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The role of exploratory talk in classroom search engine tasks

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While search engines are commonly used by children to find information, and in classroom-based activities, children are not adept in their information seeking or evaluation of information sources. Prior work has explored such activities in isolated, individual contexts, failing to account for the collaborative, discourse-mediated nature of search engine use which is common in classroom contexts. This small-scale study explored the established 'typology of talk', particularly 'exploratory talk', in a classroom search context. The authors found that the most successful pupils were those who engaged in the most exploratory talk. This finding has practical classroom implications: the collaborative nature of search and potential of collaboration and discourse should be exploited in search-based tasks. This study also indicates a rich area for future research.

Keywords: dialogue; ICT pedagogy; search engines

Introduction

The days of being able to direct students to a particular pre-moderated textbook, and sections in it, are largely over; both teachers and students expect to be able to find and use information online. However, evidence suggests that, despite their familiarity with the medium, young people commonly experience problems when searching for information online. Our suggestion is that enabling students to engage in high-quality collaborative discussion would improve the success of their information seeking.

In this paper, we first consider this issue of information seeking (IS) by young people. We then refer to research on collaborative dialogue before highlighting some research showing that collaborative IS is a quite common – yet understudied – phenomenon. In particular we note that where research has been conducted on collaborative IS, it has tended to ignore the discourse in which, and through which, IS tasks are navigated and co-constructed. In the final section of this introduction, we propose the exploration of some properties of this collaborative discourse, which we then pursue in this paper. The rest of the paper reports a small-scale study which explores the collaborative discourse in one classroom, when students were pursuing a series of IS tasks.

Children's search behaviours

Although search engines are commonly used by young children and teenagers, many report some issues with finding information (Livingstone, Bober, & Helsper, 2005;

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Walraven, Brand-Gruwel, & Boshuizen, 2008; Williams & Rowlands, 2007). While most children use the Internet, younger children rate their information-seeking abilities as significantly lower than older students (Eynon, 2009). Similarly, although adults use search more than browsing (OxIS, 2007), research suggests that children are more likely to try to retrieve information by browsing within specific pages than searching more widely (Bilal, 2001). A recent review (Bartlett & Miller, 2011) paints a bleak picture, indicating that a quarter of 12–15-year-olds make no checks at all, that they tend to emphasise aesthetics over quality, and that they take the inclusion of websites on search engine results to be an indicator of their veracity. Worryingly, two-thirds of 9–19-year-olds also claimed to have never been taught how to judge the reliability of the information they find, while over half of teachers were concerned that their students did not understand how to conduct searches. Despite these concerns, almost all teachers thought digital skills were important and, indeed, most thought the Internet was an important research tool (Bartlett & Miller, 2011).

The importance of collaboration

Evidence indicates that collaboration and high-quality discourse are strongly related to positive educational outcomes – but only if they are mediated by the kind of reasoned discussion which is known as Exploratory Talk (Mercer & Littleton, 2007; see also the collection edited by Littleton & Howe, 2010). Encouraging children to use that kind of talk when working with others, as in the Thinking Together interventional research (Dawes, Mercer, & Wegerif, 2004), has been shown to stimulate subject learning and general reasoning skills (Mercer, Dawes, Wegerif, & Sams, 2004; Mercer & Sams, 2006; Mercer, Wegerif, & Dawes, 1999; Rojas-Drummond, Littleton, Hernández, & Zúñiga, 2010). However, some concern has been raised that particularly in computer-based tasks, the shared nature of the resource – particularly the screen – may reduce the need for children to talk and articulate their knowledge explicitly, indicating the need for task-based studies which explore the ways that discourse is used (Clark & Brennan, 1991; Pickering & Garrod, 2004). There thus seems to be a need for children to be encouraged and enabled to use Exploratory Talk when working together at the computer.

