

A baseline study on the Internet information search proficiencies of polytechnic students in Singapore

Kumar Laxman
Nanyang Technological University, Singapore

ABSTRACT

The Internet has emerged as a versatile information repository tool that offers immense potential in optimizing the transactional dynamics of teaching and learning. In the context of a developed country such as Singapore, the Internet is an ubiquitous fixture in the ever expanding electronic learning landscape of the educational system. Hardware infrastructures are in place in schools in Singapore to enable them to be seamlessly connected to the Internet to tap the wide array of opportunities the Internet affords in providing a digital context of learning that extends cognitive apprenticeship from theoretical settings to applied, active instructional environments. However, having widespread access to Internet technologies doesn't translate to automatic positive learning gains. The power of technology needs to be combined with the expertise of pedagogy to form a potent partnership that elevates the quality of instructional delivery. This concern becomes particularly problematic when critical information literacy skills underpinning the success of Internet-based learning initiatives are self or peer taught, as it often happens in Singapore. Information literacy skills are too complex and diverse to be able to be readily learned through self-taught modes of knowledge acquisition by young learners. The baseline study elaborated in this paper attempts to document the Internet information search proficiencies of a sample of polytechnic students in Singapore to underscore the importance of systematic, intentional integration of information literacy skills within formal curriculum in schools.

INTRODUCTION

Watson (2001) argues that actively seeking new information from a variety of resources, integrating the new information with what is already known, organizing the new information in coherent ways and explaining the newly understood knowledge to others are key skills that have to be developed in order to become successfully learners. Jakes, Pennington and Knodle (2002) support this line of inquiry with their assertion that unless students are trained in all the necessary process skills to be able to operate as independent learners, it will be difficult for them to manage the complexities of problem-based learning. They posit that meaningful implementation of a pedagogical approach based upon modalities of problem solving is directly tied to students' effective use of the Internet for acquisition of needed information. This is due to the fact that timely information retrieval and use are critical factors in ensuring success in learning and the Internet is undoubtedly the largest digital information repository hosting information that is immediately and easily accessible.

Morris and Brading (2007) cautions that those who are not comfortable enough in locating and using the wide array of educational resources available in the information rich Internet might become disenfranchised in their learning. Schaster, Chung and Dorr (1998) found in their studies that most students generally lack crucial information searching skills and rarely employ efficacious search strategies or select appropriate search terms. They also observed that students generally spend little or no time planning their searching. The study explicated in this paper specifically sets out to analytically examine the Internet information search competencies of a class of polytechnic students in Singapore.

LITERATURE REVIEW

The Internet – A vital informational and educational medium

The Internet is an extensive system of interlinked yet independent computer networks connecting millions of computers together globally (Jonassen, Howland, Moore & Marra, 2004; McGuire, Stillborne, McAdams & Hyatt, 2002). This worldwide network of networks consists of a set of rules that allows computers to connect and communicate with other computers as long as they are connected to the Internet. The Internet has in recent times emerged as the most vital and powerful digital information medium to shape and define the educational field.

Provision of tools for inquiry

Bruce and Levin (1997) argue that the Internet provides tools for active educational inquiry. The Internet facilitates finding sources of information appropriate to a task, working to understand the information resources and how they relate to the task, and applying this understanding in an appropriately, productive way (Grabe & Grabe, 2000). By enabling students' access to resources from the outside world, including experts in the field and direct collaboration with them, the Internet enhances students' knowledge construction. Thus, exposure to real life contexts trains students to face the uncertainties of the ever-changing outside world (Labbo, Reinking & McKenna, 1998; Michaelson, 2003). Otherwise, students who are not competent in using the Internet might end up being insufficiently armed with necessary skills to function effectively in the technology-infused workforces they will face when they graduate (Leu, 2002). It becomes inherently vital that students be trained to become proficient users of the Internet.

Skills important for the effective use of the Internet

Today, traditional societies are being transformed into knowledge societies all over the world (Adebayo & Adesope, 2007). Therefore, in the knowledge based societies of today, meaningfully searching for and retrieving a wide spread of comprehensive information from the Web has critical importance. Skills essential to effectively finding information on the Web have become indispensable (Monereo, Fuentes & Sanches, 2000). Locating appropriate information on the Internet requires a variety of skills, such as the ability to use Internet tools, knowledge of search techniques, cognitive capacity to organize a search, and ability to execute the search (Carroll, 1999). Effective use of the Internet to glean relevant information requires the ability to apply boolean logic rules and an understanding of how information is organized - critical thinking skills that allow the searcher to make informed choices and acquire a working knowledge of Internet functions.

Other necessary skills involved are general knowledge about the subject of the search, specific prior knowledge of the topics being scrutinized, narrowing and expanding topics, appropriating certain language capabilities and recognizing usefulness of information (Eagleton & Guinee, 2002; Eagleton, Guinee & Langlais, 2003; Nachiamas & Gilad, 2002). Mariani (2000) advocated that Web navigation entails integration of cognitive abilities such as searching for information, scanning and skimming information and metacognitive strategies such as planning, monitoring and evaluating.

