Undergraduate students' information search practices

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Abstract. This paper investigates undergraduate students' information search practices. The subjects were 250 undergraduate students from two university departments in Greece, and a questionnaire was used to document their search practices. The results showed that the Web was the primary information system searched in order to find information for university assignments, while the level of database searching was very low. In particular, the search engine Google was used very frequently either for university assignments or for personal purposes. Regarding students' practices in evaluating Web-based information, the top criteria reported were 'relevance of information' and 'easy to understand'. Students' self-efficacy concerning Web-searching was found to be high and positively related to the variables 'frequency of Web use' and 'years of internet use'. Implications for students' training are discussed. Students' search behaviour needs to be expanded beyond the Web search engines, to include a wider range of information retrieval systems.

Keywords: Information search practices, Web, Databases, Undergraduate students, Search engines

Introduction

There is a lot of information available in the 21st century that is increasingly being made available electronically. One of the internet uses in education is the access to and searching of databases of information compiled by others, including the Web. The internet is being used by undergraduate students to access Web-based course materials, large databases and library resources (Detlor & Lewis, 2006; Owston, 1997; Wang & Wu, 2008). The World Wide Web (WWW or Web, for short) as a specific internet application provides access to a vast quantity of different types of information (text, graphics, video etc.) and its contents are unknown and continually changing. There is a growing body of research regarding students' Web or databases use in university education (Mackey & Ho, 2008; Shanahan, 2008). Academics have been encouraged to transform their approaches to teaching and learning away from the traditional transmission approach to one where the emphasis is on supporting students to become independent learners (Ramsden, 2003). Independent learning requires, among others, from students to be able to autonomously search and obtain information from appropriate resources to meet their learning needs, as well as to evaluate sources and information before using them (Walraven, Brand-Gruwel, & Boshuizen, 2009). Undergraduate students are often asked to search for information online in order to complete their university assignments (Detlor & Lewis, 2006) and they are also searching the Web for personal purposes.

This paper aims to investigate undergraduate students' information search practices and their self-efficacy concerning Web-searching.

Literature review

Students using information retrieval systems

University libraries enable students to access online catalogues, electronic journals, subscribed resources and other electronic or printed content, thus supporting users' information seeking practices. University libraries are using electronic journals, which have the advantage over hard copy in that most allow more than one student to use a journal at the same time and, as with all online information, they can generally be accessed from a location that suits the student (Bond, 2004). Undergraduate students use a limited range of electronic information resources to meet their learning needs. Research (Griffiths & Brophy, 2005; Urquhart et al., 2005) has shown that undergraduate students are dependent on the internet/ Web with the vast majority of them (over 70%) reporting they use search engines as their primary search method, while databases and e-journals are much less frequently used (by only 1-10% of students). Brophy and Bawden (2005) investigated whether searching the Web using the search engine 'Google' could replace database searching for typical undergraduate student research queries: they examined the information retrieved from Google and database searches in terms of both quality of information retrieved and coverage of the topic area. Their study demonstrated that a large number of search results were indexed by only one of the search systems, therefore both Web and database searching are required to comprehensively cover topic areas. Additionally, they showed that database searching yielded a higher percentage of good quality documents (84%) than Google (52%). According to Detlor and Lewis (2006), libraries face stiff competition from search engines like Google and Alta Vista: for example, Google's forays into scholarly content and mass digitization have diminished the already murky distinctions between libraries and commercial services even further. Shanahan (2008) designed an intervention in order to transform information searching and information evaluation behaviour of undergraduate students, in the health sector. She found that after the intervention a greater percentage of students searched more databases (in comparison to their pre-intervention searches), the frequency of searching databases was increased, and students used more criteria to evaluate information retrieved from the internet.

Students using Web search engines and evaluating Web-based information

The internet search engines are an available-good choice when users are searching for specific information because they work through continuous automatic trawling of the Web and adding to an immense database which is continually creating new categories of information and always growing. Research has shown that university students and adults face difficulties when searching for information on the Web, while a problem is evaluating search results, and evaluating and selecting sources and information (Brand-Gruwel, Wopereis, & Vermetten, 2005; Monereo, Fuentes, & Sànchez, 2000).