Prior work also indicates a range of benefits to collaborative IS – including in workplace contexts (see e.g. Amershi & Morris, 2008, 2009; Hansen & Järvelin, 2005). Evans and Chi (2010, p. 661) built on this work to propose a model of social search, indicating various ways in which, and stages at which, collaboration might occur, including:

(1) The defining of information needs and exchange of relevant information surrounding those, such as important URLs and keywords.
(2) The search process itself, such as shared understanding of information found in both the short previews given by search engines, and deeper information from websites.
(3) The evaluation and ‘use’ stage, such as organising information into various shared tools, and perhaps dissemination.

Collaborative IS in education

Some research has explored the extent of collaborative IS in educational contexts (Amershi & Morris, 2008; Ba, Tally, & Tsikalas, 2002; Livingstone et al., 2005;

SQW, 2011), finding that it is frequent and often involves the co-construction of understanding – for example via the sharing of search queries. However, these studies have focused on professionals' (teachers and librarians) reports (Amershi & Morris, 2008) or self-report methods (Ba et al., 2002; Livingstone et al., 2005; SQW, 2011) rather than direct observation.

Although self-report measures of collaborative use are important, they may neglect the specific ways in which collaborators mediate contact with the world of information through discourse. Fundamentally, self-report measures may contain bias – through sampling, interviewer effects and the subjective nature of understanding one's situation both as an interviewer and interviewee. By failing to explore collaboration in action, we may ignore means to support higher quality collaboration.

One researcher who has explored collaborative IS in an educational setting suggested 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 explored the effect of collaboration on this 'inert knowledge problem' (p. 466), suggesting that verbalisation might improve the self-regulatory processes, prompting users into better negotiating the search process. The implication here is that, by encouraging the creation of common knowledge and the joint, critical evaluation of information, we facilitate better IS processes. Indeed, from a sample of 20 students with a mean age of 20, Lazonder found that pairs performed better and faster than individuals, used more varied search strategies and provided marginal support for superior website evaluation in pairs. In particular, they tended to have better 'first answers' than individuals, who more frequently had incorrect initial answers. However, this was a small-scale study, based on older students in which, although talk or 'verbalisation' was deemed important for self-regulation, it was not analysed as a data form.

This is one reason why qualitative analysis may be of interest in this context: it would offer greater insight into the different kinds of discourse surrounding such differences, allowing, for example, an exploration of the types of language related to use of fewer keywords in search queries, and their relation to the situated context, for example drawing attention to prompts such as 'autocomplete' functions, which young individual searchers often ignore (Druin et al., 2009).

Understanding discourse

However, although research emphasises the incidence and benefits of collaboration, little has been conducted into the language used to collaborate. Furthermore, we are aware of no study to date which has explored the educational outcomes of such collaborative IS, with studies instead focusing on the processes of collaboration and the *content* of utterances as moves (which direct activity), rather than the intentions behind them and their use as tools to share knowledge. That is, current research has tended to focus on the ways moves are navigated; dominance established; the stages of IS at which particular sentence structures emerge, and so on, over the effectiveness of talk; why productive dialogue emerges; and the ways users co-construct meaning through talk.

As such, by focusing solely on the discourse's relevance to tool-mediated action researchers may miss important information regarding the nature of the sociocultural context in which discourse exists and through which shared meaning is created (Wells, 2002). In educational settings, workplaces and other contexts, this shared

use of spoken language to create meaning and achieve joint goals has been called 'interthinking' (Littleton & Mercer, 2013; Mercer & Littleton, 2007). Understanding the dialogic interactions that take place around computer-based search tasks may be an important step in improving and deploying such tools effectively.

Searching and processing information requires the identification of needs, and information which meets those needs – these are thus issues regarding 'beliefs about the nature of knowledge and knowing, which may facilitate or constrain searching and evaluating sources of information on the internet' (Mason, Ariasi, & Boldrin, 2011, p. 139). In collaborative contexts, this involves the sharing of knowledge, and the important situated cognition notion that '1) Knowledge is not passively received but actively built up by the cognizing subject, and 2) the function of cognition is adaptive and serves the organization of the experiential world, not the discovery of ontological reality' (Clancey, 2008, p. 20). Understanding learning, then, is a matter of understanding the co-construction of such understanding – and the ways talk and any other cultural tools such as digital technology are used to do this (Säljö, 1999).