Besides these generic skills, Allen (1991) had, in addition, proposed four types of prior knowledge affecting the interaction of users with information systems such as the Internet: (a) world knowledge - general knowledge that might affect the information searching (b) system knowledge - the knowledge users have about the system they are using (c) task knowledge – users' ability to carry out a search task (d) domain knowledge - the knowledge users have about the topic being searched.

Internet Information searching tools

Students can locate informational resources on the Web by either going directly to a target website, if known or using a search tool (Eagleton & Guinee, 2002). To facilitate the process of searching for information in the Internet, the Internet itself offers various search tools and applications to help us in our search endeavours. Directories, search engines and metasearch engines are some of the common Internet search tools (Monereo, Fuentes & Sanches, 2000).

Search engines and directories are the most ubiquitous tools that have been used to search for information in the Internet. Major search engines regularly undergo changes on a periodic basis to suit individual search requirements. Lawrence and Giles (1999) found in their study that many major search engines examined for coverage had minimal overlap of URLs in their return of results for each search query. Therefore, they recommended combining the results of multiple search engines to improve the coverage of web searches. Search directories such as the one that can be found in Yahoo! are databases that use hierarchical structures. Directories are an easy place to look for information on the web since people review the sites on them and group the sites into appropriate categories (Ackerman & Hartman, 2003; Jonassen, Howland, Moore & Marra, 2004). Search engines are the preferred tools when one is looking for very specific information whereas directories are useful when one wants to know more information on broad-based subjects such as general and popular topics. When one's search is carefully thought out with awareness of the exact term to be searched for, search engines serve best in locating relevant information. However, if one is unsure of the precise search term to use and wishes to avoid the overwhelming number of hits a search engine might return, then browsing directories will be more helpful in suggesting keywords and resources on the subject since directories tend to be better organized and selective. Though directories are much more focused and have higher quality links, they are usually smaller than search engines and thus, less effective when conducting exhaustive searches (Ackerman & Hartman, 2003; Schlein, 2003).

A meta search engine is one that searches across multiple search engines displaying records on the screen in any one of the different formats. Meta search engines are valuable because they provide a quick overview of what may be available on the web and make comparisons between the search results of the different search engines (Schlein, 2003). However, integration through cross-referencing from multiple search engines doesn't necessarily mean that meta-search engines are faster or more productive than regular, general purpose search engines. Results from meta-search engines are less precise since all regular search engines use arbitrary limitations on the number of results that are to be displayed and the acceptable length of time with no results. Meta-search engines also use only basic search procedures. They do not allow refinement of searches and do not have many of the advanced search services offered by individual search engines to handle complex searches (McGuire, Stillborne, McAdams & Hyatt, 2002).

Singapore Context

In Singapore, the first Masterplan for Information Technology (IT) in Education (1997 – 2002) was a blueprint for the use of IT in schools. The required technological infrastructure and IT-enriched learning environments were put in place in Singapore schools (<http://www3.moe.edu.sg/edumall/mpite/index.html>).

The Masterplan II for IT in Education (MP2) was unveiled in 2002. The goals of MP2 were to consolidate and build on the achievements of the first Masterplan by focusing on the interaction amongst the components of curriculum, assessment, instruction, professional development, pupil learning and school culture and leveraging on technology to enhance these relations to bring about engaged learning.

MP2 envisions the following six outcomes in technology use:

- Pupils use IT effectively for active learning
- Connections between curriculum, instruction and assessment are enhanced using IT
- Teachers use IT effectively for professional and personal growth
- Schools have the capacity and capability in using IT for school improvement
- There is active research in IT in education
- There is an infrastructure that supports widespread and effective use of IT

As a result of MP1, Internet services which were only available in tertiary educational institutions up till 1993, are now available on a massive scale in all primary, secondary and junior colleges thus allowing all students an opportunity to be plugged into the global network. The Ministry, through MP1, has indeed rolled out an impressive technological infrastructure for schools to access the information highways of the Internet. The success of this technology roll-out initiative has to be measured based upon an evaluation of the effectiveness of the utility of technological affordances in schools towards facilitating more structured inquiry and engaged learning. Internet technologies alone do not guarantee automatic success of an educational endeavour. Rather Internet technologies need to be used to improve pedagogical processes by providing students with a platform to locate, verify and exchange dynamic information with one another. Students also need to be able to draw meanings by reflecting upon the content of the information they find online and make sense of its application (Jonassen, Howland, Moore & Mara, 2004).

METHODOLOGY

Research site and sample

The research site for this study was a polytechnic tertiary institution in Singapore. As a recently-established educational entity where premium is placed on innovative teaching practices, this polytechnic has implemented a problem-based learning methodology for all curriculum subjects and at all academic levels of study. This model hoped to encourage a pervasive learning culture of problem solving that would serve as the catalyst in provoking students to embrace new ideas, question the validity of both their own and others' viewpoints, engage in meaning-making and consensus building.