The difficulty in finding specific information on the Web is due to the growth and diversity of information held and the way the information is organised. Although there are several search engines that make Web searches little easier, there are still navigational problems for the students because intelligent search strategies are needed to enable them to obtain access to appropriate resources and information (Lazonder, 2000): "Present day Web browsers and search engines still perform merely the routine actions of a search, leaving the brainwork to the user" (Lazonder, ibid. p.326). Fullick (1998) listed a range of internet skills such as

'finding Web documents using search engines', 'locating information using a range of strategies', and 'evaluating the likely usefulness of information'.

Evaluating the quality of retrieved documents is an important procedure of successful information searching when using the internet/ Web. The Web is easily accessible and students are seduced to cut and paste the information without evaluating it (Grimes & Boening, 2001). Earlier research (Burton & Chadwick, 2000) showed that undergraduate and research students' preferred top three criteria when evaluating internet-based sources were 'source is easy to understand', 'source is easy to find' and 'source is available'. Others (Meola, 2004; Doyle & Hammond, 2006) also showed that undergraduate students cite low quality Web resources, indicating that they do not critically evaluate Web resources: for example, they rate 'ease of access' and 'information that is easy to understand' as the top criteria they use to evaluate internet sources.

Students' self-efficacy concerning Web-searching

Self-efficacy is an individual's belief in his/her own ability to successfully perform tasks of a particular domain (Bandura, 1993). Internet self-efficacy has been defined as individuals' perceptions/ beliefs about their own abilities toward using the internet (Tsai & Tsai, 2010). The researchers designed and used a subscale that assesses/evaluates one's perceptions about his/her own abilities toward online exploration: they investigated high school students' explorative internet self-efficacy (Tsai & Tsai, 2010). Their subscale was used in this study in order to investigate undergraduate students' self-efficacy concerning Web-searching (this is discussed in the research instrument section). In this paper, we use the terms self-efficacy and confidence as synonymous.

Earlier research on students' self-efficacy concerning Web-searching, supported that increasing the time and experience involving using the internet helps students to improve their internet self-efficacy (Tsai, Lin & Tsai, 2001; Tsai & Tsai, 2010). Kaya & Durmuş (2010) found that undergraduate student teachers who frequently used the internet for research had high perceived internet self-efficacy: those who 'always' used the internet reported higher self-efficacy than that of the students who 'usually' or 'sometimes' used it. Additionally, students studying in the fourth grade had higher self-efficacy than those studying in the first grade (this was attributed to their acquisitions from the computer courses throughout their studies). Liang & Tsai (2008) showed a moderate level of internet self-efficacy among pre-service teachers. University students' self-efficacy and attitudes toward the internet have been identified as important factors that affect learners' motivation and performance in internet-based learning environments (Peng, Tsai, & Wu, 2006).

Methodology

Objectives of the study

The research objectives were:

- to identify students' information search practices;
- to identify students' practices in evaluating Web-based information;
- to investigate students' confidence/ self-efficacy concerning Web-searching.

Sample

The participants were 250 undergraduate students of two university departments from different universities in Athens, Greece (137 came from a pedagogic department and 113 from a psychology department). 92% were female, while the majority of the sample (81%) belongs to the age group of 18-21 years old. Table 1 shows the demographic characteristics of the sample. Almost all students have access to a computer at home, with an internet connection, while 66% of the sample has been using the internet for more than three years. Most of the participants spend either "more than an hour per day" or "several hours per week" using the Web (38% and 43% respectively).

The research instrument

A questionnaire was used to document students' information seeking practices. We adapted parts of the questionnaire used by Shanahan (2008), who administered it with undergraduate students studying medicine. Information search practices were assessed using a five point scale of self-reported frequency of searching: 1=never, 2=rarely, 3=sometimes (< ½ the time), 4=usually (> ½ the time), 5=always, for three electronic resources (the Web, databases and library catalogue). Closed questions were used to determine the criteria students used to evaluate Web information and to identify which search engines and databases they used. Regarding the criteria for evaluating Web information, we consulted earlier research (Burton & Chadwick, 2000; Shanahan, 2008), and the following criteria were placed (with the option for the students to add their own): publisher/affiliations of the Web site, relevance of information, easy to understand (the content of the Web site), date of publication / date information last updated, credentials of individual author(s), information is corroborated against another source.