A model for IS

Traditional approaches to IS tend to focus on structures, users and algorithms. Our approach focuses on a relatively under-examined aspect of IS: 'the various interactions between the entities of the searcher, the information need and environment' (Knight & Spink, 2004, p. 232) in which users define their information needs, seek information to address those needs and evaluate that information in light of the needs. At each stage, the object of activity is mediated by the situation in which it is embedded, and at each stage the process is understood to be iterative, in particular as mediated by the discourse – such that needs may be redefined at preliminary stages, or in light of the search tools and processes available, or indeed in light of material that has been fully evaluated. Thus the interest is the constant reconstruction of information needs in light of current and new information which is judged within a particular activity system constituted by:

- the demands of the task; both those set in the rules, and artefacts of the classroom (e.g. the worksheet, which may act as a supportive artefact to encourage pupils to reflect on their information need [De Vries, van der Meij, & Lazonder, 2008]) and those co-created in the discourse;
- the nature of the discourse;
- the tools at the subject's disposal, and their co-constructed assessments of the nature of the information required.

As such, this study set out to investigate the ways in which pupils searched for information in collaborative groups, specifically asking: 'What is the role of exploratory talk in classroom-based collaborative search engine tasks?'

Methods

Participants

The study took place in a large comprehensive school in the West Midlands, United Kingdom. Eight pupils (two groups of three, and a pair) were selected from a Religious Studies lesson by virtue of seating themselves in self-selected

Table 1. Participant prior data.

	Pupil 1	Pupil 2	Pupil 3
Group 1	33	31	n/a (a pair group)
Group 2	35	34	37
Group 3	34	Missing	35

KS2 average point score where 27 is the expected level in Year 6 (level 5b is 33, 4b is 27, 3b is 21 (sub-levels in increments of 2, 5b-33, 5c-31, 4a-29, 4b-27, 4c-25 etc.)).

groups at three PCs which had been set up as observation stations. All participants in the sample were female and between 11 and 12 years old. The participants were of a similar educational attainment on established baseline assessment scores (Key Stage 2 Average Point Scores, where the expected level at KS2 is 27) as in Table 1. The topic was a new one for all pupils and they exhibited no prior knowledge in their talk, although some other pupils in the class had heard of Marie Curie and Nelson Mandela.

Ethics

Guidance from the British Educational Research Association (2011) was followed, with consent gained from the school and all parents/guardians of the class members prior to testing; no ethical concerns were anticipated. Each participating pupil also gave verbal consent after a brief explanation of the purpose of the recordings. The use of a generic logon precluded access to the pupils' personal files, thus removing a potential concern in this area. In any of the examples below, pseudonyms replace real names.

Design

This study employs established methods of sociocultural research to explore between-group differences, particularly sociocultural discourse analysis (Mercer, 2004, 2010). In this type of research the focus is on language as a tool to engage in sharing and creating ideas and at the most co-constructive *interthinking*. Analysis involves an iterative movement from words, to utterances, to whole transcript and artefact analysis, employing a range of data sources from those familiar to observational research, to worksheet and screencast data analysis as described further in the 'analysis' section below. This combined-method approach is common in sociocultural research, which attempts to understand learning in its cultural context.

Materials

Three flipcameras were used as a backup audio recording, and provide visual assistance in transcription. Three Roland Edirol R9 Audio Recorders were used as the main audio recording devices, and placed in front of the keyboards on the workdesks. A classroom of desktop computers had CamStudio installed on them, and three of these in relatively isolated positions were selected as testing stations.

CamStudio was set up to reduce file size as far as possible and to save onto a shared network drive for later 'collection'. The worksheet was copied as requested by the teacher, for one sheet per group.

Procedure

Prior to the lesson starting, three computers were logged on to a generic pupil account and CamStudio was set up for use. The lesson was largely dictated by the class teacher, although a PowerPoint presentation and lesson plan were provided for guidance. The lesson started with:

- a brief introduction to the task: to find out about role models;
- a discussion of what a 'role model' is;
- a discussion of 'group rules' – listen to each other, work together, explain answers etc.