The participants of this study came from a class of 25 first-year students for the module of 'cognitive processes and problem solving' that the researcher facilitates. The students in the class ranged in ages from 17 to 19 and were an even mix in terms of gender distribution. Though coming from different schools of disciplinary specialization such as applied sciences, engineering and information and communications technology, this module of 'cognitive processes and problem solving' is a common subject for all first year students and thus, brought the participants together within the same class.

The main sources of data collection for the analysis phase were a structured survey and reflection journal entries. The survey consisting of six open-ended questions was administered to students to determine the levels of Internet information search literacy skills development amongst participant students during one of their regular classes (see Appendix). The survey addressed areas of students' conceptions about the Internet and the strategies they adopted during their periods of engagement with the Internet in search of educational information materials. At the end of each of the problem solving sessions, as an integral component of overall

assessment and in response to a reflection journal trigger, students are instructed to post their thoughts on the learning gains for the day in their electronic reflection journals. For the specific purpose of this study a reflection journal trigger eliciting students' perceptions of the role of the Internet as an information diffusion medium and the techniques they employed in optimizing information searching was presented. Students' contemplative feedback in their electronic reflection journal entries on these issues of interest served as a rich source of data for analysis.

The descriptive data collected was primarily analysed through content analysis. Content analysis is a research tool that is widely used to determine the significance of certain words or concepts within texts or sets of texts. Researchers identify and analyze the presence, meanings and relationships between such words and concepts, then make context-specific inferences about the representative messages embedded within the texts.

RESEARCH FINDINGS AND DISCUSSIONS

Analysis of Survey Results

Question 1

The first question that was posed in the survey was "How did you learn to use the Internet?" This introductory question was meant to evaluate students' comfort levels in basically using the Internet. This question would provide evidence supporting the key presupposition that Singapore students are indeed largely left to their own independent devices in learning Internet information search skills. These skills are not intuitive and are not easily picked up through self directed learning or peer-tutoring.

Twenty-two out of the twenty-five students mentioned that all their attempts at learning to use the Internet was mainly through self-taught efforts, random trial and error or help from novice fellow students or friends. Only three students indicated that they learnt to use the Internet through intentional instruction provided by their primary/secondary schools. Most educational institutions have ample on-site Internet access points but providing access alone is simply not enough. The student feedback to this first question provided evidence that there is a lack of formal learning of information search literacy in schools and tertiary institutions. This issue is of significant importance and directly impacts polytechnic students since for many of them the polytechnic might be the last stage of their formal education before entering the adult working world. The business community is increasingly becoming digital information oriented, with prevalent dependence upon the Internet for information to enable problem solving and decision-making.

Question 2

In response to the second question of the survey on planning searches before actually carrying them out, and if so, how they did it, twelve out of the twenty-five students replied that they do not really plan for a search and normally plunged headlong into searching for information. Some reasons ascribed by these students to such a tendency were lack of prior knowledge, skills and instructional training in understanding how information searches ought to be planned, the perceived waste of time and no recognition of any explicit need for modeling information planning and management. Many of the reasons raised by these students reveal their misconceptions or ignorance of the utility of information search planning and organization in carrying out their search activities. The following are some sample reflections by students:

“Not really. This is because once I know of the topic that I am required to find information about, I straight away go to yagoohoogle to search for the topic. I never really like to plan for what to search before my research. I simply feel that it is a waste of time.” (student C)

“No, I do not plan because I think that the net is very resourceful. I just type in the words in the search engine and upon execution, the desired information would automatically appear.” (student J)

“No, I do not plan for the search. I do the search immediately without any planning.” (student W)

Only three informed students indicated in their responses that they would analyse the information requirements of a given problem solving task to examine for key words on the subject matter to be researched upon. One of these students commented thus, “Yes, I usually plan my information search. I first investigate what needs to be searched in the Internet by listing certain key words that might provide me with the information that I need or is close to what I need ” (student H). However, interestingly, it was noted that none of these students explained the rationale behind generating keywords in carrying out information searching or specified how appropriate keywords could be effectively formulated.

Another eight students underscored the necessity of planning their Internet information search before actually embarking upon the search itself. Generally, these students knew that as with any other common everyday activity, planning is a crucial pre-requisite in Internet information searching endeavours to ensure attainment of successful problem solving outcomes. For example, one student (student Q) suggested that establishing a plan was critical for a fruitful search in order to narrow down the scope of search results and avoid being overwhelmed by an avalanche of irrelevant search hits. Student Q further reasoned that narrowing down the output of search results to more precise ones improves the search performance and facilitates finding needed information in the shortest possible time.