Table 1. Demographic characteristics of the sample (250 students)

Gender	
Female (92%)	
Male (8%)	
Year of study	**Age**
1st (30.0%)	18-21 (81.2%)
2nd (24.4%)	22-25 (12.0%)
3rd (22.0%)	26 + (6.8%)
4th + (23.6%)	
Access to a computer at home	
Yes (99.2%) (with internet connection: 92.8%)	
Years of computer experience	**Years of internet use**
<1 (4.8%)	<1 (8.0%)
1-2 (15.6%)	1-2 (26.0%)
3-5 (36.4%)	3-5 (40.8%)
5+ (43.2%)	5+ (25.2%)
Frequency of Web use	
never or about 1 hour per month (5.6%)	
about 1 hour per week (12.8%)	
several hours per week (43.6%)	
more than an hour per day (38.0%)	

The use of search engines and databases was identified by using a five point scale of self-reported frequency of searching (1=never, 2=rarely, 3=sometimes, 4=usually, 5=always), with the possibility for students to report additional search engines and databases. The search engines included were Yahoo, Google, AltaVista, while the databases were Eric, Illumina, Science Direct. Yahoo is currently the largest and most frequently accessed subject directory, but it is also known as search engine (Chuang & Chien, 2003). Google, AltaVista and Yahoo were chosen because they are among the major publicly available and heavily visited Web search engines (Anagnostopoulos, 2010; Spink, Jansen, Blakely, & Koshman, 2006). Regarding the databases placed in the questionnaire, we asked advice from the university librarian: she suggested adding the Illumina database (besides Eric), because these databases are both suggested to students whenever they ask advising from the librarians.

In order to investigate students' self-efficacy concerning Web-searching, we used 5 items from the internet self-efficacy subscale which was designed and used by Tsai and Tsai (2010). These 5 items for the online exploration subscale assess "one's self-confidence about his/her ability of navigating or searching information on the internet", and they were: "Keying in a URL in a Web browser to open a specific website, Clicking a hyperlink to open another webpage in a Web browser, Using keywords to search information on the WWW, Reading the content of information provided in a website, Download information or materials provided on a website" (Tsai & Tsai, 2010). The researchers used this subscale with high school students and found that the reliability alpha was 0.91 (thus it is a valid and reliable instrument). Student teachers were asked to rate their confidence on a 5-point Likert-type scale (1=strongly disagree, 2=disagree, 3= I am not sure, 4=agree, 5=strongly agree). For the purpose of this paper we call it as "Web confidence/ self-efficacy scale".

Before administering the questionnaire, it was trialed with two university librarians and 10 undergraduate students (who did not participate in the main survey) in order to check that there were no ambiguities in interpreting the statements. Feedback from the respondents resulted in minor revisions.

Data on students' demographic characteristics (gender, year of study, age), access to a computer at home, years of experience with computers and frequency of Web use were also collected. Regarding frequency of Web use, we used a five point scale (never, about one hour per month, about one hour per week, several hours per week, more than one hour per day) which was used in earlier research (e.g., Preston, Cox, & Cox, 2000). The questionnaire was administered at the beginning of the Easter semester of the academic year 2009-2010 and one of the researchers-authors was available to answer any queries that the students had. The responses were anonymous, the students were assured that there was not right or wrong answer and their responses were not going to be related to any assessment.

Data analysis

The results were entered into the SPSS software package for analysis. We used frequencies analysis for the description of data and Factor Analysis in order to reveal the validity of the self-efficacy measurement instrument. Ordinal regression analysis was used in order to investigate the impact of certain factors on the web self-efficacy.

Results

Students' information search practices

Table 2 shows the percent (%) of students and the frequency of search on information retrieval systems, while Figure 1 shows the combined responses of "usually" and "always" (percent of students who search on information retrieval systems either "usually" or "always"). 76% of the sample is using the Web, about 34% is using printed and digital library catalogues, and only 13% is using databases. Students reported that in order to obtain information for university assignments, they mainly search the Web, while they are rarely using printed/digital library catalogues or databases.

