UNDERGRADUATES IN COMPUTER SCIENCE AND INFORMATION TECHNOLOGY USING THE INTERNET AS A RESOURCE[∗]

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ABSTRACT

The study explores the use of the Internet by final year undergraduates at the Faculty of Computer Science and Information Technology during the initial stages of their Final Year Project. A total of 360 survey returns indicate that undergraduates heavily use the Internet (98%). Other sources, which the students use is also listed. The students seem to exhibit high level of information literacy. They utilize various search strategies while searching the Internet, able to locate and retrieve information, able to analyse and evaluate information gathered. They use various methods to validate the authenticity of the information obtained and able to synthesize what they have read to shape the initial chapters of their final year report. The students are also aware of ethical issues surrounding the use of Internet resources. A focus group of 14 undergraduates who kept a diary of their information seeking and use behaviour, provide a clearer picture of the students behaviour and the approaches adopted when using the Internet. The outcome of the approaches is also explained.

Keywords: Information literacy; Internet use; Internet resources; Information seeking behaviour; Undergraduates in Computer Science; Undergraduates in Information technology; Modeling behaviour

INTRODUCTION

The use of resources in an electronic environment becomes more pronounced when information becomes more readily available in electronic formats. This would result in an increase use of CD-ROMs, online databases and the Internet (Lyman and Hal, 2003). This situation has given rise to studies on understanding how users utilize the

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electronic environment to search for information and how the information is actually used. Fortin (2000) for example, develop Internet information seeking behaviour model to describe how Faculty members at Angelo State University seeks information on the Internet. Four stages of information seeking behaviour are identified and these are seeking, validating, linking and monitoring. Fortin's "Internet Information Seeking Model" reveals that academics place more emphasis on validating information retrieved from the Internet. His subjects' other related behaviours conform to Ellis's model (1986, 1989, 1993) of eight behaviours of research activities comprising starting, chaining, browsing, differentiating, monitoring, extracting, verifying and ending. Catledge and Pitkow (1995) identify two types of users, those who browse would spend less time looking at a web page and those who are searchers would usually bookmark popular websites. They also found that only 2 percent of web pages looked at are either saved or printed. This is also verified by Taucher and Greenberg (1997a, 1997b), that web users often revisit web pages (60% once and 19% twice) and they tend to browse small clusters of pages. Holsher and Strube (2000) indicate that participants who have both domain and web knowledge would achieve overall more successful searches. Those with strong domain knowledge but lack in web searching knowledge tend to rely heavily on terminology and avoided using search operators and modifiers. Those with lower domain knowledge use less flexible search strategies and tend to return to earlier stages of their searches rather than try new approaches. Cockburn and McKenzie (2001) analyse four months of user actions with Netscape Navigator and found that users revisit web pages often, the pages are visited for a short time period, and large numbers of web pages are book marked. Kim and Allen (2002) study 160 completed search logs by 80 individuals and find that successful search activities and outcomes are strongly influenced by the type of task, techniques use and the ability to formulate search strategies. The above-mentioned information seeking studies therefore demonstrate users' behaviours as they progress through the different stages of recognizing and articulating their information needs.

However, other studies highlight the prerequisites of successful information searches in an electronic environment. This includes users' abilities to properly utilize the electronic information sources made available through the Internet (Kebede, 2002). The available data and information would be minimally used if users are deficient in the skills of utilizing the information. The other factors regarded as barriers to information seeking and use are lack of Internet skills (Dorsh, 2000), readily accessible information (Mecho and Haas, 2001), availability of time (Hollander, 2000; Dee and Blazek, 1993), demographic factors (Dorch, 2000) and user search experience (Hsieh-Yee, 1993; Yuan, 1997).

This study explores the use of the Internet by undergraduates in their final year at the Faculty of Computer Science and Information Technology, University of Malaya. These undergraduates are required to write a nine credit final year project report based on the development of a working system. The types of Internet use, the search strategies formulated, the problems faced and how this behaviour are reflected in the information searching and use skills of undergraduates is the focus of this paper.

