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EXAMINING INFORMATION-SEEKING BEHAVIOUR IN A GEOGRAPHY WEB-BASED CONSTRUCTIVIST LEARNING ACTIVITY

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Abstract

In the official launch of Singapore's "IT Masterplan 2" on 24 July 2002, the Ministry of Education has announced that the efforts in implementing Information Technology into Education should move beyond providing and sustaining Information and Communication Technology (ICT) infrastructure into effective pedagogical practices using ICT. It is how these ICTs are used rather than what is used that is important. Indeed, one such aspect of ICT use within Geography education – information seeking within web-based learning will be examined in this paper. Much of current literature on web-based learning highlights the flexibility of the web in providing information and enabling students to perform self-guided exploratory learning (Scott 1996 and Kahn 1998). Little empirical research has been done on the actual information-seeking behaviour in web–based learning, especially in Singapore. This paper examines the interactions between the learner and the web through the browsing behaviours of 16 Secondary 3 students when given a task that requires them to search for information on the web to solve a problem. One of the major conclusions from the data analysis is that the students tend to be engaged in rudimentary information-seeking behaviour that does not extend beyond simple keywords searches and following sequential links from search results.

Introduction

We often assume that when we engage a student in a constructivist learning activity on the internet, the student will be more motivated, learn more effectively and attain higher-order learning outcomes. Little empirical research exists to confirm these. Indeed, the central research question of this study was to explore what happens when a student is engaged in constructivist learning in a small group using resources from the web. Concepts from a few existing studies such as Borgman et al (1990) and Kuhlthau's (1993) study of information seeking behaviour were used to explore some of these elements in the activity system conceptual framework. In essence, a Creswell (1998) and an adaptation of the Goetz and Lecompte (1984) conception of a quasi-ethnography was used as the constructivist methodology for this study. Three types of data were collected to study the student search behaviour – observations, interviews and web-tacking.

Information Seeking Strategies

Research on web browsing behavior has been scarce despite the Web's growing popularity. Catledge and Pitkow (1995) were the first to publish a major study of Web browsing behavior configuring the browser to generate a client-side log file that showed user navigation strategies and interface selections. They hypothesized that users in their study categorized as "browsers" spend less time on a Web page than "searchers." This offers little

to answering the central research question in the this paper beyond the amount of time spent on the web.

Tauscher and Greenberg (1997) focused on the history mechanisms that Web browsers use to examine the rate that Web pages were visited; how users visited old and new Web pages; the distance (in terms of URLs) between repeated Web page visits; the frequency of Web page visits, the extent of browsing in one cluster of Web pages; and repeated sequences of "path-following behavior" (1997: 400). They proposed seven Web browsing patterns: first-time visits to a cluster of pages; revisits to pages; page authoring (where the subject used Reload to view the newly modified page); use of Web-based applications; hub-and-spoke visits (navigating to each new page from around a central page); a guided tour where links guide navigation through the Web pages; and a depth-first search where link paths are followed without returning to the first page in some cases. However, this model focuses on path-following procedures rather than information-seeking strategies.

A model proposed by Ellis et al (1993) categorises information seeking pattern into starting, chaining, browsing, differentiating, monitoring and extracting. Starting refers to activities characteristic of initial search for information such as using key words that were supplied to them. Searchers seldom follow chains of links nor cross reference the information between materials. Chaining involves searches that follow chains of links and cross-referencing with other web-pages or other non-web resources. Browsing refers to a more advanced form of searching which is semi-directed or semi-structred in the area of interest. This usually involves broadening, narrowing or using coordinates of word form changes. For example, searches in this task may broadened to “agricultural enhancement” from “green revolution”; narrowed to “India’s rice production increase”; or word form changes like “pros and cons of green revolution” vis-à-vis “advantages and disadvantages”. Differentiating involves using the differences between sources as a filter for more refined search. For example, “why does rice yield fall with green revolution” may be used as search parameters if one source reports “increased rice production” while another source reports “lower than expected rice yields with genetically enhance rice varieties”. Monitoring refers to maintaining an awareness of developments in a field through the monitoring of particular sources. For example, students may visit the same site over a period of time to determine if new updates had been posted. Extracting refers to the systematic examination of sources to locate material of interest. In this case, the web page may not be directly relevant to the search topic, but may contain paragraphs or images that are of relevance to certain aspects of their search. For example, the student may visit a site on loan calculation to extract information that they need to compute the interest payable for their farm loans. This model focuses on the search strategies and could be used to classify the behvaiour that has been observed while not losing focus on the central research question of how students use the web to obtain information.