Table 3 shows the percent (%) of students and the frequency of using different search engines, in order to find information for university assignments (i.e. for academic purposes). In parallel, Figure 2 shows the combined responses of "usually" and "always" (percent of students who search on different search engines either "usually" or "always"). 93.6% of the sample is using the search engine Google either "usually" or "always", while only a small percent (15%) reported using the Yahoo at these frequencies. The percent of students who use different search engines in order to obtain information for personal purposes is quite similar (see Table 4). Again, Google is the search engine of choice by the majority of students (97% use it either "usually" or "always") followed by Yahoo (22%). However, very few students explained shortly, why they are using the above mentioned search engines for academic and for personal purposes. The reasons given, same for both purposes, were "I can find the information I want /need" (13% of the sample) and the "ease of access /use" (11% of the sample).

Table 2. Percent (%) of students and frequency of search on information retrieval systems

	never	rarely	sometimes (< ½ the time)	usually (> ½ the time)	always
the Web (www)	2.4	3.6	18.0	27.2	48.8
databases	53.2	22.8	10.8	10.0	3.2
digital library catalogues	24.4	21.6	19.6	18.0	16.4
printed library catalogues	25.2	17.6	22.4	19.2	15.6

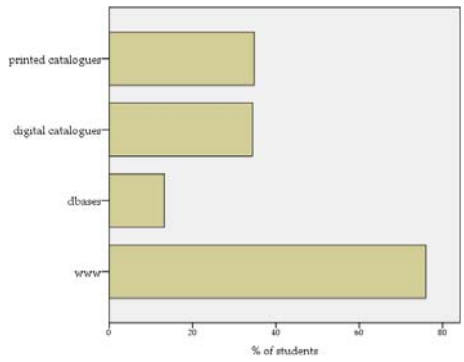

Figure 1. Percent (%) of students who search on information retrieval systems

Table 3. Percent of students (%) using different search engines (for academic purposes)

	never	rarely	sometimes	usually	always
Yahoo	40.8	29.2	14.8	11.6	3.6
Google	2.0	1.2	3.2	20.0	73.6
Alta Vista	85.9	8.8	4.0	0.8	0.4
other	86.8	4.8	3.6	3.2	1.6

Table 4. Percent of students (%) using different search engine (for personal purposes)

	never	rarely	sometimes	usually	always
Yahoo	45.2	18.4	14.0	16.8	5.6
Google	0.4	0.4	1.6	15.2	82.4
Alta Vista	88.8	7.2	3.2	0.0	0.8
other	89.6	4.0	3.6	2.0	0.8

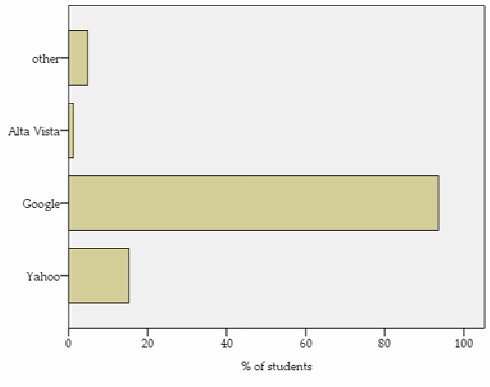

Figure 2. Percent (%) of students who search on different search engines (in order to find information for academic purposes), either "usually" or "always"

As mentioned above, the frequency of students searching on databases to obtain information for university assignments is very low. Table 5 shows the frequencies of (not) using databases: 73% of students are not using a database at all, a small percent of 13% reported using the 'Science Direct' and 10% (all of them being psychology students) reported using other databases such as 'Scopus' or 'Psyc-Info'.

Students' practices in evaluating Web-based information

Regarding students' practices in evaluating Web-based information, they reported using some of the criteria shown in the questionnaire (none of them provided other criteria). Table 6 shows the frequencies of criteria used in evaluating information on the Web. Ranking the criteria used, most students (62%) reported the criterion "relevance of information", followed by "easy to understand (the content of the Web site)" (58%), followed by "credentials of individual author(s)" (51%). Around one third of the sample reported the criteria "information is corroborated against another source" and the "date of publication / date information last updated". Regarding the number of criteria used when evaluating information on the Web, the modal number of criteria was 3 (median value=2.76).

