/>

	resources, to offer constructive criticism or make suggestions.”	counter-assertions (‘Yes it is.’ ‘No it’s not!’).”
Cumulative	“Speakers build positively but uncritically on what the others have said. Partners use talk to construct ‘common knowledge’ by accumulation.”	“Cumulative discourse is characterized by repetitions, confirmations and elaborations.”
Exploratory	“Partners engage critically but constructively with each other’s ideas. Statements and suggestions are offered for joint consideration. These may be challenged and counter-challenged, but challenges are justified and alternative hypotheses are offered. Partners all actively participate, and opinions are sought and considered before decisions are jointly made. Compared with the other two types, in exploratory talk knowledge is made more publicly accountable and reasoning is more visible in the talk.”	Explanatory terms and phrases more common – for example, ‘I think’ ‘because/’cause’, ‘if’, ‘for example’, ‘also’

*(Adapted from Mercer and Littleton 2007, pp. 58–59)

Other researchers have offered allied characterisations of educationally productive dialogue. For example, ‘Accountable Talk’ (see Michaels, O’Connor, Hall, & Resnick, 2002; Resnick, 2001) has been described as encompassing three broad characteristics:

1. accountability to the learning community - in which participants listen to and build their contributions in response to those of others;
2. accountability to accepted standards of reasoning, talk that emphasizes logical connections and the drawing of reasonable conclusions; and,
3. accountability to knowledge, talk that is based explicitly on facts, written texts, or other public information. (Michaels, O’Connor, & Resnick, 2008, p. 283)

As with the typology of talk developed by Mercer and colleagues, the emphasis of Accountable Talk is on learning to engage constructively, yet critically, with other’s ideas, and in so doing develop and use the skills of explanation and reasoning - learning to use language as a tool for thinking together rather than focusing solely on learning particular subject or topic knowledge. Thus, while the individualistic focus of much psychology research covers facets of interest, it seems less complete given closer scrutiny. In many cases problem solving and learning more generally involves deploying the resources around you – including the minds’ of other people.

Wherever education is taking place, commonality – a shared perspective – is imperative, and dialogue is the tool used to co-create and constitute such a perspective (Edwards & Mercer, 1987). Furthermore, the dialogue used to create ‘common knowledge’ is related to the educational development of children, as it constitutes a way of ‘interthinking’ (e.g. Littleton & Mercer, 2013). There is now strong consensus that high quality educational dialogue among peers is associated with positive learning outcomes (see the collection edited by Littleton and Howe (2010)). Engaging children in extended talk which encourages them to interthink (Littleton & Mercer, 2013) and reason together in talk, impacts both their subject learning, and general reasoning skills (Dawes, Mercer, & Wegerif, 2004; Mercer, Dawes, Wegerif, & Sams, 2004; Mercer & Littleton, 2007; Mercer, Wegerif, & Dawes, 1999; Mercer & Sams, 2006; Rojas-Drummond, Littleton, Hernández, & Zúñiga, 2010) as well as their social and language skills (Wegerif, Littleton, Dawes, Mercer, & Rowe, 2004).

Relating CIS and the Educational Context

CIS Tasks and success

In the context of the kind of potential for higher-order (inter)thinking described above, it is important to consider what learning outcome we aim for in CIS tasks. As Shah notes:

...if two people working together can find twice as much information as either of them working independently, was that a good thing? How about the amount of time they spent cumulatively? The participants may not be able to find twice as many results, but what if they achieved better understanding of the problem or the information due to working in collaboration? Then there are other factors, such as engagement, social interactions, and social capital, which may be important depending upon the application, but are usually not looked at in non-interactive or a single-user IR evaluations. (Shah, 2012, pp. 115–116)

CIS is complex, and multi-faceted – and this complexity is carried over into assessment of its success. However, as the quote indicates, the potential for understanding of ‘success’ which goes beyond F measures, duration, or diversity of results is great (see Shah, 2012, Chapter 7 for a review of evaluation methods). A key element of understanding information seeking in learning contexts is understanding not just the processes of using the system, but the sorts of tasks the system is being used to accomplish. One factor here is the type of search users engage in:

A hierarchy of information needs may also be defined that ranges from basic facts that guide short-term actions (for example, the predicted chance for rain today to decide whether to bring an umbrella) to networks of related concepts that help us understand phenomena or execute complex activities (for example, the relationships between bond prices and stock prices to manage a retirement portfolio) to complex networks of tacit and explicit knowledge that accretes as expertise over a lifetime (for example, the most promising paths of investigation for the seasoned scholar or designer) (Marchionini, 2006, p. 42).