COMPUTER SCIENCE AND INFORMATION TECHNOLOGY UNDERGRADUATES

All third year students enrolled in the Bachelor of Computer Science (CS) and Bachelor of Information Technology (IT) at the University of Malaya are required to fulfill a 4 credit part I of their Final Year Project. This is part of a nine-credit course, which extends over two semesters. The first half (4 credit) requires the students to choose a project title, carry out an extensive literature review as well as identify similar systems in the domain they are developing, interview clients, understand their project scope, analyse their project objectives as well as requirements and write these in the first four chapters of their report. Before they began to actually start detailing the proposed design and coding, they also need to identify the most suitable platform, the system architecture and appropriate hardware and software to effectively develop the proposed system. It is at this stage that the students need to know how to locate, obtain and use information.

A total of 470 third year undergraduates were given a questionnaire each and this comprises 70.3% of a total of 669 undergraduates. These students were chosen for the following reason: they form a group faced with a definite problem situation, which requires them to obtain information; they are expected to be computer and Internet literate by virtue of being adequately exposed to the CS and IT programmes for at least 2 years; and they are expected to be information skilled as they have taken a 1-credit course in "Information skill" offered by the University Library in their first year. The undergraduates have also been briefed by the coordinator of the Final Year Project Committee of what is expected in the first half of their report and the Faculty web portal also provide similar details for those who did not attend the briefing session.

In order to obtain a more detailed view of undergraduates information searching and use behaviour, which includes the use of the Internet, a group of 14 undergraduates are used as case studies observing their daily diary entries, their answers to questions

posed by the researcher through emails and from the transcriptions of interview sessions.

The results obtained from a total of 360 (76.5%) usable returned questionnaires and the diary-interview sessions form the basis of this paper to describe the extent of use undergraduates made of the Internet when searching for information in a particular context, so as to be able to write the first four chapters of the final year project report. The respondents comprise 209 in the Bachelor of Computer Science and 151 in the Bachelor of Information Technology programmes. Majority of respondents are female (232, 64.4%) and comes from urban home background (248, 68.1%).

THE INTERNET AS AN INFORMATION CHANNEL

The majority of undergraduates spent a great deal of time surfing the Internet. The undergraduates confirm using the Internet for educational purposes (332, 99%) and for email (327, 98%). Undergraduates recorded high level of satisfaction in using the Internet for these purposes. About 98% (261) of undergraduates confirm downloading files from the Internet. They also use the Internet for chatting (247, 73%) and to play computer games (208, 66%). Emails are mainly used for educational and leisure purposes. Those undergraduates with CGPA of 3.5 and above recorded the highest usage of the Internet. The responses confirm that undergraduates in Computer Science and Information Technology are heavy users of Internet, are satisfied with it, uses it heavily to obtain information and for downloading files.

SOURCES OF INFORMATION USED

The undergraduates use a variety of sources and the most heavily used is the Internet. A total of 325 undergraduates (98.2%) indicated heavy usage of the Internet to obtain information (Figure 1). This is expected as undergraduates exhibit basic characteristics of e-geners or e-generation or "homo zappiens" (Wim Veen, 2002; Wim Veen et al, 2003). They are also heavy users of books, which they bought either from bookstores or through the Internet.