The pupils then worked through a worksheet, the first seven questions of which were 'assigned' or 'directed' tasks (find out about role model x) and the last two involving more self-directed tasks (pick a role model as a group, and find out about them). These appeared alongside probing questions as indicated in Figure 1. These tasks were constructed with the teacher to maximise validity. The assigned or closed tasks were used to provide a means for assessment (fact retrieval) and self-directed tasks to provide opportunity for more open-ended search.

The teacher chose appropriate points at which to stop the pupils, ensure they were all moving along well and check answers. The audio recorders were appropriate for recording these sections of teacher-led talk as well as recording the small groups when they were working on the activities. The lesson was a single 75-minute session of which about 65 minutes were spent working (roughly 10 minutes being

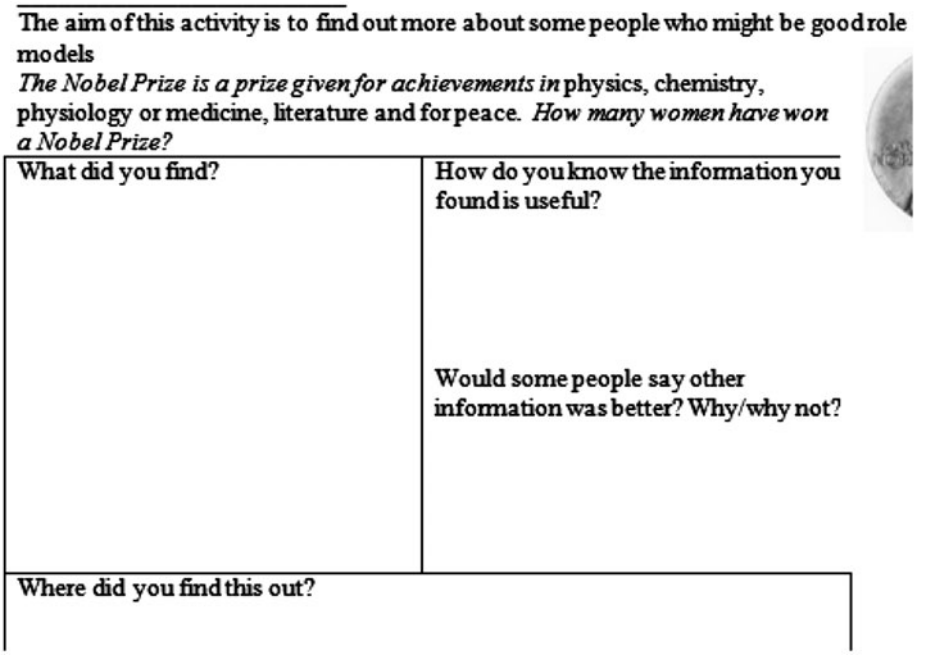

Figure 1. Example IS question taken from worksheet.

spent on admin tasks). The teacher for this session was covering for a planned absence by the usual teacher. The pupils received one worksheet per group, and chose their own groups of two or three.

Analysis

Analysis was conducted on group talk transcribed from the audio recording, with video recording to support this process. Audio was transcribed with little technical notation except ellipses '…' to indicate overlapping speech, and relevant annotations made in square brackets (e.g. [inaudible] where the words could not be made out).

Screencast data were also used as a secondary form of analysis to explore the context of utterances where relevant. Following transcription, some relatively simple counts were taken, such as number of utterances made by individuals, and the type of behaviour (off-task, teacher talk, search related, task related). This latter analysis was based on a time-based quantification of coded talk in which codes are applied over periods of spoken dialogue as opposed to counting numbers of sequences, or words coded. While this approach is not unproblematic (in particular, individuals speak at different speeds), analysis of other approaches indicates similar proportional relations to those indicated in the results section. To our knowledge, there is no body of research discussing these various methods for the quantification of talk.

The broad methodology offered by sociocultural discourse analysis (Mercer, 2004, 2010) is a direct response to the joint nature of thinking, and the importance of language to the construction of common knowledge. In this methodology, language-based methods are used to highlight salient features of talk particularly as related to learning outcomes, an area in which little IS research has been conducted (Imazu, Nakayama, & Joho, 2011).