Some of these notions are described by Marchionini (2006) who suggests that 'Lookup' tasks, involving fact retrieval, verification, question answering and so on are separate from 'Learn' and 'Investigate' – exploratory search – tasks, in which there is knowledge acquisition and comparison, accretion, analysis, discovery, and so on.

Marchionini associates these search-types with levels of Bloom's taxonomy of educational objectives (Bloom, 1956) – a common tool for conceptualising classroom questions in a hierarchy of complexity in educational settings. In particular, Marchionini notes the relationship between relatively low level questions – e.g. when was Freud born? – and 'lookup' search tasks where a single query can deliver a single correct result, as opposed to more complex learning and investigation based questions, which relate to 'exploratory search'. Marchionini notes that 'learning' searches, where learning is taken in the broad sense to include lifelong and self-directed learning, involve iteration, managing multiple resources and making judgements on those, and comparison:

Much of the search time in learning search tasks is devoted to examining and comparing results and reformulating queries to discover the boundaries of meaning for key concepts. Learning search tasks are best suited to combinations of browsing and analytical strategies, with lookup searches embedded to get one into the correct neighborhood for exploratory browsing (Marchionini, 2006, p. 43).

Thus, these are "searches that support learning aim to achieve: knowledge acquisition, comprehension of concepts or skills, interpretation of ideas, and comparisons or aggregations of data and concepts" (Marchionini, 2006, p. 42). Marchionini's work on information seeking raises interesting issues regarding 'success' in search activities. If one seeks some token of factual information, ascertaining success – whether determining one's own success, or systems determining the success of their users – this task may be relatively easy. In the context of exploratory search this is not so.

Importantly, as Sundin & Johannisson note, "...information seeking is not carried out for its own sake but to achieve an objective that lies beyond the practice of information seeking itself." (Sundin & Johannisson, 2005b, p. 107). Within this sociocultural perspective:

...judging the truth of an idea becomes a question of whether the idea makes any difference to practice or not, whether the idea provides us with a useful tool or not. (Sundin & Johansson, 2005a, p. 27).

That is, analysis of ‘success’ cannot focus solely on whether some clearly defined need is plugged by finding ‘the answer’. Instead, in exploratory information seeking success goes far beyond the verification of uncontroversial facts. Information needs arise from, and are addressed in activities in which knowledge is distributed, bi-directional, and in constant negotiation – it is within this process that our information needs are defined, and addressed. The kinds of language described in the preceding section, used to co-construct common knowledge, are thus associated with the ways in which information seekers negotiate and make sense of meaning together, building on their shared cultural context.

The Role of Dialogue in CIS Research

The example of CIS is in fact particularly interesting in a learning context because, as we note above, unfortunately children in particular are not adept in the use of search engines, and this deficit appears to be only marginally related to any lack of technological skill. It is also interesting because, as we note above, the role of task-context in understanding success is key. As is the importance of understanding the role of dialogue in pedagogic outcomes, as a tool for learning in its own right. It is thus that we have become interested in ‘exploratory talk for exploratory search’ – the kinds of higher level searches users engage in, making use of collaborative language to share and make meaning together. Our argument in this section will be that, at these ‘higher-level’ types of search, success is tied up with collaborative practices, and the ways in which students engage in the kinds of negotiation of knowledge described above.

Hertzum (2008) discusses the role of this shared motivation towards knowledge accumulation alongside the types of dialogue which facilitate such information seeking activities.