Though these eight students mentioned that they consciously plan their searches, they were however not able to explicate in a clear manner the ways in which they would frame their search plans. The arguments presented by these students either lacked coherence or were extraneous to the search objectives of the given task. The eight students could not translate their understanding of the need to plan into a viable blueprint of executable action to organize their information searching. This could largely be attributed to a want of proper knowledge in knowing how an efficacious search plan can be developed and implemented to locate desired information. For instance, one student (student N) responded that her conception of planning for an information search was simply reproducing the given search question as the query term in the search engine and seeking targeted information. Though student N was aware of the importance of planning for information searches, her reflection indicated her misinformed understanding of what actually constitutes effective information planning. Attached are a few typical responses of this category of students:

“Yes, planning is important to finding the information we want. Not too sure how it is done or of any particular techniques. But I know that otherwise time will be wasted.” (student B)

“Yes, I plan a search by relating the issues I am exploring. I guess in this way the information I am searching for would be relevant to the topic.” (student T)

“Yes, I plan my search by looking in the Net for answers and then recording everything I find.” (student V)

Only 2 discerning students (O and F) emphasized that planning for an Internet information search involved mentally mapping out a repertoire of search strategies and evaluating these strategies for their efficacy before actually executing the search. These students realized that constructing

such cognitive roadmaps allowed them to better frame terminal search goals and have a better grasp of the sequence of actions they needed to undertake in achieving these goals. Planning beforehand allowed them to check their own progress during the search process and adopt more responsive strategies of information seeking. In short, planning for a search ensured that the search becomes more systematic in its structure and helped to avoid the frustrations associated with haphazard, random searching. The two students also proposed a plan that allows them to organize and manage the search process more productively. The students suggested that the process begins with formulating in the mind a list of what is to be searched for and then identifying information needs by carefully selecting broad themes for exploration. The next stage would be assessing the appropriateness of various search strategies and sieving out the better ones before trying them out in action. Student O confidently remarked that "I usually begin my search by mentally planning for it in my brains, trying different options and if my search ends in success, I would gladly share the technique with my team mates."

Question 3

The third question queried on students' knowledge of search tools and the reasons behind their choice of search tools in carrying out their information searching. Almost all the surveyed students specified search engines as the common search tools they frequently access. Effective users of Internet information must first be effective searchers in trying to locate information found in the Web. Todd (1999) pointed out that effective searching of the Web requires knowledge about how search tools such as search engines function, which particular search engines matches specific types of information demands, what kinds of information access search engines specialize in and how the search engines index information. Generally, students' responses to this question were brief, shallow and superficial, without delving into the specific details of which search engines best handle queries on particular information subjects and topics. Some of the explanations proffered by students contained misconceptions or were driven by popular choices and conveniences of access. None of the students could explain the ways in which search tools such as search engines work, the differences between various search engines, their individual strengths and drawbacks and their focal areas of search expertise. Attached beneath are some sample inputs supporting these findings:

"I use search engines that most people commonly use." (student J)

"I prefer search engines that give me the most number of hits for the information need I have." (student A)

"The ones that give the most specific searches to the things I am looking for.....search engines that are generally reliable." (student V)

"By listening to my friends and through experience." (student E)

"The search engines that are easy to use and have most information." (student G)

Question 4

The fourth question in the survey probed students' patterns of preferences in using search engines and their supporting reasons. Not surprisingly, a majority of the students i.e. twelve students mentioned Yahoo! and another eight students stated Google. Yahoo! and Google have been found to be the two most popular choices of search engines amongst all Internet users. Three students also specified MSN, Ask Jeeves, Lycos and Ask.com.

Some of the reasons attributed by students to their preference for Yahoo! and Google include the wide popularity of these search engines, unfamiliarity with other search engines, the perceived relevance of the search results listed and the convenience of the features provided including

offering of tool bars and presentation of brief information statements on each search result. Only one student (student X) made the compelling statement that “there is no one search engine I stick to usually, I run multiple searches simultaneously and get a variety of results to choose from.” Another student (student Z) stated his preference for Wikipedia in looking for information pertaining to basic sciences. One well-informed student (student F) referred to Dogpile since it integrates the searching powers of Yahoo!, Google and Ask Jeeves. She argued that Dogpile’s capability to present an integrated compilation of the search results of multi search engines positioned it as a better and more relevant information search tool.

Question 5

The fifth question was an extension to the fourth: “Do you use multiple search engines in doing your information searching? Why so?” The objective of this question was to investigate students’ familiarity with the plethora of available search engines and their awareness of which of these search engines best suited their contextual needs. Vansickle (2002) argued that using multiple search engines allows for more extensive searching of the Web since even top ranked search engines have a relatively low degree of coverage overlap with one another. Todd (1999) stated that students needed to be informed that simple searches using a single search engine will not always return the best results since even the best search engines are slow in indexing information. Howe and Tillman (1999c) cautioned that searchers should learn how to use approximately two or three search engines well rather than learning just the bare necessities of several.

Significantly, twelve students responded that they use only one search engine to carry out their information searches. These students did not realize that one single search engine would not fully satisfy in entirety all their information needs. Search engines can be differentiated by the search algorithms they employ to perform their searches and each search engine has its own strengths and weaknesses. Furthermore, certain search engines specialize in focusing their search interests on specific areas of expertise. The choice of use of a particular search engine is determined by the parameters of the information requirements. Generally, accessing multiple search engines would be a more advisable technique since the information output would be more comprehensive, with a greater degree of success in finding relevant, cross-referenced information. Of greater concern were some of the misconceptions that surfaced in attempts by students at justifying the use of one search engine to execute their searches. For example, one student (student M) argued that “I believe that not many people can multi-task and handle the complexities of various search engines. Personally, I usually use Yahoo! since I think it is the best and serves all my needs.”

