How Students Search for Consumer Health Information on the Web

Efthimis N. Efthimiadis, PhD
Information School
University of Washington
Seattle, WA, USA
efthimis@u.washington.edu

Abstract

This study investigates how undergraduate and graduate students search the web for consumer health information. The 32 participants were asked to find answers to four health related topics. Data was collected through pre- and post search questionnaires, think-aloud protocol, and transaction logs. The results presented focus on the search process as a whole and by question and on the user satisfaction.

1. Introduction

American internet users have been consistently searching the web for health information and they do so in large numbers. The Pew Internet research studies of 2002, 2004, and 2006 showed that the same proportion of about 80% of American searchers seeks health related information [1-3]. This is about 113 million adults, 18 years or older, in 2006. Based on Pew's survey 7% of health information seekers searched for a health topic on a typical day in August 2006, which is about the same frequency with which searchers do other transactions online, such as, paying bill, or reading blogs.

Despite the large numbers of health information seekers and the importance and impact that such information has on individuals most research seems to have focused on the credibility [4-6] and quality of information resources [5-10], and relatively little research has been conducted on issues, such as, how people search, the types of information sought, health information seeking behaviors, and impact to health care [11-14].

1.1. Goals and objectives

This study investigates how graduate and undergraduate students search the web to find answers to questions relating to consumer health information. The goals of the research were to study:

- What is the starting point of a search, that is, do they start using a general search engine or a health related engine or directory?
- How students formulate and refine queries
- How they search and evaluate results
- How they evaluate websites
- The types of sources consulted by the searchers
- How familiar they were with the subject, and how that affected their search experience and satisfaction with the resutls.

1.2. Background

Lorence *et al.* studied the problems encountered by health information consumers who have unequal access to information [12]. They also looked into how consumers form self selected subgroups in web-based discussion forums to share information on unsettled diagnostic methods or ambiguous treatment protocols [15]

Zeng *et al.* conducted a study in which they asked health consumers to search for health information on the Internet after first stating their search goals. Upon the conclusion of the session searchers were asked to evaluate their searches. The results of the study showed that many consumers were unable to find satisfactory information when performing a specific query, while in general they group viewed health information retrieval on the Internet in a positive light [13].

Toms and Latter [11] observed users, drawn from the general public, search Google to find answers to four health questions, two of their own choice and two that were pre-chosen. They concluded that searchers had problems in query formulation in selecting from the results lists.

In a study that looked at the provision of consumer health information in public libraries it was found that there are many barriers to the use of public libraries by health care consumers. Once a person has decided to try the public library as an avenue for searching for health information, interactions with library staff may pose some challenges, both for the library user and for the librarian at the reference desk. The study concluded that perceptions and expectations on both sides often differ and recommended that awareness of these issues can be helpful for both parties, as well as training, Web resources, and outreach to consumers [16]. Such findings emphasize the importance of studying how consumers search for health information, especially, how they formulate queries and evaluate results.

2. Methodology

2.1. Study Subjects

Thirty-two subjects were recruited from the student population of the University of Washington: a group of graduate students and a group of undergraduate students. Recruitment was conducted via email postings to campus list servers, and printed posters on campus bulletin boards.

2.2. Search Task

Subjects were asked to find answers to four questions in the consumer health information area. These tasks are based on the tasks devised by the TREC 10 Interactive Track (http://trec.nist.gov) and were further modified for this research. All four tasks were fully specified and participants were instructed to search them and find websites that provide the answers to the questions. The four questions were:

Question 1: Tell me three categories of people who should or should not get a flu shot and why.

Question 2: Find a website likely to contain reliable information on the effect of second-hand smoke.

Question 3: List two of the generally recommended treatments for major depression.

Question 4: Identify two pros and cons of taking large doses of aspirin.

2.3. Procedure

At the beginning of each session, subjects filled out a questionnaire that collected demographic information, educational background, and experience with searching. After each question was searched, the subject answered a questionnaire measuring satisfaction with the search, reliability issues with respect to the website and information sources found.