In a collaborative context, information is typically distributed unevenly across actors, and they may interpret the information known to them in different ways or be unable to make coherent sense of it. On the one hand, this is what makes communication and information seeking worthwhile activities. On the other hand, it also emphasizes the considerable work and constraints involved in making coherent sense of information within a group of actors. (Hertzum, 2008, p. 958).

Hertzum’s suggestion is that, as the collaboration becomes closer, the ‘common ground’ underpinning both the dialogue of collaboration, and the shared understanding of the information need should also increase, while in looser

collaboration, such common ground can be more temporary and may require more continual effort².

For example, there was some evidence of this kind of grounding in Hyldegård's work, which suggested that particularly for more effective groups:

...group communication formed part of the constructive and cognitive process of the project assignment, each group member also acted as an information source during this process. Through group meetings and email-communication, for example, information was exchanged either as concrete references or as documented comments and suggestions to a group member's written manuscript. This was also a way to ensure or provide for a shared understanding of the project focus (Hyldegård, 2006, p. 287)

Indeed, the difficulties younger users face in search tasks has led one researcher who explored collaborative information seeking in educational settings to suggest that teenagers may be, "largely unable to select appropriate search strategies (planning), check their progress (monitoring) and assess the relevance of search outcomes (evaluating)." (Lazonder, 2005, p. 466). Lazonder's research focussed on 20 pairs of students with a mean age of 20, searching for information together, with the aim of exploring the effect of that collaboration on this "inert knowledge problem" (Lazonder, 2005, p. 466). Lazonder's suggestion was that through the use of verbalisation learners might improve their self-regulatory processes, prompting users into better negotiating the search process. And indeed, it was found that the pairs did perform better, and faster, than individuals. They also used more varied search strategies and evaluated websites marginally better than the individuals. There are two readings of this example. The first (which Lazonder notes) suggests that language can facilitate individual psychological development. However, in line with the research discussed above with regard to a deeper role for collaboration, a second interpretation is motivated – that effective collaborative dialogue had a key role in the co-construction of knowledge.

However, despite the centrality of collaborative dialogue in this research, little analysis was conducted on the dialogue data itself; a contribution of this chapter is to motivate such analysis as fundamental to a fuller understanding of the potential of CIS for learning. Qualitative analysis of this data offers potential for insights into differences in information seeking behaviours, as related to dialogue differences. For example, there is potential to explore differences in the number of keywords used in search queries, and search success measures, alongside the types of language used in dialogue. As Kuiper Volman and Terwel (2009) conclude, "...the conditions for students working collaboratively deserve attention. Our results confirm the importance of collaborative inquiry activities being more than just 'working together'" (Kuiper et al., 2009, p. 679); a fundamental part of these conditions for collaboration includes language which, for successful groups: "showed students who helped each other, who knew what everyone else was

² One model using this suggestion is offered by Karunakaran, Spence and Reddy's model of Collaborative Information Behaviour (2010).

doing and who all shared the same goals. This resulted in a high motivation and an accumulation of knowledge”(ibid).

With a focus on dialogue, Ellis et al., (2002) note that interaction between mediating experts and searchers, is driven by dialogue which addresses the terminology of search, and the ways in which one might search. However, much of the analysis focussed on the *content* of the utterances, rather than the intentions behind them, and the style of talk engaged in. As such, by focussing solely on the dialogue’s relevance to tool-mediated action they may miss important information regarding the nature of the ‘speech acts’ (Grice, 1975) and the practices in which they are embedded to create shared meaning (Wells, 2002). Similarly, Foster (2009) analysed discourse in an educational context, although his work was on undergraduates studying information management – who one might reasonably expect to display somewhat particular information seeking behaviours. This work focuses on understanding the motivating problem – part of the shared history of those in the discourse – and considers the nature of the task, with “...users as active constructors rather than passive receivers of information...” (Foster, 2009, p. 85). Although the analysis focuses on only a later stage in the information process – planning a presentation – it is interesting to note that in their analysis, 50.9% of talk was ‘exploratory’, 33.53% what they describe as coordinating (planning), with the rest disputational or cumulative in nature (Foster, 2009, p. 88). Yet, other than these studies, despite the dialogue oriented context of information needs, the role of dialogue in such activities is understudied (Savolainen, 2012)^{3 4}.