Within Mercer and Littleton's (2007) work, a three-part typology (Table 2) has been used, aiming not to reduce data to a tally, but to highlight the nature of talk used towards learning outcomes. This forms the key element of the analysis in this work.

Such analysis involves the use of both qualitative and quantitative methods; however, the quantitative data should be taken as an aid to understanding the broad qualitative data (including that which cannot be included in the body of the text) and not as a means to reduce the data to a numerical tally. Thus, excerpts from sections of talk are presented alongside concordance analysis of keywords associated with 'exploratory talk' – such as 'I think', 'because', 'so' etc. Such use of concordance analysis allows researchers to 'test … hypotheses about how topics are being carried forward and how meaning is being jointly developed through talk' (Mercer, 2000, p. 69) by providing not only a numerical count but also the context in which keywords and phrases are used, as we now describe further.

Understanding the context of such utterances is important for understanding how utterances are used by collaborators to think together. In 'systemic functional linguistics', the perspective is taken that types of text have contexts by being members of a particular genre, which is revealed through the way such texts are written (see Halliday, Hasan, & Christie, 1989) – thus, context is imbued into texts at the time of writing. However, in the context of co-construction through discourse, '"context" is created anew in every interaction between a speaker and listener or writer and reader. From this perspective, we must take account of listeners and readers as well as speakers and writers, who create meanings together' (Mercer, 2000, p. 21). One

Table 2. Typology of talk; disputational, cumulative, exploratory.

Type of talk	Characteristics	Analysis
Disputational	'Characterised by disagreement and individualised decision making. There are few attempts to pool resources, to offer constructive criticism or make suggestions.'	'Short exchanges, consisting of assertions and challenges or 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).

particular technique to understand the temporal aspects of context, as involving continuity across talk, is to look for repetition of words, to understand how 'speakers can jointly, co-operatively create cohesion in … their speech' (p. 62); an approach we also adopted here aided by our use of the concordance analysis.

Results

Following the analysis described above we now present our results, starting with some general points regarding the amount and type of interaction within the groups. We then relate this to the task completion of the groups, highlighting a number of ways to measure 'success' in this context. Finally, we present analysis related to the nature of the discourse within groups, using the 'typology of talk' first to present quantitative analysis which should be used to inform the reading of the subsequent section, which presents a brief discussion of each group's discourse and some short transcript extracts to illustrate these.

As Table 3 illustrates, it is significant to note that within Group 1 (a pair) the utterances tended to be longer than the other groups, thus they engaged in similar durations of talk overall. In Group 3, the pupil who seemed to speak less was more likely to control the mouse, keyboard or worksheet than either of the others. Furthermore, in that group the pupil who talked the most also instigated the most 'off-task' talk. However, the discrepancy here is of interest and may help to explain some of the problems this group experienced.

Table 3. Relative number of utterances in each group.

	Pupil 1	Pupil 2	Pupil 3
Group 1	81	89	n/a (pair)
Group 2	71	78	103
Group 3	38	68	101

Success – issues with measures, and measures of issues

In terms of task completion, Group 1 completed four questions, and had discussed the fifth (in fact, they had almost found the answer). However, they did not find the correct answer for question three (to find another name for Nelson Mandela). Group 2 completed all nine questions, although no talk was transcribed for the ninth. Group 3 completed only three questions.

In particular, Group 2 did not discuss question 7 (on Florence Nightingale) at all, and discussed only one aspect of the final two questions – which they based on 'mums' being a good role model. It was also very difficult to draw out sections of discrete talk regarding where they had found the information, and whether other information might be more useful – although in at least some instances such talk did occur, in the context of answering other questions, and the worksheet answer is drawn from that talk. In any case, Group 3 clearly completed the least work, and were the least effective group; while Group 2 was very effective, this was sometimes in superficial ways – however, they did complete the most questions. Group 1 worked together effectively – as will be more apparent from the discourse analysis below – although they completed fewer tasks. This comparison highlights the importance of contextual information in assessing success in such tasks.