The order for searching the questions was alternated in order to reduce the learning effect. The block design used is given below. This was used in its entirety and repeated for multiples of users for each of the two groups:

$$1\ 2\ 3\ 4$$
$$2\ 3\ 4\ 1$$
$$3\ 4\ 1\ 2$$
$$4\ 1\ 2\ 3$$

The subjects' search activity was monitored in different ways and is discussed below.

2.4. Data Collection Instruments

WebQ [17], one of the Catalyst tools developed by the University of Washington's Learning & Scholarly Technologies, was used to generate the pre- and post- questionnaires that were administered online, collected data electronically, and helped with data formatting for analysis.

During each search session, the searcher's interaction with web resources was tracked, that is, the queries typed and the URLs of the different websites the searcher visited. Tracking was accomplished via the use of a modified version of URL Tracer [18], an application that keeps track of the URLs accessed during a search session and archives them into a file. This information can then be studied to analyze individual search patterns and compare across groups and questions. Figure 1 provides an example of the data collected.

The think aloud process was also employed. Subjects were asked to verbalize and describe what decision making steps they were making during their search. This included search strategies, website evaluation, and question interpretations. The notes from the think-aloud

engineering major, two business students, and two comparative literature majors. The age range of the undergraduate group was between 19-27 years old, with about 75% between the ages 20-23, or 95% between the ages of 19-24. The graduate group age ranged from 21-52

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Sequence #, Date, Time, URL accessed & query/command, browser event
1,"date","time","http://www.ischool.washington.edu/","Window_Main"
2, "date","time","http://www.yahoo.com/", "Window_Main"
3," date","time ","http://dir.yahoo.com/Health/","Window_Main"
4," date","time ","http://www.google.com/","Window_Main"
5," date","time", "http://www.google.com/search?hl=en&q=%22teatments+for+depression%22&btnG=Google+Search","Window_Main"
6," date","time", "http://www.google.com/search?hl=en&q=%22treatments+for+depression%22&spell=1","Window_Main"
7," date","time ","http://www.treatments-for-depression.com/","Window_Main"
8," date","time ","http://www.treatments-for-depression.com/html/pop.html","Window_New"
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Figure 1: Sample of transaction log data collected

process were analyzed to better understand the cognitive steps of the searchers.

2.5. System set up

The set up for the searches was controlled for all participants. A Windows-based PC was used and participants accessed the web through the Internet Explorer (IE) browser, which was set up to the default home page of the University of Washington's Information School.

This was the default starting point for all participants, who were then left on their own to search and navigate the web in pursuit of answers to the questions.

3. Results

The results presented focus on the search process as a whole and by question and on the user satisfaction.

3.1. Subject Characteristics

The pre-search questionnaire data collected using WebQ was exported to Excel spreadsheets for analysis.

The pre-search questionnaires elicited demographic information and experience with searching at different levels and systems. The graduate students group was composed of eleven females and five males, all part of the Master of Library and Information Science (MLIS) program of the Information School. The undergraduate group was represented by thirteen males and three females, twelve with a science or

years, with about 25% 30 years or younger, 40% between 30-35 years, 15% between 35-40, and 20% between the ages of 49-52. As expected the age group of the undergraduates is concentrated to a five year window, whereas the graduates are spread wide between their late twenties to the late forties.

The age differential contributes to their experiences and helps explain the responses regarding search patterns and use. When asked how often they conduct a search of any kind, 87.5% of undergraduates and 72.2% of graduates responded "daily" and the remaining 12.5% and 27.8% respectively responded 1-2 times a week. Age was a factor in search use, though 100% of both groups responded of using the computer daily for work or personal purposes.

The responses with respect to familiarity with different search systems showed that 100% of both the undergraduates and graduates were very familiar with web search engines. Differences were observed when reporting use of OPACs and scientific databases from vendors like Dialog, Proquest, or PubMed. Between 75%-87% of undergraduates reported some or no experience using OPACs, while the range for graduates was 28-33%. Similarly, about 7% of undergraduates reported average or a great deal of familiarity with scientific databases, as opposed to about 28% of graduates.