Table 5. Frequencies of using databases in order to find information (250 students)

	Responses	Percent of students (%)*
none	184	73.6
Science Direct	32	12.8
other	26	10.4
Eric	15	6.0
Illumina	3	1.2
Total	260	

* Students could name more than one database

Table 6. Frequencies of criteria used in evaluating information on the Web (250 students)

	Responses	Percent of students (%)*
relevance of information	155	62.0
easy to understand (the content of the Web site)	144	57.6
credentials of individual author(s)	128	51.2
information is corroborated against another source	92	36.8
date of publication/date information last updated	91	36.4
publisher/affiliations of the Web site	67	26.8
none (criterion)	16	6.4
Total	693	

* Students could name more than one criteria

Table 7. Factor Analysis: loadings on the Web self-efficacy scale

	Factor 1
Clicking a hyperlink to open another webpage in a Web browser	.697
Reading the content of information provided in a website	.681
Keying in a URL in a Web browser to open a specific website	.646
Download information or materials provided on a website	.639
Using keywords to search information on the WWW	.555
Cronbach's Alpha	.776

Extraction Method: Maximum Likelihood, a. 1 factor extracted

Students' self-efficacy concerning Web-searching

We performed factor analysis for the 5 items of the Web self-efficacy scale in order to confirm the one-factor structure of the scale and to investigate its reliability (Cronbach α coefficient). Different criteria, such as script plot, did show that the script plot and the number of eigenvalues greater than one, confirmed the one-factor structure. The Cronbach α reliability coefficient had a satisfactory value (0.78). Table 7 shows factor loadings extracted from the factor analysis on the Web self-efficacy scale items.

Self-efficacy subscale scores were calculated by averaging of responses. By rounding the scale scores, we finally obtained a five point ordinal scale (1 to 5). In order to use this scale as dependent variable in a multiple regression analysis, we grouped the values 1 (= strongly

disagree), 2 (= disagree) and 3 (= I am not sure) into one value: this was done due to the very small number of responses (only three responses) corresponding to the values 1 and 2. In this way, the value 3 represents the lower self-efficacy among the students. An ordinal regression analysis was performed with dependent variable the self efficacy scale (three ordered categories) and independent variables: gender, age, years of computer experience, years of internet use, frequency of Web use. The results showed significant ($p < 0.05$) effects of 'frequency of Web use' and 'years of internet use' (see Table 8). The relationships were positive, which means the greater 'frequency of Web use' and 'years of internet use' the higher the self-efficacy. There were no significant links as to the variables age, year of study, gender, and years of computer experience.

Table 8. Ordinal regression analysis Parameter Estimates

		Estimate	Std. Error	Wald	df	p
Threshold	[w_s_e_round = 3.00]	-.175	.573	.094	1	.759
	[w_s_e_round = 4.00]	2.088	.561	13.836	1	.000
Location	frequency of Web use	.246	.098	6.280	1	.012
	years of internet use	.299	.097	9.496	1	.002
	[gender=female]	.082	.317	.067	1	.795
	[gender=male]	0[a]			0	

a. This parameter is set to zero because it is redundant
Link function: Complementary Log-log

Discussion and conclusions

Regarding undergraduate students' information search practices, the Web seems to be the primary information system searched, with 76% searching it either "usually" or "always" in order to find information for university assignments. The level of database searching is very low, as 73% of the students reported they are not using a database. These findings are in some agreement with earlier studies (Callinan, 2005; Griffiths & Brophy, 2005; Shanahan, 2008). Shanahan's (2008) pre-intervention study showed that 83% of second year undergraduate students in the health sector searched the internet usually/always, in comparison to 53% who searched databases (however, after the intervention the frequency of database searching increased). Callinan's study (2005) showed that both first year and final year undergraduate students ranked books, material from lectures and Web sites as their top three information resources, indicating that Web searching is more routine/regular activity than, for example, database searching (the percentage was around 20%). In our study, with regard to students' frequency of using different search engines, the majority of the sample reported using the search engine Google "usually"/"always" in order to find information, either for university assignments or for personal purposes (93.6% and 97% respectively). For the same frequencies and for the same purposes, the use of Yahoo is far behind the use of Google (15% and 22% respectively). Although Google is among the major heavily visited Web search engines (Anagnostopoulos, 2010), students' dependency on one search engine, together with often non-critical evaluation of the internet sources, may limit the quality of the information retrieved. University tutors assigning research papers need to be aware that a significant majority of students will seek sources on the Web as well as in the