The remaining thirteen students gave the feedback that they usually use multiple search engines in performing their Internet information searching. Though, there evidently was a lack of depth in the explanations provided by the students on the underpinning reasons for their use of multiple search engines, at least, at a fundamental level, they were able to recognize the benefits of leveraging upon multiple search engines. Though these students cannot be considered as expert Internet searchers, the ubiquitous availability of computers and Internet access, both at home and in school, has undoubtedly acquainted students with a basic overview of the structure of the Internet and the common search tools it offers. Only two amongst these thirteen students highlighted the opportunities for cross-referencing the search results produced by different search engines for the same query. As one student (student H) poignantly expressed: “By trying my search in multiple search engines, I am better able to compare and contrast the information presented in the different results of the search engines. I can then filter out and use the reliable ones.”

Attached are some excerpts from the responses of these thirteen students to

question 5:

"Yes, using various search engines is useful. Usually, they produce different search results and so I will have access to more information to do my research." (student I)

"Yes, I use both Google and Yahoo search engines. This gives me a wider and broader range of search results. I have formed this understanding based upon my previous Internet activities." (student E)

"I like to use multiple search engines since it allows me to find as much information as I possibly could, making my research more constructive." (student T)

"Different search engines search in different ways and conventionally, present the result hits in the order of frequency of access by other Internet users. Each individual search engine has its own merits and strengths. Using multiple search engines can ensure that all information required of is there and nothing has been left out." (student R)

Question 6

The sixth question that was posed to students in the survey was "Do you think there are any similarities/differences in the ways different search engines work? What would they be?" This question was framed in alignment with the objective of investigating students' awareness of search engines and the structural similarities/differences of the search methodologies employed by these search engines. This question was also intended to elicit students' perspectives, if any, on the strengths and shortcomings of popular search engines in their responsiveness to dealing with information requests. Nine students provided the honest feedback that they did not know or were not sure if there existed any differences/similarities in the ways in which the variety of search engines operate, with one student commenting that he never really felt it was a critical issue to want to find out more. Six students were of the erroneous opinion that there are no differences between the different search engines in terms of their functional attributes. They had the misconception that all search engines search for information in the same manner and the information displayed upon initiating a search request would also be similar. Students' feedback reinforced the dominant finding that participant students obviously lack robust Internet information search literacy acumen.

The remaining few students understood correctly that there were some underlying similarities as well as differences between the search engines. The similarities include the aim of searching for relevant information and ranking the search results according to a defined algorithm. Some differences between search engines that were highlighted include the distinct ways in which information is processed and presented, the differential search scope and output as well as varying emphasis on particular keywords. From a conceptual level of analysis, a number of entrenched misconceptions were again exposed in students' explications. For example, one student (student K) commented that some search engines require a few keywords to execute a search whereas other search engines need part of a sentence or a complete sentence to perform a search. Student K failed to provide necessary supporting evidence to back-up his unsubstantiated claim. Another student (student D) had the misconceived notion that search engines produced varying output due to the differences in speed at which the search engines work to retrieve information!

Only three students contemplated deeper by providing anecdotal explanations of the working differences they had experienced to exist between the different search engines. Unfortunately, all three of them limited their ruminations to Yahoo! and Google only. Though none of them explained the reasons, this preference for Yahoo! and Google, as explained earlier, could be

attributed to the soaring popularity enjoyed by these two search engines amongst Internet users. Some of the claims made by these students, based upon their prior interactions with the two search engines, could not be ascertained for their veracity. Nevertheless, unlike their peers, these three students had invested more thoughtful thinking in responding to this survey question - something indeed noteworthy. The following are the cogitations of these students:

"Yahoo! uses tabs that narrow down the range for easier research whereas Google has a smaller range of tabs making it less user friendly." (student X)

"Both Yahoo! and Google are almost the same but I feel that Google provides better details for more 'serious' matter e.g politics, medical stuff etc whereas Yahoo! provides better info for entertainment/leisure issues." (student O)

"Both Yahoo! and Google give general results that cover a wide field. However, Yahoo! is more orientated towards industrial sites, thus producing more accurate results related to industrial matters." (student H)

Analysis of Reflection Journal Postings

Prior to the intervention training being administered, participating students were instructed to ponder over the following reflection trigger and articulate their thoughts in their electronic reflection journals:

- (1) What are your views on using the Internet as a learning tool to search for information?
- (2) What strategies or techniques do you use in conducting an information search in the Internet?

The first part of the trigger was aimed at eliciting students' perspectives on how they perceived the usage of the Internet as an information medium in accomplishing problem solving. Students' anecdotal perceptions, preferences and dispositions towards Internet information searching were also analysed from these responses. In the tertiary institution in which the participant students are enrolled in, the Internet plays a vital role in shaping their learning activities. Thus, students have rich, first-hand experiences interacting with the Internet on a daily basis and are able to comprehensively present authentic feedback on the use of the Internet as an electronic educational information platform.