When asked for who do they search 81.3% of undergraduates and 94.4% reported searching for themselves or others, while 12.5% of undergraduates and 5.6% of graduates reported searching only for themselves.

3.2. Searchers' First Destination

All subjects started their search task using the IE browser which was set to the Information School homepage as the default. From that point subjects made a choice to navigate to a web resource in order to start their search. This is their first search strategy destination choice. For each of the four questions the URLs for the first

About 10% of the graduates and 7% of the undergraduates turned to local University of Washington resources first. Not-for-profit professional organizations were the starting point for about 10% graduate and 3% undergraduate students. Finally, government sites were used by 7% graduate and 3% undergraduate students.

Table 1: Categories and examples of first destination websites

Categorization	Example Sites Included	Explanation
Commercial* - Internet Directory	about.com msn.com yahoo.com	**A collection of links** and subject categories created, mostly by humans, to address specific topics.
Commercial* - Medical Information	aspirin.com secondhandsmoke.com	Web sites **created specifically to give medical information**. These sites were created by **corporate entities**.
Commercial* - Medical Internet Directory	health.com webmd.com	Similar to first category, except has an **explicitly health-care focus**.
Commercial* - Search Engine	ask.com google.com	Search Engine – **non-human made**, does not feature human-made directories or collections of links.
Government** - Internet Directory	healthfinder.gov	Human-made **collection of links** and subject categories created to address specific topics.
Government** – Medical	cdc.gov nih.gov	**Federal Government Agency** that serves the health and medical fields, e.g., *Centers for Disease Control* and *National Institutes of Health*.
Government** - Medical Search Engine	medlineplus.gov	Similar to search engine; searches **medical literature (*PubMed*) exclusively**
Health Care Organization	ghc.org	Non-profit **health care organization**
Medical Association	ama-assn.org lungusa.org	Non-profit medical associations: e.g., *American Medical Association* & *American Lung Association*
Political Advocacy	thetruth.com	*The Truth* Anti-Smoking political advocacy campaign organization.
University of Washington	washington.edu	University of Washington main portal.
University of Washington – Main Library System	lib.washington.edu	University of Washington – Main Library System
University of Washington – Health Library	healthlinks.washington.edu	University of Washington – Health Sciences Library portal

search strategy destination was extracted and categorized. Table 1 shows the categories that were developed together with examples for each. The categories can be further grouped into four broad categories: commercial, government, not-for-profit organizations, and University of Washington (local or other .edu) resources.

The results are given in Table 2 where we see that 61% of graduate and 71% of undergraduate students started off their search task by going to a search engine. The second, but rather distant, starting point was the directory-based search with a combined 17% for commercial and government directories for the graduate students and a negligible 2% for the undergraduates.

Table 2: Searchers' first search destination choice

First Search Strategy Destination Choices			
Web Site Type	Graduates	Undergrad	Total
Commercial - Internet Directory	12%	2%	7%
Commercial - Medical Information	0%	3%	2%
Commercial - Medical Internet Directory	3%	2%	2%
Commercial - Search Engine	61%	81%	71%
Government - Internet Directory	5%	0%	2%
Government - Medical	2%	3%	2%
Government - Medical Search Engine	0%	0%	0%
Health Care Organization	5%	0%	2%
Medical Association	5%	0%	2%
Political Advocacy	0%	3%	2%
UW	2%	2%	2%
UW - Library	3%	5%	4%
UW - Medical Library	5%	0%	2%
Total	100%	100%	100%

3.3. Search Length & Website Visitations

Time to complete each search task was logged for all searchers. Figure 2 shows the average time in minutes and seconds for each of the four questions by group. The three bars in the figure show average time, the left bar is the average for both groups, the middle bar for the undergraduates, and the right bar for the graduates. The same order appears in all figures presented in this section.