Nearly half (48.8%) would use listservs and e-groups to gather insights and opinions when they are faced with problems. Undergraduates also depend on their supervisors or lecturers to help them solve problems faced.
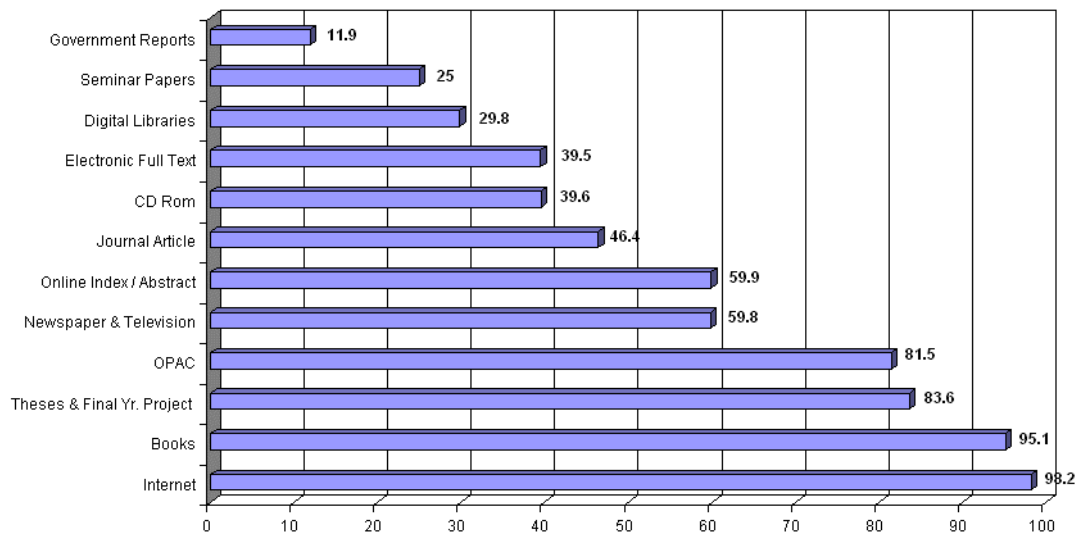
Figure 1: Percentages of Library-Related Sources of Information Used

SEARCH STRATEGIES USED

The undergraduates seem adept at using online resources and are able to employ the correct search strategies using popular search engines. A high number of respondents indicate using keywords (353, 98%), followed by subject search (327, 91%) and Boolean searches (217, 60%). Respondents' academic achievement groupings (Cumulative Grade point average) is not related to their ability in using complex search strategies.

If respondents fail to get sufficient information from the online resources they would adopt the following actions: (a) change their search strategy (301, 83.6%); (b) try using more specific keywords (288, 80%); (c) try using broader keywords (265, 73.6%); (d) check the correctness of the spelling of words submitted (255, 70.8%); (e) consult friends (155, 44.2%) and (f) if all else fail, ask the librarian (33, 9.2%). A few respondents talk to their lecturers or try using different search engines.

If respondents fail to obtain the required results from their searches, they would either see their supervisors (212, 59%); consult their friends (186, 52%); go to other

libraries (185, 51%); leave out the source they could not obtain (53, 15%) or try searching again the Internet at a later stage (36, 10%) or buy the needed books themselves (6, 2%).

The results indicate that undergraduates are versatile as well as resourceful in their information gathering behaviour and possess basic information literacy skills, able to locate and decide which sources of information to use, able to formulate search strategies on the Internet and able to use a variety of information sources to obtain the information needed.

EVALUATING THE INFORMATION OBTAINED

Undergraduates seem able to evaluate information obtained. Only the correct and timely information are utilized as undergraduates are pressured for time to complete the first part of their report within 3 months.

For sources obtained from the Internet, they would validate the correctness by checking the publication date or copyright statement on web pages. They are careful to ascertain that the information is not bias by comparing information with other sources such as books, articles, experts, or check in reference sources. Undergraduates therefore are aware that need to validate the authenticity of information they have obtained by checking with multiple reference sources. This is a trait of an information literate person.

ORGANIZING INFORMATION GATHERED

The undergraduates seem able to organize the information obtained, shaping it into the required report. They organize their proposal chapters according to the guidelines given by their supervisors or instructions that they obtain from the Faculty web portal. They tend to download everything they found relevant from the Internet or other electronic resources in their computer hard disk (137 responses). They also keep a copy of all information in a journal/log book, folders, special file or note book (104 responses) or they keep all bibliographic details in a diskette (103 responses).

Apart from writing references down in a journal or notebook, undergraduates also keep photocopies of printed resources downloaded from electronic resources and keep backup copies in diskettes, CD disks or their hard disk. They would stop collecting information or know when they have had enough when they start finding

duplicate references (173, 48%) or when they obtain more than 10 references (69, 19%) or when time is running out and they have to start writing the report. Over 79% of undergraduates learn how to shape their report by looking at other reports kept at the Faculty library.