Using language to think together

While raw success – and its measurement – is of interest, we are also interested in the ways in which the pupils searched, and talked, together to find information and make meaning. This section provides some quantitative analysis to illustrate these issues. However, while in coding systems excerpts are taken to be illustrative of the quantitative information, in this case the quantitative data should be taken to illustrate the qualitative. That is, the analysis provided is not that of a coded quantification of data, thus the numbers should help the reader to understand the context, but it is the qualitative data from which the core meanings are drawn.

A key element of our analysis involved the typology of talk (see Table 2). One method to highlight the presence of exploratory talk is the use of concordance analysis for keywords associated with such talk – as indicated in the relative incidence of exploratory talk words highlighted in Table 4.

This illustrates one issue with the quantification of discourse, in that Group 3's 'cuz' instances were often not being used as explanatory devices (i.e. substitutes for 'because, xyz') but rather as devices to close off conversation, a commonly known (and infuriating) example being the exasperated response, 'oh, just because!' – as in: 'it just is – now stop asking about it'. Similarly, Group 2 has two cases bracketed from the concordance analysis, 'I don't really wanna read it cuz it's too long', and 'cuz I'm very bad at this' – neither of which is aimed at the joint construction of knowledge. A final example serving to highlight the usefulness of concordance

analysis as a means to provide numeric, but qualitatively contextualised, data comes from Group 1's use of 'if' (4 occurrences), all of which co-occurred with another word often associated with exploratory talk, 'so', and were thus removed to avoid double counting.

Table 5 gives some indication of the presence of such types of talk – although it should be noted that sometimes more than one type may be present in any one section. It is striking that Group 3 engaged in very little exploratory talk while Groups 1 and 2 engaged in similar amounts, varying more around the cumulative and disputational types.

To illustrate the types of talk engaged in, we use two devices – firstly, reference to the typology of talk in a fairly broad sense. However, it is also possible to draw out some commonalities within the types of talk within groups. Thus, the extracts below should be taken as illustrative both of the typology, and – with reference to the description offered – of the groups' behaviours more generally.

Group 1

Specifically, Sequence 1 illustrates the use of exploratory talk to build new knowledge, and create shared meaning, in this case dominated by Frances, while other instances showed similar interventions from Karen. This example is particularly interesting because the pair is not prepared to simply take at face value that Marie Curie is a good role model, indicating some awareness that understanding why someone is a good role model is important. A frequent term tying together this group's discourse was 'why' – a term used with reference to *why* information was good.

Sequence 1 – Illustrative example of exploratory talk from Group 1

Karen:	And then we, do you think this person is a good role model? Yeah
Frances:	wait no, let's read a bit first because we don't know
Karen:	she received a general education
Frances:	ah look, Dr of science, she succeeded her husband as head of physics at the laboratory at the Sorbonne, gained her Doctor of Science degree in 1903 following the tragic death of Pierre Curie in 1906, she took his place as professor of General Physics in the faculty of science, the first time a woman had held this position
Frances:	Well yeah, I think she's a good role model
Karen:	Because she's the first woman
Frances:	Yeah, she's a good role model

Table 4. Relative incidence of exploratory talk words in group talk.

	Group 1 occurrences	Group 2 occurrences	Group 3 occurrences
Because/cuz	23	22 (24)*	9
So	15	8	9
Therefore	1	0	0
Think	13	13	1
But	7	10	2
If	-*	4	2
Total	59	57 (59)	23

*See discussion above regarding the use of 'cuz' and their removal.

Table 5. Relative incidence of exploratory talk (time percentages from the total time recorded).

	Group 1%	Group 2%	Group 3%
Cumulative	21.04	28.86	18.08
Disputational	12.28	2.92	31.91
Exploratory	19.98	15.75	1.70
Total	53.3	47.53	51.69

We can also see a use of repetition in this short sequence, to create 'cohesive ties' for continuity (Mercer, 2000, p. 59), for example Frances says 'the first time a woman had held this position', which Karen then highlights 'Because she's the first woman.' These cohesive ties are used throughout, and we can see differences in the ways they relate to the talk of the three groups.