From Figure 2 we see that time taken to complete the searches, for the flu and smoke questions, is about the same for both groups. We also observe that time taken to complete the question on depression is about twice as long for both groups, while there is a threefold increase in time for completing the aspirin search task. This is an indication of the difficulty of the latter questions, something that was acknowledged by the searchers in their responses in the post search questionnaires.
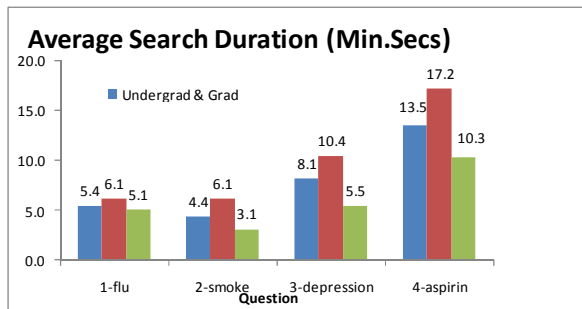

Figure 2: Average search length

During the search task subjects accessed many websites and visited many of their web pages. For the purposes of this study a website is the base URL of a site, e.g., www.nih.gov, and a web page is a page in the same site, e.g., www.nih.gov/health/infoline.htm.

Figure 3 presents the average number of websites (base URLs) accessed for each question by the subjects. Figure 4 shows how many web pages were visited on average for each question.

The questions on flu and smoke are almost the same for both groups with an average of 3.9 and 3.8 websites and 12.3 and 11.1 web pages respectively. As the questions on depression and aspirin took longer to complete, these resulted in more website visits 6.1 and 7.8, with 26.2 and 36.8 web pages respectively. It is worth noting that the undergraduates visited close to 50% more web pages than the graduates for the

depression question and 100% more web pages for the aspirin. This is an indication of increased difficulty in answering these two questions for the undergraduates.
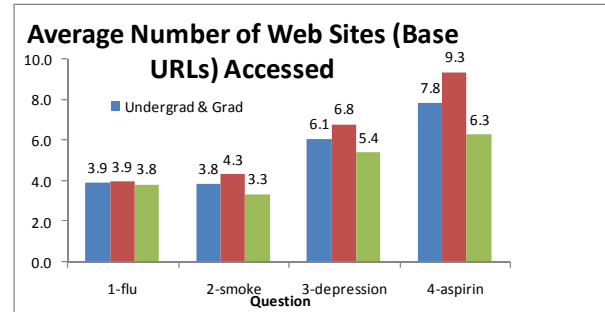

Figure 3: Average number of Web sites visited
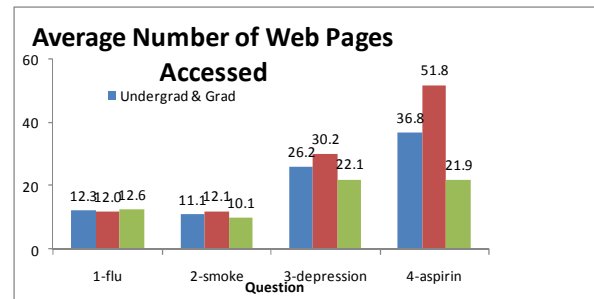

Figure 4: Average number of web pages visited

The number of browser windows a searcher opens often provides an indication of multi-tasking search behavior. The average number of additional windows opened for parallel interaction during the search for all questions were 1.2 for the undergraduates and 1.5 for the graduates. It seems that the more difficult the questions the more multiple windows were opened. For example, depression had an average of 1.9 windows by the undergrads, while aspirin had 2.6 windows for the graduates. Similarly, flu had 0.8 windows for the undergraduates while smoke had 0.5 for the graduates.

3.4. Query Formulations & Search Terms

The average number of queries per question for the undergraduates ranged from 1.6 for flu, to 2.1 for smoke, to 2.5 for depression, and to 5.9 for aspirin (Figure 5). The corresponding range for the graduates was 1.9, 1.6, 2.8 and 4.7. The

average number of queries by group was 2.8 for graduates, 3.0 for undergrads, and 2.9 for both.