Earlier work by one of the authors of this chapter (Knight, 2013b) noted the significance for information seeking of a possible association (see Reznitskaya & Gregory, 2013) between more advanced ways of evaluating and synthesising complex information and the kinds of dialogue which are associated with building common knowledge (in education often known as exploratory dialogue, or accountable talk). Indeed, one of us (SK) has explored precisely this relationship between collaborative classroom dialogue and search based tasks (Knight, 2012; Knight, Arastoopour, Williamson Shaffer, Buckingham Shum, & Littleton, 2014; Knight & Mercer, 2014, n.d.). In that work, despite generally similar academic attainment, the success of the small number of groups appeared to be directly related to their ability to use the kind of dialogue we label ‘exploratory’ (Mercer & Littleton, 2007) in which collaborators explain their ideas, listen to each other’s ideas, and seek to build common knowledge together. In that work we noted that the least successful group also engaged in the least exploratory talk, as well as reflecting very little on the relationship between the information they found and the purpose for which they were seeking it. Indeed, that group appeared to be primarily concerned with the quantity, ease of access, and aesthetic value of

³ C.f. (Sundin & Johannisson, 2005a, 2005b)

⁴ One theoretical paper has explored models of communication in context of information behaviour, but only of mass communication rather than of collaborative information seeking behaviour (Robson & Robinson, 2013).

information. In contrast the other two groups focussed on the ‘importance’ of information and particularly that information was ‘explained’; and the detail and novelty of information, respectively.

To draw an analogy, just as whole class questioning can involve a range of question types (including open or closed, and those aligned at a stage on the popular Bloom’s Taxonomy (Bloom, 1956)) so too can search tasks. In search tasks, then, there is potential in thinking about open questions, and considering the ways in which questions should be broken down into components to understand how one question might lead to another (e.g. “What is the name today of the town where the founder of the Boy Scouts of America was born?”). Indeed, the seeking of information is a prime context for the promotion of dialogue to explore misconceptions, discuss evaluation of results, and sharing of strategies⁵. Of course, searching for information also involves identification with other points of view – representations of knowledge which are ‘given’, and served up through the search engine.

Conclusions

CIS covers a broad range of activities, and this is true in the educational context just as much as professional or leisure contexts. Consider the classroom, two students sitting next to each other on shared or individual computers, a student or teacher leaning over the shoulder of another giving a helpful suggestion, a teacher putting key terms on a whiteboard to assist students searching, and so on. Such contexts are familiar, too, in other learning situations – formal and informal workplace learning, and the kinds of learning we engage with in leisure or personal contexts from seeking health information to holiday tips. In some situations, what is required is “the answer” – and tasks in which information seeking (collaborative or otherwise) is conducted in order that *individuals* come to know the specific information sought certainly have a place.

However, the cases we are interested in here offer a rich perspective on the value of collaboration in information seeking. Specifically, we have claimed that the rich potential of exploratory search is enriched further when considered in tandem with the potential of productive educational dialogue. Drawing on the prior research, we suggest that educators should be interested in CIS, but that to view it as simply a means to share resources, save time, divide labor, and so on is to have an impoverished perspective on its full potential. We suggest that in the context of learning, tasks which involve exploratory search and in which

⁵ The first author has written some teacher notes on this point, available (under a Creative Commons licence) here <http://sjgknight.com/finding-knowledge/edusearch-tips/> and in abridged form published (Knight, 2013a).

exploratory dialogue is explicitly encouraged, create learning situations in which the whole is 'greater than the sum of its parts'.

So too for researchers: factual retrieval tasks; tasks in which precision and recall, or task completion-time are core success metrics; analysis of transfer of information between partners or counts of message frequency; and so on, will certainly provide some insight into CIS, but it is unlikely to provide the fullest insight into the co-constructive learning. The potential of CIS as a rich learning tool for contemporary literacy incorporating productive educational dialogue around the wealth of linked resources on the internet is considerable – we encourage researchers and educators to explore this potential.

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