Methods

For this study, three types of data were collected to study the student search behaviour – observations, interviews and client-side web-tracking. The study is largely exploratory in nature and hence a qualitative method approximating a quasi-ethnography was used to examine the student search strategies.

Some considerations in this method were site selection, access to site and individuals, purposeful sampling, forms of data collection, recording procedures and resolving field issues. According to Creswell (1998:114), it is important that the site or sites selected have an intact "culture-sharing group" that has shared values, beliefs and cultures. The researcher has selected a group in which the researcher is a "stranger" but to which he can gain access. Since most classrooms in Singapore practice group work and teachers would usually form groups that the students are members of for the rest of the academic year, the problem then is one of finding a site in which the researcher can gain access to intact groups. Both issues were considered when searching for sites.

For ethical purposes, the two schools and all students will be given pseudonyms to protect their identities. Redhill Secondary School is a small sized nieghbourhood school of about 800 students. The total number of students in the class is 18 and the teacher has already formed 6 intact groups of 3 students at the beginning of the year. Peace Secondary School on the other hand has more students (about 1000 students). It is another neighbourhood school and the class chosen for this study has 40 students and the teacher had formed 8 intact groups of 5 students at the beginning of the year.

Secondary 3 students were sampled based on the theoretical premise that constructivist learning builds on existing knowledge as well as meeting the criterion of using the upper secondary level Geography topic of Green Revolution. Further, the groups to be chosen must be proficient at using the web. This avoids the issue of web-competence, or the lack of it. Normal Academic stream students were chosen as they represent a group of students who are not in the mainstream. They are often perceived to be not as motivated and are academically weaker than mainstream students. However a number of them do complete their secondary education and proceed to the Polytechnic tertiary education and may eventually move on to the University. It is my intention that the needs of this group of students should also be researched and hence this selection. And most certainly the subjects were chosen based on their willingness and the convenience as they are already in their intact groups. Indeed the subjects were chosen purposefully by theory based sampling, politically important cases, criterion sampling and convenience sampling.

The students were then assigned an inquiry-based task on the web to find information they require to solve a decision making problem. Bascially, the task required the students to take on roles in a farmer family that had to decide if they would modernize their farm, taking into consideration government loans and technical support. This task requires them to apply their understanding of the pros and cons of green revolution to perform a decision-making procedure. The data collected revealed some rather interesting findings.

Findings

The interviews, observations and web-tracking all pointed to some interesting information-seeking behaviour.

Interviews

A few of the students tend to take the information off the web wholesale without validating the information they have found, through starting and chaining. Others either visit other websites to confirm and supplement the information found, or refer to the textbook to see if the information found is relevant. Generally, most of them are still are the starting and

chaining phase of information seeking as described by Ellis (1993) but some of them have moved on to the browsing phase.

In qualitative methodologies, it is often necessary to report the findings in a high level of detail to establish some degree of reliability in the data collected. However, excerpts and summaries of the findings will be presented here considering the constraint of the imposed word limit. Table 1 summaries the findings from the student interviews conducted at the end of the task.

Table 1: Summary of student-web interactions and web concerns extracted from interviews.

Student	Search Strategies
Grace	Usually takes information wholesale without validation – mostly starting
Germaine	Usually visits more than one site on the same piece of information. –some chaining. Validate information with non-web resource (textbook and encyclopedia) Uses simple keywords like "Green Revolution"
Ming	Usually visits more than one site on the same piece of information. –some chaining. Emails friends to validate some of the information found.
Chieh	Usually visits more than one site on the same piece of information. –some chaining. Validate information with non-web resource (textbook , resource book and email people)
Nicole	Usually takes information wholesale without validation - starting
Hubab	Usually takes information wholesale without validation -starting Will highlight what he thinks is relevant and then save it on diskette
Dan	Usually takes information wholesale without validation, except for using the textbook at the beginning to help in the search. Will highlight what he thinks is relevant and then save it on diskette
Ping	Usually takes information wholesale without validation - starting
Boon	Would use the textbook occasionally to validate the information found.- starting
Zaini	Would occasionally validate the information found with team mates.
Desmond	Usually takes information wholesale without validation -starting
Yani	First reads the title and then skim the first paragraph. Ignores the web page if information is not relevant in the title or first paragraph. –some chaining and browsing
Fazila	Usually takes information wholesale without validation, especially when deadline is near.
Zinnira	Uses other search engines to validate the information she has obtained. - browsing
Murshidah	Usually takes information wholesale without validation. - starting Occasionally she would check the information with her teammates.
Siti	Would sometimes validate the information found with books from the library and with team mates.