The second part of the trigger hoped to draw informed understandings of the catalogue of strategies and techniques, if any, employed by students in their attempts at navigating through Internet information in search of needed answers. This could provide meaningful insights into students' current knowledge, perspectives and competencies on how they model their information searching approaches.

Students' responses showed that generally they were aware of the potential of the Internet in furthering learning. Due to the long durations of exposure to the Internet, both at home and in school, for educational as well as entertainment purposes, students have a reasonably good overview of the structure of the Internet and the ways it functions. Most students were generally able to distinguish between the benefits and pitfalls of working with the Internet.

An overwhelming majority of twenty-two participating students underlined the positive impact of positioning the Internet as a vital information provider and problem solving enabler in tertiary institutions. Only three students expressed scepticism on the constructive role the Internet could play in promoting meaningful learning. Even then, some of the concerns raised by these students were neither substantive nor convincing. For example, student C highlighted the difficulties

encountered in navigating through and locating desired resources within the expansive information landscape of the Internet. He likened the endeavour to searching for a needle in a haystack. He pointed out that surfing on the Internet, exposed the computer/laptop system to the menace of viruses, risking disruption to the healthy functioning of the system. Student J felt that at times the Internet search harvests information output that is too generic, unfocused and diffused. Though there is some credibility to these claims, students did not realize that developing sound information searching and PC maintenance skills is the key to resolving many of the stated problems without resorting to rejection of the Internet and its information potential.

Twenty-one students repeatedly used words such as 'convenient', 'helpful' 'useful' in describing how the Internet helps them in their information searching. They found the Internet to be a powerful, invaluable and versatile information vault that facilitated quick and easy access to a wealth of educational resources at the click of a fingertip. Student S commented that the information found in the Internet is presented in multimodal formats, involving a combination of text, pictures, audios and animations, whereas traditional textbooks features information in predominantly textual representational modes. This she reasoned explains the positive correlation between Internet-oriented problem solving experiences and improvement in learner motivation. Student Z remarked pertinently that training students to be effective Internet users prepares them to operate comfortably well within the increasingly prevalent technology-centric culture of workplaces. Student H suggested that the Internet unlike traditional pedagogies "allowed for independent learning and inspired creativity." Moreover, updated information on global happenings such as recent breakthroughs in scientific research, developments in the international business scene could instantly and easily be accessed in the Internet.

Though emphatic in stressing the strengths of harnessing the power of Internet, surprisingly, fifteen students also discussed at length the immanent drawbacks of the Internet. It is indeed commendable that without being carried away by the Internet hype and erroneously believing in the absolute good or infallibility of the Internet, these students had reflected on the potential instructional conundrums posed by the Internet. Some of these students were able to articulate well the caveats associated with Internet usage. Nine students mentioned that the copious amounts of information presented by the Internet in response to a query often could be overwhelming and distracting, with many of the listed hits being irrelevant to the search focus. This results in laboriously scanning the hits for their appropriateness and sieving out the relevant ones from those irrelevant. Students complained that this often required excessive amounts of time being spent, with the problem becoming exacerbated when the search query had been poorly constructed. Twelve students underscored the difficulties faced in assessing the credibility and fidelity of information hosted by the Internet since anyone can easily erect a website and post information in cyberspace. Thus, the quality and reliability of many online resources are invariably questionable. Students, especially those with a lack of competent information literacy skills are susceptible to accepting inaccurate, biased information to be valid. This could result in misinformation being appropriated by students.

Though participant students had a working knowledge of the functional mechanisms and tools of the Internet, what was strikingly lacking in students' reflections was cognizance of the various information searching strategies that underpin successful information seeking. Students had rudimentary understandings of the multiple search approaches that could be adopted to mine the Internet for relevant information. In fact, upon reading the reflection question, students having never heard of the term 'Internet information search strategy/technique", were generally confounded by the term. They were unable to define their search objectives and how these goals could be accomplished. As student W aptly put it, "I never really use any strategies or techniques when searching. This is so since I am not good when it comes to Internet searching." This response is telling in light of the fact that though these students were comfortable searching the Internet, due to a dearth of knowledge on competent search tactics, in reality, students were

unable to strategically optimize their search attempts at information gain. Twelve students could recall only one search strategy - the popular and commonly used search engine and keyword search technique. This compelling evidence is indicative of students' limited knowledge of Internet search devices and their simplified notions of how they work. Attached is a sample of typical responses from students:

"When I search for information, I usually go to search engines and type in the keywords I am looking for. Then I will select the one that has the information closest to what I want and I will read through the content." (student A)

"I will usually use search engines. I will pick out the keywords from the information I need to find and type them in the search engines. Usually by doing this, the range of results will be huge. Thus, I will need to read through the links and pick out the relevant information." (student G)

"If I were to search the Internet for information, I would make use of the online search engines like Google, YaHoo, Altavista, Search.com, etc. I would then type in the key words of what I want to search for into the search bar so as to obtain a more relevant search result." (student D)