The results indicate that undergraduates are skilled in organizing the information they have gathered and shaping it out into a coherent report. Even when they are in doubt, they know where to locate information, which would provide them with the answers. The only problems undergraduates mention facing are deciding, which database to use in their searches, varying the references obtained, interpreting ideas gleaned from the various resources and writing in the English Language.

UNDERSTANDING ETHICAL ISSUES

From a list of five ethical issue statements, undergraduates are asked to give their ratings about ethical issues that accompany the use of information (Table 1). In general undergraduates agree with the statements listed and understand as well as accept that citing sources is a way of according recognition to an author.

Table 1: Level of Agreement amongst Respondents on Information Use

and Ethical Issues

Information Use and Ethical Issue	Agreeable		Fairly Agreeable		Do Not Agree		
	Count	%	Count	%	Count	%	Mean
Information from the Internet can be used if the sources are listed in the references	230	64.6	107	30.1	19	5.3	2.59
Information gathered, analysed and used can be considered new information	161	45.2	168	47.2	27	7.6	2.38
Using information verbatim without listing the source is unethical	186	52.2	117	32.9	53	14.9	2.37
Taking information (cut & paste) from the Internet is wrong	98	27.2	141	39.6	117	32.9	1.95

A total of 130 (42%) undergraduates are able to clearly explain the term plagiarism and some of the definitions given are "copying someone else's work", "copying without permission and putting one's own name", "using information without citing

the references". Respondents are agreeable or fairly agreeable that information on the Internet could be used in their writing if the sources are listed in their list of references at the end of their report (95%). Over 90% of respondents agree that information gathered, analysed and used would bring about new information. A total of 66% of the undergraduates agree that taking information from the Internet verbatim is wrong and that cutting and pasting information from the Internet is wrong.

THE FOURTEEN CASE STUDIES

Part of this study involves closely studying 14 undergraduates, 9 who majored in Computer Science (CS) and 5 in Information Technology (IT). All 14 undergraduates indicate using the Internet, They use the Internet at the initial stage to familiarize themselves with the project title and also use it as a source of information besides conferring with their friends and lecturers. None of them utilize the services available in the University library, or are aware of the inter-library loan or document delivery services. They are unaware of how librarians could help them or doubt that librarians have the ability to help them.

The 14 undergraduates use the Internet because it is a quick way of getting information and it is accessible readily to them. The undergraduates indicate that they are often pressed for time with both academic and non-academic commitments that makes searching in the Internet for information a convenient option. The Internet could be searched between classes, in the evenings and over the weekends. Searches could be carried out on campus, their hostels, and their homes and at cyber cafes. The information obtained could also be saved and read later.

The 14 undergraduates believe that they are getting the most up to date information from the Internet, which provide them with the links to explore other information they are looking for or are unaware of. Every informant feels that the Internet is the ultimate source of information and that information obtained from the Internet is sufficient. Informants claim that, "Internet and books cover 70%-80% of the information I need"; "Internet provide the majority of information, if I want to find other sources it would take a longer time". Figure 2 illustrates the information search process using the Internet as indicated by the 14 informants.