It is again observed that the number of queries increased with the difficulty of the questions. Although the number of queries per question and by group is rather small the subjects generated many terms as seen in Figure 5, as well as visited quite a large number of web pages (Figure 4).

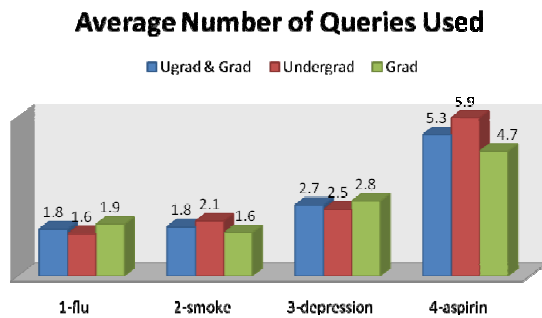The average number of search terms used by group was: graduates 9.3, undergraduates 7.7, both 8.5 (Figure 6).

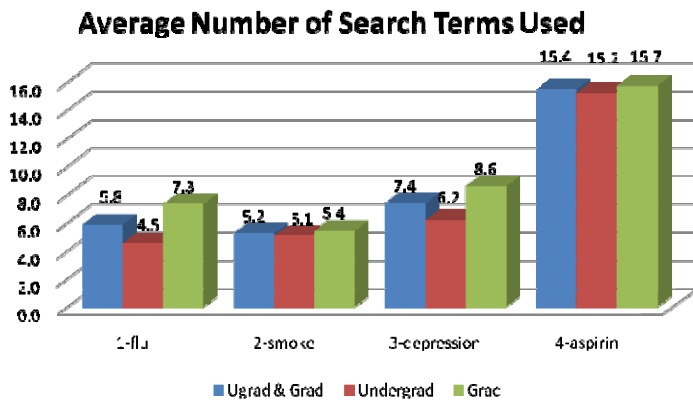**Figure 5: Average number of search terms used**

Figure 6: Average number of queries used

Table 3 lists the top then terms used by the subjects in their queries. The terms were left as entered by the subjects, that is no stemming or stop words lists have been applied. The main concept of each question is at the top of the rank. Overall there were 241 search terms used in the queries for question 1 (flu), 252 for question 2 (smoke), 291 terms for question 3 (depression), and a stunning 688 terms for question 4 (aspirin).

3.5. Familiarity with the Topics and Searcher Satisfaction

Following the completion of each search subjects filled out a post-search questionnaire which elicited information on the subjects' familiarity with the topic, their search experience and satisfaction. The results are summarized in the five sections of Table 4.

Both graduates and undergraduates felt in their majority somewhat familiar with the topics on flu and smoke (Table 4, section 1). There was a difference in depression and aspirin, with the graduates denoting more knowledge on those two topics.

Table 4 section 2 presents the searcher perceptions on planning and searching for the four topics. The topics on flu and smoke were easiest to plan for both groups, whereas depression and aspirin was more challenging to plan for both groups.

Similarly, both groups felt that the first two topics were "extremely" easy to search, whereas the last two somewhat easy.

Table 4 section 3 presents searcher satisfaction with search time and results. Undergraduates were "extremely" satisfied with the results found in all four questions. The graduates, on the other hand, were in their majority satisfied but more conservative than the undergraduates.

Table 3: Top ten query terms per question

q1 - flu		q2 - smoke		q3 - depression		q4 - aspirin	
Terms	Total	Terms	Total	Terms	Total	Terms	Total
flu	67	smoke	58	depression	90	aspirin	208
shots	30	hand	27	major	39	large	61
shot	28	second	27	treatment	33	and	51
health	12	second-hand	17	treatments	24	dose	45
get	10	secondhand	13	and	17	doses	41
should	8	american	12	health	8	of	31
who	7	association	11	recommended	8	pros	27
a	6	lung	11	for	7	cons	22
public	6	effects	9	american	6	high	14
not	4	and	8	mental	5	effects	12