Although a couple of the students (Yani and Nicole) do find that the web enables them to find information beyond the text and that the web is handy for looking up information, most of them would tend to take the information off the web wholesale without validating the

information they have found. There are exceptions like Zinnira, Siti, Boon and Chieh who either visit other websites to confirm and supplement the information found, or refer to the textbook to see if the information found is relevant. Most of them are still are the starting phase of information seeking as described by Ellis (1993) but some of them like Zinnira and Yani have moved on to browsing.

Observations

These observations were performed while the students were performing their search on the web. Each session lasted about half and hour to an hour and field notes were taken. A video recording was also taken to be used as and archive for checking the filed notes. An independent rater viewed the videos to corroborate the observations in the field notes. As for the observable navigation styles, the students largely perform starting, chaining and browsing. There is very little evidence of differentiating, monitoring and extracting. Some of them like Hubab do not go beyond simple starting type of navigation. As noted on 19 April by the rater, "Hubab seems to take a very mechanical view of his research as he searches web pages without any conscious intent of retrieving information for his project." Chaining and browsing was present for a number of examples. For example on 1 April, "Chieh's search tactic is such that he looks up the book or notes, then search for further information on the web. He then validates the information with that found in his notes or textbook. Sometimes, more than 1 window may be opened.". On 2 April, "Germaine begins to take a more hands-on approach, in contrast to his earlier demeanor as he begins to print out relevant material for his research, followed by his copying down of the URL for future reference and even helping Grace with some questions." And on 8 April, Zinnira was seen to refer to a book while browsing the web. These types of navigation pattern indicate that the students are rather inexperienced in their information seeking behaviour. In summary, the students also did not move beyond browsing web search activities.

Track of the sites visited

At the beginning of each search session, the students were asked to track their navigation using a software application. However, the students were not entirely cooperative in this aspect. Despite having practiced using the software during the familiarization phase of the project and despite having been told repeated and even warned and threatened by the teacher, I suspect the students knew that the tracking programme will be not assessed in their exams and are hence not too worried about not doing it properly. Indeed, the students have clearly indicated that their motivation is largely extrinsic and dependent on the examination marks. Further, some of the students performed their searches at home rather than at school, this made enforcing the use of the software difficult. Perhaps a solution to this was to only monitor search sessions while they were working in school. The researcher should also be the one who keeps the log files after every session rather than to let the students bring it home. However, the procedure cannot be reversed now and the main compromise is an incomplete set of navigation tracks. There were some responsible individuals after all, and some tracks are available for some conclusions to be drawn from these tracks.

Most of those who have submitted their search tracks have done some work. The navigational styles are described using the same Ellis, 1993 model. Like what has been noticed during the search sessions, the students are proficient at starting and chaining. Most of the students are able to use the search engines to search the simple keywords that define

the scope of their study. For example, they would invariably use keywords such as "positive" and "negative effects" with "green revolution". They appear to understand that they need to collate the positive and negative effects in order to arrive at a decision.

Boon for example, "started by using the search engine at yahoo.com. He used the keywords 'positive effects of the green revolution' " and Desmond "used these keywords '+ and - effects of green revolution' in the search box" on 8 April. Siti also searched for "positive and negative effects of Green Revolution" on that same day. While Grace and Hubab searched using the keyword "green revolution" on 13 and 19 April, respectively. There is also indication that the students do make mistakes that are associated with "Starting" behaviour – Yani "mistakenly types www.goggle.com rather than her intended www.google.com. She realizes her mistake and then went on to the right site" on 8 April. From the field observations, I have also noted that most of the students are able to engage in "Starting" behvaiour without much guidance.