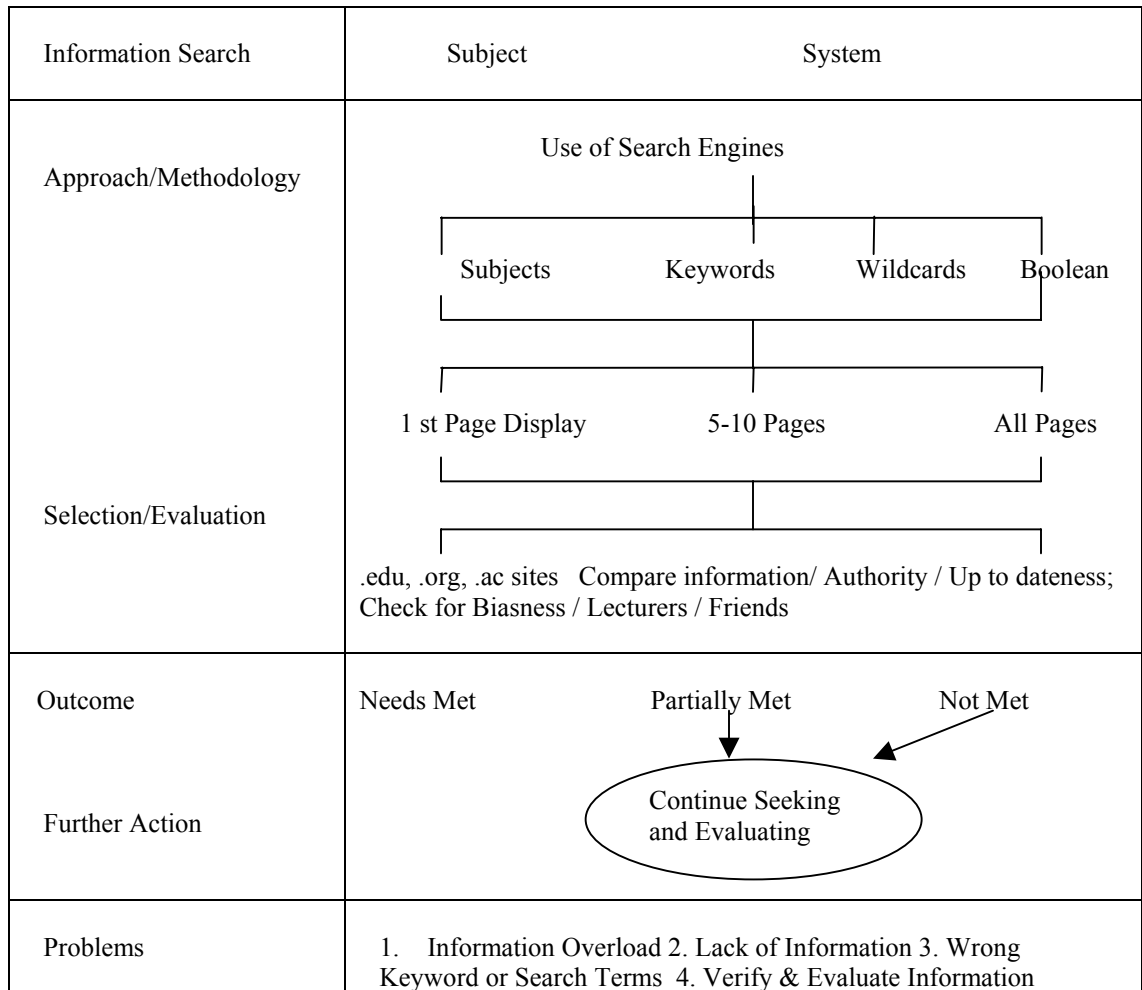| Information Search	Subject	System
Approach/Methodology	Use of Search Engines	
	Subjects Keywords Wildcards Boolean	
Selection/Evaluation	1 st Page Display 5-10 Pages All Pages	
	.edu, .org, .ac sites Compare information/ Authority / Up to dateness; Check for Biasness / Lecturers / Friends	
Outcome	Needs Met Partially Met Not Met	
Further Action	Continue Seeking and Evaluating	
Problems	1. Information Overload 2. Lack of Information 3. Wrong Keyword or Search Terms 4. Verify & Evaluate Information	

Figure 2: Internet as a Source of Information

Some of the informants find the Internet a confusing channel, especially when they receive long listings of web sites when submitting a search by the subject matter of their project title. At times they do feel overloaded and this has lead to problems of selecting and filtering the information obtained. The informants also use various search engines such as Alta Vista, MSN, Web Crawler, Google and others. Most informants prefer using Google, which they perceive to be a good search engine that would provide them with the needed information. Some of the comments

volunteered are: "Alta Vista, Google are the frequent search engines for me. I have learnt the concept and theory of search engines from my e-commerce and cyber law courses"; "My resources are found through long searches using Googles.com." "During my first year our lecturer has exposed us to use Google"; "Google is a good search engine, reliable and dependable most of the time compared to other major ones"; "Google has more references, the hits are more precise".