Table 4: Responses to post-search questionnaires

Table 4, Section 1: Familiarity with the subject matter of the query

Are you familiar with this topic?								
	Q1-flu		Q2-smoke		Q3-depression		Q4-aspirin	
	Undergrad	Graduate	Undergrad	Graduate	Undergrad	Graduate	Undergrad	Graduate
1 - Not At All	6.3%	23.5%	6.3%	5.9%	25.0%	0.0%	12.5%	0.0%
2	31.3%	11.8%	25.0%	29.4%	25.0%	12.5%	43.8%	18.8%
3 - Somewhat	37.5%	52.9%	31.3%	58.8%	31.3%	31.3%	37.5%	12.5%
4	12.5%	5.9%	31.3%	0.0%	12.5%	37.5%	6.3%	62.5%
5 - Extremely	12.5%	5.9%	6.3%	5.9%	6.3%	18.8%	0.0%	6.3%

Table 4, Section 2: Planning and searching the topic

Was it easy to plan this search?								
	Q1-flu		Q2-smoke		Q3-depression		Q4-aspirin	
	Undergrad	Graduate	Undergrad	Graduate	Undergrad	Graduate	Undergrad	Graduate
1 - Not At All	0%	5.9%	0%	0%	6.3%	0%	6.25%	6.3%
2	0%	29.4%	0%	5.9%	18.8%	18.8%	18.75%	31.3%
3 - Somewhat	18.8%	35.3%	12.5%	17.6%	37.5%	37.5%	56.25%	37.5%
4	56.3%	29.4%	50.0%	35.3%	31.3%	37.5%	6.25%	18.8%
5 - Extremely	25.0%	0.0%	37.5%	41.2%	6.3%	6.3%	12.50%	6.3%

Was it easy to do the search on this topic?								
	Q1-flu		Q2-smoke		Q3-depression		Q4-aspirin	
	Undergrad	Graduate	Undergrad	Graduate	Undergrad	Graduate	Undergrad	Graduate
1 - Not At All	0%	0%	0%	0%	12.5%	0%	12.50%	0%
2	6.3%	0%	0%	0%	12.5%	18.8%	25.00%	18.8%
3 - Somewhat	31.3%	23.5%	18.8%	23.5%	31.3%	50.0%	43.75%	37.5%
4	18.8%	47.1%	37.5%	23.5%	25.0%	18.8%	12.50%	37.5%
5 - Extremely	43.8%	29.4%	43.8%	52.9%	18.8%	12.5%	6.25%	6.3%

Table 4, Section 3: Searcher satisfaction with search time and results

Are you satisfied with your search results?								
	Q1-flu		Q2-smoke		Q3-depression		Q4-aspirin	
	Undergrad	Graduate	Undergrad	Graduate	Undergrad	Graduate	Undergrad	Graduate
1 - Not At All	0%	0%	0%	0%	0%	0%	0%	0%
2	0%	0%	0%	0%	12.5%	25.0%	12.5%	6.3%
3 - Somewhat	18.8%	11.8%	6.3%	5.9%	31.3%	25.0%	31.3%	18.8%
4	31.3%	29.4%	43.8%	64.7%	25.0%	37.5%	25.0%	62.5%
5 - Extremely	50.0%	58.8%	50.0%	29.4%	31.3%	12.5%	31.3%	12.5%

Are you satisfied with the time it took to complete the search?								
	Q1-flu		Q2-smoke		Q3-depression		Q4-aspirin	
	Undergrad	Graduate	Undergrad	Graduate	Undergrad	Graduate	Undergrad	Graduate
1 - Not At All	6.3%	0%	0.0%	0%	12.5%	6.3%	12.5%	0.0%
2	6.3%	5.9%	0.0%	0.0%	12.5%	18.8%	12.5%	18.8%
3 - Somewhat	18.8%	11.8%	12.5%	5.9%	43.8%	37.5%	43.8%	37.5%
4	25.0%	29.4%	25.0%	47.1%	12.5%	25.0%	12.5%	31.3%
5 - Extremely	43.8%	52.9%	62.5%	47.1%	18.8%	12.5%	18.8%	12.5%