If these responses are analysed further, what is revealing is that most of the respondents mentioned Yahoo! and Google as their preferred search engine choices to carry out their information searching. Though Yahoo! and Google are the most popular search engines, students have questionably interpreted this preference to mean that these two search engines were necessarily the best or would provide the most exhaustive search results. Students appeared to be unaware of the plethora of other available search engines that could just as effectively be employed, since no one search engine can comprehensively present all information related to a query. Students apparently were unaware that search engines varied in their search capabilities and employed different search logic and algorithms in enacting their search operations. Some typical sample responses from students in this regards are as follows:

"I would always use www.google.com as the search engine as it has the ability to search for only Singapore sites which are usually the more relevant ones. Furthermore, Google contains 'much more' information than yahoo (another preferred search engine) based upon my searching experiences." (student K)

"In terms of search strategies and techniques, in searching for information on the Net, I like to use Yahoo.com & Google.com. I find that these two search engines normally produce the most & best results in terms of websites." (student V)

"When I use the internet, I only use yahoo to find information since it satisfies all my needs. I don't really know how to use other search engines as well as I am not familiar with them." (student Y)

Some of the responses on this theme also highlighted varying degrees of students' misconceptions. For example, student E had the flawed understanding that only Google had features that allowed configuring a search to be limited to a localized focus on Singapore websites or websites hosted by Singapore-based web domains. Student C was of the opinion that since the now defunct Yagoohoogle search site juxtaposed the search results of both Yahoo and Google search engine, by default, it was the best. He seemed not to know that though Yagoohoogle presented a combined presentation of the individual set of search results from the search engines, this was a compressed version of the total search output of the two engines.

Only two well-informed students, F and X mentioned that besides search engines, periodically they also make use of search directories. They justified their choice of using search directories by correctly reasoning that search directories, having been developed by human indexing, tend to

produce more reliable and relevant search output listings. Based upon prior anecdotal search experiences, student F noted the drawbacks of typing in long search query phrases that have been reproduced word for word from the research questions in the given task. The user is then faced with the laborious task of having to sieve through an avalanche of search results to locate the ones that accurately match the search focus. Student F intelligently suggested the strategy of maximizing the number of search queries and minimizing the number of words per query by breaking down the main research question into its component sub-parts. The information collected in response to each of these queries could then be integrated into a coherent composite whole and presented as the solution.

Only student O articulated the application of known site strategy as one option she would pursue if she knew of specific websites from prior experiences that contain information on the subject matter she wants to explore. Astutely, she also suggested the technique of variations by entering multiple alternative keywords in searching for the same piece of thematic information. "I would also use specific websites for different subjects I am researching on. For example, for science, I will go to a certain website which has tutorials on science concepts such as <http://howstuffworks.com>. I will also use different keywords although I am looking for the same information."

Only two students (students L and X) mentioned the use of the helpful '+' arithmetic Boolean operator when constructing keyword search phrases. Applying the '+' operator ensures that the search output produced by the search engines is more precise and corresponding to the search quest. Of concern was also the finding that only student L pondered over the necessity of entering quotation marks to define search terms more precisely and instruct the search engine to locate web content that contains the specified words in the order mentioned within the quotation marks. These indicated students' ignorance of the utility of Boolean operators in streamlining the search process and ensure its successful fruition.

Based upon the pattern of findings, it is obvious that the majority of students were deficient in their knowledge of a range of information search strategies. Students obviously needed explicit, structured instructional mediation to raise their capabilities to become skillful Internet information searchers. One student candidly admitted thus: "I believe that there are still many other ways of searching for Internet information but I guess I am yet to gather the necessary skills." (student Y)

CONCLUSION

The findings of this study emphasize the cognitive complexity of Internet information literacy skills, the learning of which is non-trivial to be left to students' own independent devices. Due to the extensive exposure they receive on a daily basis through their interactions with the Internet both in and outside school, students in Singapore are largely familiar with the Internet interface and the multiplicity of tools it offers. However, it was found in this study that students generally seemed to lack fluency in the core 'soft' skills of information literacy to structure learning to become more focused, engaged and productive. They were also not well acquainted with the broad repertoire of information search strategies and techniques that would enable them to plan for and execute their information search actions in efficient and efficacious ways. This was primarily due to the fact that there are currently no mandatory programs in Singapore schools during formal curricular hours specifically aimed at intentionally training students to become information literate. Hence, students generally were deficient in their understanding of the search capabilities of the Internet to be able to fully exploit the educational computing potential of the Internet in fostering dynamic, independent learning environments. This study significantly highlights the need to consciously train students to be aware of the strengths, limitations and situation-specific utility of the different search devices of the Internet for them to take better

advantage of these search tools in accessing, processing and applying online information in educationally meaningful ways. Students also need to be familiarized with the various strategies and techniques of effective information searching to better harness the pedagogical strengths of the Internet. These outcomes in the opinion of the author of this article is best achieved through the explicit articulation of educational goals centering upon the attainment of mastery in digital information literacy within the broader framework of formal curriculum and systematically embedding competency-based information literacy instructions either as a stand-alone or integrated multi-disciplinary subject in school syllabus.