Group 2

Sequence 2 was a common feature of Group 2's talk. Here, we see a point is raised by Ada, asking a question – which is then simply affirmed from their prior assumption, rather than fact checked, or explained. This sort of acceptance of 'the given' – either from websites, or each other's talk, was common in a number of Group 2's interactions. This group tended to focus on newly discovered information and repeating it. A tie seen throughout their responses (inter-question tie) made reference to the fact that 'I didn't know that…'.

Sequence 2 – Illustrative example of cumulative talk from Group 2

Ada:	erm, he was the president
Ada:	was he a president or a prime minister?
Barbara:	I think he was a president, I'm not sure…
… Ada:	that's what I thought

Group 3

Finally, **Sequence 3** indicates the sort of disputational talk characteristic of Group 3's interactions. The group are discussing Nelson Mandela, and why he might be a good role model. However, they have failed to select pertinent information, and after a period of silence, a vague suggestion is posed – but not followed up, the group instead moving on to name the website, and then a stretch of off-task talk. These periods of silence and off-task talk within fairly short exchanges – that is, identifiable sections of talk regarding a particular topic – were characteristic of this group. Similarly, their talk exhibited few cohesive ties. This was partly in virtue of the fact that identifying inter-question ties, as opposed to intra-question ties, was challenging because they made so little progress.

Sequence 3 – Illustrative example of disputational talk from Group 3

Anita:	Erm … he has he had 6 children
Mary:	and he has 20 grandchildren

Silence [16 seconds]

Anita:	Just put, he stood up for what he believed in, put something like that, he stood up for what he believed in
Jean:	What's this called?
Anita:	Mtholyoke [reads website name]

[Chatter about year 6 plays]

Summary

Thus, while ostensibly Group 2 was the most 'successful' group, closer analysis of task completion indicates that Group 1 was also rather successful. Furthermore, quantitative analysis of the discourse shows that Group 1 engaged in a longer duration of exploratory talk than Group 2 (a claim supported by the incidence of 'exploratory talk words' in Table 5), while the brief discussion indicated above relates some of the further differences between these groups. It should also be noted that Group 3 (which completed by far the fewest tasks) also engaged in the least constructive dialogue, and the most 'off-task' talk. These findings will now be discussed in more detail.

Discussion

The results thus indicate the importance of group discourse in successful collaborative IS. The study set out to explore the role of exploratory dialogue in collaborative classroom-based search engine tasks, and results indicate that the success of groups in such tasks is related to their use of educationally productive dialogue, specifically exploratory dialogue. Here we first discuss some general accords in our findings with prior work, before discussing the distinct contribution of this work as an analysis of collaborative dialogue in IS tasks. We go on to highlight some weaknesses with the study and some areas for further work, before concluding.

In accord with prior work, a range of issues were experienced by all three groups to varying extents. Table 6 below summarises the main issues students faced, almost all of which were reproduced to some extent in this study; although much of this prior research is 10 or more years old, many of the same issues remain.

The further contribution of this study is the analysis of collaborative IS in the normal classroom context, mediated by talk. While the differences between Group 1 and 2 are more nuanced, it is interesting that Group 3 – which was clearly the least successful – also engaged in the least exploratory talk, and reflected very little on the nature of the tasks, or information on which attention was focused, and the ways these could be tied together. In a similar vein, their concern with gathering information focussed on quantity and easy access (or aesthetic value), over the focus on explanation and important information of Group 1, and novelty and detail – with some degree of selection (i.e. not *just* quantity) – of Group 2. Findings indicate that particular kinds of productive dialogue, notably exploratory talk, can be identified in and are related to effective collaborative information seeking.

These findings have implications for the ways that search engines and information management tasks are used in classroom contexts. Perhaps most prominently, they reiterate the concern that even where pupils may have prior experience with technology, they may not necessarily be adept at using it – even when they can share their expertise in collaborative contexts. Moreover, although pupils may be familiar with the particular functions of tools – such as 'suggested search', spelling

Table 6. Comparison of findings in this study with those of prior work.