Informants also appear to be at ease when searching the Internet. A variety of search strategies are used and most of the informants use advance search options such as wild cards and keyword/subject or phrase searching. This is indicated by the following comments, "when I am searching the databases or search engines, I use **. I seldom use Boolean operators since using ** is easier"; "Enter the keywords or phrase in this (+"phrase/keyword") format or use the advance search in those search engines". The informants also indicate the number of pages they would scan from a single hit, from just looking at the first page to going down to 5 to 10 pages or stopping after scanning the first 50 to 100 listings. They do not seem to be worried about getting more hits as they feel that that would give them more choice. Only one informant considered herself to be overloaded with information.

When browsing through web pages they would only use those obtained from .**edu** or .**ac** sites, as they know that these addresses belong to educational institutions that are credible and authoritative. They volunteer clues as to how they verify the correctness of information, such as, "Do not trust a particular web site at a glance. I would browse through a collection of web sites, and then I would decide which web sites are reliable and not bias. I would compare the information on the Net with books to make sure that the information is correct". One informant feels that it is the onus of the user to analyse information obtained and make conclusions "I look over several sources, I never trust one single resource especially from the net. If the information I found are cited in several contents, then I would conclude that the information is reliable and not bias. I also read what others have to say about the topics and from people's ideas and information from these trusted sources, I would make an analysis and form my own conclusion". Most of the informants would also seek the opinion of their supervisors or friends.

Kuhlthau Information Seeking	Eisenberg/Berkowiz Information Problem-Solving (The Big6 Skills)	Irving Information Skills	Pitts/Stripling Research Process	New South Wales Information Process
1. Initiation	1. Task Definition 1.1 Define the problem 1.2 Identify into requirements	1. Fomulation/analysis Of Information need	1. Choose a broad topic	Defining
2. Selection			2. Get an overview of the The topic	
			3. Narrow the topic	
4. Formulation (of focus)			4. Develop thesis/purpose statement	
	2. Information Seeking Strategies 2.1 Determine range sources 2.2 Prioritize sources	2. Identification/appraisal Of Likely sources	5. Formulate questions to guide research	Locating
3. Exploration (investigation Info on the general Topic)	5. Collection (gather Info on The focus Topic)	3. Location & Access 3.1 Locate sources 3.2 Find Info	3. Tracing/locating indiv. resources	6. Plan for research & production
			4. Examining, selecting & Rejecting indiv resources	7. Find, analyse Evaluate resources	Selecting
	4. Information Use 4.1 Engage (read,view,etc) 4.2 Extract info	5. Interrogating/using Individual resources		Organising
		6. Recording/storing info	8. Evaluate evidence Take notes/compile bib.	
6. Exploration	5. Synthesis 5.1 Organise 5.2 Present	7. Interpretation, analysis, Synthesis and evaluation Of information		Presenting
		8. Shape, presentation, and communication of info	9. Establish conclusions/ Organise info in outline	
7. Assessment (of outcome/process)	6. Evaluation 6.1 Judge the product 6.2 Judge the process	9. Evaluation of the assignment	10. Create and present Final product	Assessing

Figure 3: Information Searching Process Models Chosen by Informants (Adapted from Eisenberg & Brown, 1992)

When respondents are shown the information literacy Process Model taken from the Eisenberg and Brown Matrices of Information Skills Models (1992), 6 informants

choose the Eisenberg/Berkowitz Information Problem Solving Model (Big 6 Skills); 3 choose the Pitts Stipling Research Process Model, Kuhlthau Information Seeking and Irving Information Skills were each chosen by 2 persons and 1 choose the New South Wales Information Process Model (Figure 3). The informants believed that these models resemble their information search process. They feel that these models of their choice describe clearly what they had undergone for their final year project.