library. This fact, together with the fact that different search engines have different capabilities and the overlap among them is low - searching one engine will not yield the absolute best results of the Web (Spink et al., 2006) - has implications for undergraduate students' training (this is discussed later in the section).

Regarding students' practices in evaluating Web-based information (second objective), the top three criteria reported by over half of the sample were "relevance of information", "easy to understand (the content of the Web site)" and "credentials of individual author(s)", while students did not mention their own criteria. There is some agreement with an earlier study (Burton & Chadwick, 2000) with research students who found that among the top three criteria was the 'source is easy to understand'. Although a comparison with secondary school students' evaluating practices is not equivalent, students' practices from secondary school affect their practices later on. For example, Walraven, et al. (2009) showed that secondary school students do not usually evaluate Web sources, and such a lack of evaluation might continue till they enter university.

Regarding the third objective, students' self-efficacy concerning Web-searching was found to be very high and positively related to the variables 'frequency of Web use' and 'years of internet use'. This finding is in agreement with recent studies (Kaya & Durmuş, 2010; Liang & Tsai, 2008; Tsai & Tsai, 2010) and in a way, it constitutes common sense that the greater the 'frequency of Web use' and 'years of internet use' the higher the Web self-efficacy. Kaya & Durmuş (2010) found that undergraduate student teachers who frequently ('always'/ 'usually') used the internet for research, had high (above-moderate levels) perceived internet self-efficacy. Tsai & Tsai (2010) showed that high school students' internet use, experience and intensity played significant roles in students' internet self-efficacies. High Web self-efficacy may lead to a better performance in completing various learning tasks/ assignments. For example, Tsai & Tsai (2003) indicated that students with higher internet self-efficacy performed better than those with lower, in the Web-based learning task, as they applied better information searching strategies.

The above findings have implications for undergraduate students' training. Initially, students' search behaviour could be expanded beyond the Web search engines, to include a wider range of information retrieval systems. For example, by supporting awareness of and skill development in database searching in undergraduate degrees, students are being prepared for their professional performance in the future. Searching databases and the Web are an important part of the information search process for undergraduate students. Students' training is useful to include practical experiences on relevant searching activities/ tasks, so as to be able to independently obtain and evaluate information. It is useful for them to have a critical attitude towards information on the Web and know the criteria they can use to evaluate information. Koch et al. (2010) showed that although for first year undergraduate nursing students Web-activities are supplementary to face-to-face teaching, students needed assistance to develop Web searching skills. Also, the fact that several tutors are assigning research reports without giving instruction in source evaluation may be indicative of the belief that they are not responsible for teaching students how to conduct research. Students' training in using and evaluating internet sources might take place within the context of Information and Communication Technology related university modules. University libraries could also play a role by informing students about the databases they have been subscribing to (currently such information is mainly provided to postgraduate

students), and by keeping communication with university tutors. Students' training is expected to influence their search practices and the quality of information retrieved. For example, limited evaluation of search results is expected to lead to a less optimal product.

This study is limited in that it used subjects from only two university departments, the majority of them being female. Also, it is a limitation that students' prior knowledge was not taken into account: when searching the Web, students' prior knowledge influences the criteria used to evaluate results (Walraven et al., 2009). Regarding the number of evaluation criteria, we placed six criteria providing the option for the students to mention their own. However, as they did not do so, it is a limitation that a greater number of criteria of other types was not included (such as 'ease of access/ use'). Future research is useful to include undergraduate students of different university departments as well as other disciplines, in order to obtain a better representation of specializations and of gender. Our future research plans include the investigation of undergraduate students' perceptions of and feelings about their experiences with internet use.

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