However some of the students engage in "Chaining" navigational behaviour, following chains of links or other forms of referential connection between material. For example, on 8 April, Boon "visited http://www.public.iastate.edu/~rmazur/411/study-gude.html from the results page, he then returns to the search results and clicked on http://csf.colorado.edu/mail/ecol-econ/nov96/0001.html. After that he chose http://www.recoftc.org/download/International_Report_Series/Crossroads/Gilmour_fisher.pdf which cannot be displayed. Boon then looked at http://www.alltel.net/~bsundquist1/se0.html for topsoil loss. After this, he went back to the search results page and clicked on the next 20 results. He clicked on an article by Richard Lugar at http://www.senate.gov/~lugar/990317a.htm. After this he continued with the next 60 search results." Clearly Boon was able to follow one piece of information to another that was chained using the hypertext links provided on the search results and within the pages he has opened.

Another example is Grace, who on 15 April "visited www.agron.iastate.edu/courses/agron342 which was a site featuring 'World Food Issues: Past And Present; The Green Revolution' linked from the search results of the search engine. She then went on to http://www.irri.org. However she did not retrieve this site from the search engine. This was a site given to her on the WebQuest resource page. From here she clicked on the first link of the navigation bar 'What is IRRI?' and went to http://www.irri.org/Aboutirri.htm. She then went BACK to the Google search site and clicked on the 19th page of search (I suspect she was just randomly clicking on one of the search results page). She then went to http://www.awd.org.au/books.htm, which is a site about Action for World Development: Books. There is an entry on this site about 'Rice Beyond The "Green Revolution" ' She then ended up at the page http://museum.agropolis.fr/english/pages/expos/agriculteurs/dico/dictionnaire19.htm This is a glossary of terms associated with wet rice farming." Like Boon, Grace managed to click from one link to another following what seems to be relevant material.

Hubab on the other hand, "visited the link on India's Green Revolution at http://www.indiaonestop.com/Greenrevolution.htm. From there he followed the link to www.westbangal.com. in on of the paragraphs. He then went on to use the search engine within the West Bengal page. After that he went back to the WebQuest page at

http://www.arts.nie.edu.sg/hsse/changch/padi/ and then went on to use LycoAsia's web search function at http://www.lycoasia.com/ to search for the keywords green revolution" on 19 April. Like Boon and Grace, Hubab followed the links from one piece of information to another. However, they also move back to the search engine when they find that the information they have "followed" or chained is not relevant. This is truly using the hypertext capability of the web. Short of giving another two detailed but highly similar account of where they have gone from where, I state for the record that Zaini and Yani also showed their ability in "Chaining".

There are quite a few examples of browsing this study. On 8 April for example, Boon started first by searching for "positive effects of the green revolution", browses a few search results and then searched for "negative effects of the green revolution". This is clearly some form of semi-directed, semi-structured searching strategy. On 15 April, Grace "visited http://www.enviroliteracy.org/article.php/234.html which is essentially a webpage on Green Revolution by the Environmental Literacy Council. One of the sites was http://www.microcreditsummit.org/, which is a site featuring plans to help alleviate poverty in the developing world. This link was from the first link in the first paragraph of the article at the Environmental Literacy Council site. After that, Grace made a "u-turn" back to the Environmental Literacy Council site and visited http://www.wri.org/wr-96-97/fa_txt3.html which features the article 'Future Global Cereal Production: Feast Or Famine?' This site was visited based on a link in the Environmental Literacy Council's paragraph: 'World Resources Institute: Sustainable Agriculture'. Grace then went back to the Environmental Literacy Council's site and visited the Food link on the navigation bar : http://www.enviroliteracy.org/category.php/6.html followed by the Land link http://www.enviroliteracy.org/category.php/2.html and the Air and Climate link http://www.enviroliteracy.org/category.php/1.html. She then went back to the main page before clicking on the Environment and Society link http://www.enviroliteracy.org/category.php/5.html" Clearly, Grace has not only just chained from one link to another, she has developed a semi-structured strategy to visit each of the sub-sections within the main page in turn, perhaps to obtain a clearer overview of the site. This can also be seen in Yani's search on 8 April. She appears to have a semi-structured strategy to first search for "Green Revolution and advantages" and then, she goes on to search for images of green revolution before searching for just "Green Revolution" in general.

On the other hand, after searching for the keywords "Green Revolution", Zaini visited several pages on 8 April. However he must have read something that made him perform a search now using the keywords "Modernizing the Farm" and looked through 37 results returned. After that he (see pg 6,7 and 8). He then used the keywords "Green Revolution again. Clearly Zaini has first used a broad term such as "Green Revolution", read some results, decided to narrow the search terms to "Modernizing the Farm" and then broadens the searches to "Green Revolution" again. This conforms to our definition of browsing.