REFERENCES

- Adebayo, E.L., & Adesope, O.M. (2007). Awareness, access and usage of information and communication technologies between female researchers and extensionists. *International Journal of Education and Development using ICT, 3(1)*, <http://ijedict.dec.uwi.edu/viewarticle.php?id=282&layout=html>**
- Allen, B. (1991). *Cognitive research in science: Implications for design*. Medford, NJ: Learned Information.
- Ackerman, E., & Hartman, K. (2003). *Searching and researching on the Internet and World Wide Web*. Wilsonville, Oregon: Franklin, Beedle & Associates Incorporated.
- Bruce, B., & Levin, J. (1997). Educational technology: Media for inquiry, communication, construction and expression. *Journal of Educational Computing Research, 17(1)*, 79-102.
- Carroll, J. B. (1999). Expert internet information access. *Journal of Educational Computing Research, 20(3)*, 209-222.
- Eagleton, M., & Guinee, K. (2002). Strategies for supporting Internet inquiry. *New England Reading Association Journal, 38(2)*, 39-48.
- Eagleton, M., Guinee, K., & Langlais, K. (2003). Teaching Internet literacy strategies: The hero inquiry project. *Voices From the Middle, 10(3)*, 28-36.
- Grabe, M., & Grabe, C. (2000). *Integrating the Internet for Meaningful Learning*. Boston: Houghton Mifflin.
- Howe, W., & Tillman, H. (1999c). Search engine comparison. Retrieved from <http://www.delphi.com/navnet/faq/searchcomparison.html>
- Jakes, D., Pennington, M., & Knodle, H. (2002). Using the Internet to promote inquiry-based learning. Retrieved 21 April, 2005, from <http://www.biopoint.com/inquiry/ibr.html>
- Jonassen, D. H., Howland, J., Moore, J., & Marra, R. M. (2004). *Learning to solve problems with technology: A constructive perspective*. Upper Saddle River, New Jersey: Merrill Prentice Hall.
- Labbo, L. D., Reinking, D., & McKenna, M. C. (1998). Technology and literacy education in the next century: Exploring the connection between work and schooling. *Peabody Journal of Education, 73(3-4)*, 273-289.

- Lawrence, S., & Giles, C. L. (1999). Accessibility of information on the web. *Nature*, 400(6740), 107-109.
- Leu, D. J. (2002). Internet workshops: Making time for literacy (Exploring literacy on the Internet). *The Reading Teacher*, 55(5), 466-467.
- Mariani, L. (2000). *Cloned by the computer? New technologies, learner profiles, old and new strategies*. Paper presented at the 19th British Council Italy Annual Conference for Teachers of English, Bologna.
- McGuire, M., Stilborne, L., McAdams, M., & Hyatt, L. (2002). *The Internet handbook for writers, researchers and journalists*. New York: The Guilford Press.
- Michaelson, J. (2003). *The Internet: Information power or pitfall? An Ethnographic investigation of the teaching and learning practices of the Internet*. Ph.D. dissertation, University of California, Santa Barbara, California, United States.
- Monereo, C., Fuentes, M., & Sanchez, S. (2000). Internet search and navigation strategies used by experts and beginners. *Interactive Educational Multimedia*, 1, 24-34
- Morris, A., Brading, H. (2007) E-literacy and the grey digital divide: a review with recommendations. *Journal of information literacy*, 2 (3), <http://jil.lboro.ac.uk/ojs/index.php/JIL/article/view/RA-V1-I3-2007-2>.
- Nachiamas, R., & Gilad, A. (2002). Needle in a hyperstack: Searching on the world wide web. *Journal of research on technology in education*, 34(4), 475.
- Schacter, J., Chung, G.K.W.K., & Dorr, A. (1998). Children's internet searching on complex problems: Performance and process analyses. *Journal of the American Society for Information Science*, 49, 840-850.
- Schlein, A. M. (2003). *Find it online: The complete guide to online research*. Tempe, Arizona: Facts on Demand Press.
- Todd, R. J. (1999). Transformational leadership and transformational learning: Information literacy and the world wide web. *NASSP bulletin*, 83(605), 4-12.
- Vansickle, S. L. (2002). Tenth graders' search knowledge and use of the world wide web. *Knowledge Quest*, 30(4), 33-37
- Watson, J. S. (2001). Issues of confidence and competence: students and the World Wide Web. *Teacher Librarian*, 29(1), 15-20.

APPENDIX: Survey

- 1) How did you learn to use the Internet?

- 2) Do you plan your search before actually carrying it out in the Internet? If so, how do you do it?

- 3) Which search tools do you use to find information in the Internet? Give reasons in explaining your choices.

- 4) When using search engines, which search engines do you normally prefer to use? Why so?

- 5) Do you use multiple search engines in doing your information searching? Why so?

- 6) Do you think there are any similarities/differences in the ways different search engines work? What would they be?

Copyright for articles published in this journal is retained by the authors, with first publication rights granted to the journal. By virtue of their appearance in this open access journal, articles are free to use, with proper attribution, in educational and other non-commercial settings.

Original article at: <http://ijedict.dec.uwi.edu/viewarticle.php?id=936>