CONCLUSIONS

The undergraduates in Computer Science and Information Technology are adept at using computers. Hence it is not surprising that using the Internet to locate and obtain information comes naturally to them and is their first choice of information channel. This is also true of the 14 informants who are interviewed and studied closely by the researcher, most of whom indicate being exposed to using the computers since they were fifteen. They aptly fit the characteristics of Wim Veen's (2003) e-generation or N-geners. They use the e-mail and mobile phones to communicate, are skilled at using the Internet, actively involving themselves in online communities, skillful at downloading videos, music as well as free software and programmes over to their computers and are capable of locating information from electronic or virtual libraries. This rampant use of technologies would unquestionably change the nature of their use of the library for learning. They seems to have developed the following skills; (a) fast scanning skills; (b) able to multi-task; (c) able to handle discontinuity; and (d) able to learn through a non-linear approach.

The typical course of action, which seems to be displayed by the survey respondents are as follows. They would choose a topic either suggested by their lecturer or themselves. Before making their decision they would scan the Internet for information or read anything that they can find on the topic they intend to pick. Once they have picked the topic they would again glean through the Internet for information, looking at .org and .edu and .ac web sites as well as digital libraries subscribed by the University library. They would use the Internet because it is readily available from all laboratories in the Faculties, or they can use it from their hall of residence, from their homes or cyber cafes. They choose the Internet because they feel that it is the quickest method of providing them with the information they need. Time is the main issue since they are often stress for time due to other assignments and non-academic commitments. If they were not happy with the information they have collected, they would seek their supervisors or friends' advice. Some would try searching the Internet again. The undergraduates behaviours

concurs with the findings of Cmor and Lippold (2001) who observe that students use the Web for "everything" and would spend hours searching or just a few minutes.

The most popular search engine they use is Google and Alta Vista because they have been exposed to using these search engines in one of their course. This is similar to the findings by Griffth and Brophy (2002) where 45% of the students studied uses Google. They are adept at searching, able to formulate searches by subjects, wildcards and Boolean operators. Navarro-Prieto et al (1999) observe that Computer Science students are able to describe the workings of search engines but few know how search engines use the queries to search for information. The 14 informants from the current study use the top-down strategy (Narro-Prieto, 1999) where they would submit general terms first and then narrow down the search from links provided until what they are looking for is found. They are discriminate in their selection and evaluation behaviour. Some would just look at first page displays, while others would browse though up to 10 pages. This result indicates that the undergraduates have a higher "staying power" compared to other studies which indicate users do not view more than 10 results (Hoelscher, 1998; Silverstein et al, 1999). Everything they find would either be book marked or downloaded either on to their hard disk, diskette or CD-ROM. They would also print what ever they find to read these at leisure. Every information are studied and analysed, They would verify the authenticity of the formation obtained by either checking in books, see if similar information are referenced in other web pages, email the author or the publisher of the information or seek advice from their supervisors. Their subsequent course of action depends on whether they perceive to have gathered all that they need. They would know when they have collected enough information when they start to retrieve duplicate information or when they are close to the submission date. If they feel that the information they have gathered are not sufficient, they would continue searching and evaluating information. Before they begin to start writing their report, they would check for instructions from the Faculty portal concerning "Final Year Project Report" or "Latihan Ilmiah" as well as look at other project reports in the Faculty Library. Some respondents would follow the instructions given by their supervisors in the hope that they would be able to obtain better grades. They respondents are aware that they should make a reference to sources of information they obtain from the Internet or other electronic resources. They generally know that it is wrong to "cut and paste".

In general the undergraduates in Computer Science and Information Technology at the University of Malaya show a high level of information literacy in locating, evaluating as well as using the information they obtain from the Internet and this is

reassuring. This is clearly indicated by informants understanding of life long learning, that places emphasis not on the amount of information but rather the ability to interpret and use the information obtained. This sums up their literacy skill. However, their lack of faith in the library or the librarians' ability to help them when in problematic situations need to be addressed in order to acquire the necessary quantity and quality information needed for their academic writing.

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