Table 4, Section 4: Searcher perception of accuracy and reliability of results

Did you find an answer to the question?								
	Q1-flu		Q2-smoke		Q3-depression		Q4-aspirin	
	Undergrad	Graduate	Undergrad	Graduate	Undergrad	Graduate	Undergrad	Graduate
Yes	100%	100%	100%	100%	100%	87.5%	100%	87.5%
No	0%	0%	0%	0%	0%	12.5%	0%	12.5%

To your opinion, is this answer correct?								
	Q1-flu		Q2-smoke		Q3-depression		Q4-aspirin	
	Undergrad	Graduate	Undergrad	Graduate	Undergrad	Graduate	Undergrad	Graduate
Yes	100%	88.2%	100%	94.1%	75.0%	81.3%	75.00%	62.5%
No	0%	0%	0%	0%	0%	0%	0%	12.5%
I Don't Know	0%	11.8%	0%	5.9%	25.0%	18.8%	25.00%	25.0%

In your opinion, how reliable are the websites where you found the answer?								
	Q1-flu		Q2-smoke		Q3-depression		Q4-aspirin	
	Undergrad	Graduate	Undergrad	Graduate	Undergrad	Graduate	Undergrad	Graduate
1 - Not At All	0%	0%	0%	0%	0%	6.3%	0%	6.25%
2	0%	0%	0%	0%	12.5%	6.3%	12.50%	6.25%
3 - Somewhat	6.7%	5.9%	6.3%	5.9%	37.5%	31.3%	37.50%	37.50%
4	53.3%	47.1%	56.3%	58.8%	25.0%	12.5%	25.00%	25.00%
5 - Extremely	40.0%	47.1%	37.5%	35.3%	25.0%	43.8%	25.00%	18.75%

Table 4, Section 5: Searcher familiarity with SE used

Were any of the search engines you used new to you?								
	Q1-flu		Q2-smoke		Q3-depression		Q4-aspirin	
	Undergrad	Graduate	Undergrad	Graduate	Undergrad	Graduate	Undergrad	Graduate
Yes	0%	5.9%	18.75%	11.76%	6.3%	6.3%	6.25%	25.00%
No	100.00%	94.1%	75.00%	82.35%	93.8%	93.8%	93.75%	68.75%
No answer	0%	0%	6.25%	5.88%	0%	0%	0%	6.25%

Both groups were satisfied with the time it took to complete the first two topics. However, both expressed concern about the time it took to complete the last two searchers.

Table 4 section 4 presents the searcher perception of accuracy and reliability of the results. All undergraduates felt that they have found the answer to all questions, whereas about 12.5% of the graduates had some reservation for the last two questions.

When asked if the answer found was correct, graduate students had reservations on all four questions that ranged from 5.9% for smoke to 25% for aspirin. A quarter of the undergraduates expressed reservation only for the last two questions.

The undergraduates in their majority felt that the websites where they found the answers were reliable for the first two questions. However, they were more conservative for the depression and aspirin questions. The graduate students again expressed more reservation across the board.

4. Conclusions

Searching the web in general [19] and for consumer health information in particular is a challenging process [11, 13, 14].

This study investigated how undergraduate and graduate students search the web for consumer health information. The 32 participants were asked to find answers to four health related topics: flu, smoke, depression, and aspirin. As the result show the majority of the subjects chose a search engine to start their search. The length of search time was a good indicator of the difficulty of the topic. Similarly, the longer it took the higher the number of web pages visited to find an answer.

The opinions of undergraduate and graduate students differ in many areas, especially relating to the mechanics of searching. The graduate students expressed more reservation with respect to the search process and their satisfaction with the results. Undergraduates thought that planning and searching was rather easy.

An examination of the queries used by the subjects shows that many had problems in formulating queries.

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