Unfortunately information seeking behaviour of differentiation, monitoring and extracting appear to be lacking. Perhaps except for one instance in which Yani (on 8 April) decided that the keywords "green revolution and advantages" and "advantages of green revolution" might return different results. She tried using both sets of keywords, in turn and apparently decided to use the results from the second set. This is perhaps the only instance in which an

information seeking behaviour tracked for a student, somehow differentiates between the types of keywords use. However, there is no evidence that Yani actually differentiated between the two sets of search results. What is clear is that the students are proficient with starting, chaining and browsing. Skills such as differentiating, monitoring and extracting need to be developed in order for the students to become more proficient at information seeking.

Discussion and conclusion

A reasonable induction is that they appear to be inexperienced in searching for information and will require more specific instructions than those already given. The student interviews showed that most of the students' description of their search behaviour could be classified under starting and chaining of Ellis (1993) model. A couple of students, Zinnira and Yani showed that they performed some "browsing". In terms of validating information, Zinnira uses other websites such as "MSN Search, ahm Googles, sometimes …Lycos-Asia." to find addition information on what she has found. Yani has a very pragmatic search strategy. She would first read the title and then decides if the information is relevant, if it is, she would continue to read the first paragraph. She would skip the pages without relevant information in the title or the first paragraph. As for the observable navigation styles, the students largely perform starting, chaining and browsing. There is very little evidence of differentiating, monitoring and extracting. Some of them like Hubab do not go beyond simple starting type of navigation. As noted on 19 April by the rater, "Hubab seems to take a very mechanical view of his research as he searches web pages without any conscious intent of retrieving information for his project." While the results from the web tracking software showed that the students were proficient with starting, chaining and browsing. Skills such as differentiating, monitoring and extracting were not evident.

In summary, the web was used in a rather novice manner by the students. Although, the students largely used starting, chaining and browsing information search strategies, they were still rather diffident. They lack self-directedness in their information searching and would probably do better if more guidance was given. Some of them also get distracted easily and are impatient with waiting for information to be returned on their searches on the web. However, this is an exploratory study of how Secondary 3 Normal Academic Geography Elective students perform web searches for an inquiry-base activity. It is unfair to derive diagnostic conclusions based on the anecdotes of a dozen and a half students. However, the data does point to some indication of a general lack of ability in students' information search strategies. Clearly, the implication for teaching and practice is to provide more direction in web searches. Perhaps there is a need to formalize the acquisition of information seeking skills – we cannot simply assume that they know. There is also a need to consider the information seeking skill level when designing instruction or construction.

In quoting an introductory remark in this paper, we should seriously consider equipping them with necessary information seeking skills, if we would like to see student engaged in a constructivist learning activity on the internet, becoming more "motivated, learn more effectively and attain higher-order learning outcomes"

References

1. Borgman, C.L., Gallagher, A.L., Krieger, D. and Bower, J. (1990) "Children's used of an interactive catalog of science materials" *Proceedings of the 53rd American Society for Information Science Anuual Meeting*, Vol. 27, pp. 55 -68
2. Catledge, L. and Pitkow, J. (1995*). Characterizing browsing strategies in the World-Wide Web*. In Proceedings of the Third International World Wide Web Conference, Darmstadt, Germany.
3. Creswell, J.W. (1998) *Qualitative Inquiry and Research Design: Choosing among five traditions*, London: Sage
4. Ellis, D., Cox, D. and Hall, K. (1993) "A comparison of the information seeking patterns of researchers in the physical and social sciences." *Journal of Documentation*, 49, 356-369
5. Goetz, J. P., and M.D.Lecompte. 1984. *Ethnography and qualitative design in educational research*. Orlando, FL: Academic Press.
6. Kahn R.L. (1998) "Seamless integration of lecture notes and web-pages" *Journal of Educational Technology Systems*, Vol. 26, No. 4, pp. 283 - 290.
7. Kuhlthau, C.C. (1993) *Seeking meaning: A process approach to library and information services*, Norwood, NJ: Ablex.
8. Scott B.D. (1996) "Teaching the Net: Innovative techniques in Internet training", paper presented at the *Annual Computers in Libraries* Conference (Washington DC, February 1996).
9. Tauscher, L. and Greenberg, S. (1997). "Revisitation patterns in World Wide Web navigation". ,in *Proceedings of the ACM SIGCHI Conference on Human Factors in Computing Systems*, March, ACM Press.