Key issue	Finding	Issue for…?
Query Formation (IR)	Students look for the words they have entered (and only those terms) in search results to decide relevance (Hirsh, 1999).*	All
	Students often fail to use synonyms or alterative phrases, often repeating the same query more than once, failing to narrow these (Chen, 2003).*	All
	Students tend to use full phrases, natural language search and assume search engines understand questions – often directly entering the question they have been asked as a full phrase (Bilal, 2000; Chen, 2003; Marchionini & White, 2007; Schacter, Chung, & Dorr, 1998).*	All
Search and Exploration	Students keep exploration of websites to a minimum and ignore multimedia to reduce effort required (Fidel et al., 1999)*	All
	Younger students tend to invent URLs that sound appropriate if they do not know a site to turn to (Madden, Ford, Miller, & Levy, 2006).	No evidence
Source selection	Pupils tend to use the same sources over a number of searches for assignments (Shenton & Dixon, 2003a, 2004).*	Group 1
	Authority of websites not considered by students (Hirsh, 1999).*	Group 3
	Students (15–17 years old) take the fact that a site is indexed (in this study, in Yahoo) as a signal of authority (i.e. no further evaluation required) (Lorenzen, 2002).*	Group 2 Group 3
	No attempts to check veracity of information (in students aged 4–6) (Shenton & Dixon, 2003b).*	All, particularly Group 3

*Cited in Williams and Rowlands' (2007) review article.

correction, and image or video searches – they may not be adequately equipped to deal with the information these searches present them with, using naive strategies and failing to consider – particularly collaboratively – results fully.

Although this study did not explore individuals' search capabilities, the pupils were all of a similar ability in terms of academic attainment. It is therefore interesting that, despite this, they were not equally successful, and their success appears to be related to their ability to work together and use the kind of dialogue which mediates this collaboration most effectively. These are important considerations. Just as whole-class dialogue can involve a variety of dialogue and questioning styles, including short closed questions and longer open ones, so too can search tasks. Some more open questions might involve multi-part factual search tasks which involve finding one answer before finding another (and working out that this is the correct strategy), while others might involve exploratory search – getting a 'feel' for a domain. Then aims should be to encourage dialogue which explores misconceptions, discusses the utility of results and shares strategies for finding information. These are important considerations when setting students tasks which involve the use of search engines, particularly given that in the general classroom context, both

whole-class and small-group dialogue are associated with improved educational outcomes – as discussed in the introduction.[1]

Limitations and future work

A concern can be raised, regarding the generalisability of findings, with respect to the small scale of this study and the fact that all participants were of a similar academic level, and female. We accept that limitation, but suggest that the interesting results gained from this exploratory research encourage investigations on a larger scale. The methods chosen for this particular study were well suited to a small-scale analysis of the specific situation. However, following on from the introduction to the lesson, which might be described as 'grounding', the worksheet could be thought of as 'scripting' – providing a structured space for thinking – which might lead to longer, and more structured, responses (Schoonenboom, 2008). Thus, while this method is a useful prompt for encouraging particular types of talk – and response – in group activity, and indeed it reflects a naturalistic classroom task, the validity of observations made outside of the context of such tasks may be called into question.

These concerns addressed, there are some ways in which further research could give deeper insights into the issues raised, including checking reliability of qualitative analysis through dual-coding techniques, and the use of pre/post lesson knowledge assessment for analysing learning outcomes – perhaps both for search and subject knowledge.

In addition, there are other concerns regarding the particular setup. Further research should explore the impacts of: group configuration; search engine interface changes; and extended task designs.

Concluding remarks

The importance of understanding student IS is highlighted by the fact that teachers can no longer direct students to one or two books, and while they may be able to direct them to some appropriate websites, it is both unlikely that students will restrict themselves to these, and undesirable that we should wish them to. Understanding the ways that children work together to navigate such information searches, and of ways that teachers can help them to do so more effectively, are not only important for improving their IS activities but also for promoting their ability to use productive dialogue in small groups.

Note

1. The first author has written some teacher notes on this point, available (under a Creative Commons licence) at http://people.kmi.open.ac.uk/knight/edusearch-tips/ and published in abridged form (Knight, 2014).

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