

DOCUMENT RESUME

ED 411 811

IR 056 638

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TITLE Web Search Engines: Key To Locating Information for All Users or Only the Cognoscenti?
PUB DATE 1996-00-00
NOTE 10p.; In: Online Information 96. Proceedings of the International Online Information Meeting (20th, Olympia 2, London, England, United Kingdom, December 3-5, 1996); see IR 056 631.
PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Academic Libraries; Access to Information; Computer Software Evaluation; Higher Education; Information Dissemination; *Information Retrieval; Information Seeking; Information Skills; Librarians; *Library Instruction; Natural Language Processing; *Online Searching; Online Systems; Optical Data Disks; *Search Strategies; User Needs (Information); *Users (Information); *World Wide Web
IDENTIFIERS Search Engines

ABSTRACT

This paper describes a study that attempted to ascertain the degree of success that undergraduates and graduate students, with varying levels of experience using the World Wide Web and Web search engines, and without librarian instruction or intervention, had in locating relevant material on specific topics furnished by the investigators. Because different search engines use dissimilar search protocols and interfaces, potential problems paralleling those perceived in CD-ROM and online searching were of concern. Results of the study demonstrate that most end-users can effectively use at least two search engines without professional assistance. The reasons for the contrast in end-users' success with World Wide Web search engines compared with problems found in other types of database searching appear to be related to the effectiveness of WWW search engines' software, which can quickly scan a large number of documents and weight the retrieval for relevance. While online database and CD-ROM vendors have made proprietary search syntaxes standard, Web search engines generally provide for natural language searching. The success of users' searches is no longer necessarily contingent on a knowledge of search protocols but rather on the ability to identify correctly the key concepts for which they are searching. (Contains 30 references). (Author/SWC)

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Web Search Engines: Key to Locating Information for All Users or Only the Cognoscenti?

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Web search engines: key to locating information for all users or only the cognoscenti?

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Abstract: *The proliferation of online services and CD-ROM databases offered by many competing vendors has led to innumerable products with many different interfaces. Information professionals have spent a great deal of time teaching end-users how to use these widely varying interfaces. The World Wide Web is similar to its predecessors inasmuch as it is navigable by search engines provided by various services. The purpose of this research was to determine if end-users, without the benefit of professional instruction, could employ different search engines to locate relevant information on specific topics located on the World Wide Web. Because different search engines use dissimilar search protocols and interfaces, potential problems paralleling those perceived in CD-ROM and online searching were of concern. The results of this study, however, demonstrated that most end-users could effectively use at least two search engines without professional assistance. The reasons for the contrast in end-users' success with World Wide Web search engines compared with problems found in other types of database searching appear to be related to the effectiveness of WWW search engines' software, which can quickly scan a large number of documents and weight the retrieval for relevance. While online database and CD-ROM vendors have made proprietary search syntaxes standard, Web search engines generally provide for natural language searching. The success of users' searches is no longer necessarily contingent on a knowledge of search protocols but rather on the ability to identify correctly the key concepts for which they are searching.*

Keywords: end-users, natural language, search engines, searching, students, World Wide Web

1. Introduction

World Wide Web search engines, variously called 'navigation services,' 'Internet directories,' 'searchable subject trees,' 'WWW databases' or 'meta-search engines' are presently the only practical solution for locating specific information in cyberspace. Although numerous print resources offer important information concerning the content of valuable Web sites, these columns, articles, newsletters and directories are static (Ref 1). The World Wide Web's salient characteristic is its dynamic nature. The Web's constant evolution renders even the most authoritative site reviews dated almost as quickly as they are published. Search engines are key to unlocking the Web's potential. As information professionals we correctly view ourselves as a cadre possessing the advanced training and skills required to assist end-users in performing efficient searches of resources of all types (including print, CD-ROM and online). Having participated in continuing education and workshops, digested articles, read monographs and practised our craft for years, we assume that searching is the quintessential blending of art and science that invariably requires ingenuity, experience and thesauri. This is unquestionably true when the online files being searched emanate from, for instance, STN or Dialog. CD-ROMs from SilverPlatter, University Microfilms International and NewsBank, not to mention the dozens of small companies offering compact disc databases (each 'contributing' its own nuances to the searcher/database interaction), require considerable mental agility to ensure efficient searching. Professional searchers scans their memories for the answers to questions such as 'What is the truncation symbol?' 'What is the order of processing of operators?' 'What are the correct field qualifiers?'

Similarly, many Web search engine sites harbour pages of 'Help,' 'Hints,' 'Tips' or 'FAQs' (Frequently Asked Questions) to facilitate relevant retrieval. End-users, especially novices, are often oblivious to these aids. Can end-users expect to locate useful information on the World Wide Web given their untrained approach to searching? This experiment provides a starting point for consideration of this topic.

2. Literature review and comments from Internet discussion list participants

As Nelson stated in 'The lonely life of the end-user,' electronic resources pose significant problems for casual database searchers (Ref 2). Friend referred to 'interface chaos' (Ref 3). Distress is pervasive among information professionals concerned with end-users' ability to negotiate electronic resources (Refs 4,5,6). Although many articles have discussed training information professionals to use the World Wide Web for research and reference purposes (Refs 7,8,9), few have considered training students (Refs 10,11). Brandt covered teaching end-users to search the World Wide Web from a conceptual perspective (Ref 12). He also authored practical articles addressing instruction in the use of the Web through a text-browser called Lynx (Refs 13,14).

The investigators found no published papers addressing the more specific issue of teaching end-users to interact with Web search engines. A question posted on the discussion lists WEB4LIB (discussion of WWW in libraries) and BI-L (Bibliographic instruction discussion group), in which an investigator requested anecdotal accounts of librarians' perceptions of students' search engine usage, drew a significant number of interesting responses. The following overview of responses reinforces the impression that end-users seldom use search engines effectively. One information specialist commented, 'My consistent experience has been that students are using the search engines the way they use the card catalogue — haphazardly until they find something that works. When they finally ask for help, they are amazed at the hits I am (usually) able to generate and I see them use that information in future searches. What I'm finding with the Internet is that it's taking a lot of one-on-one time to teach students how to search with various engines' (Ref 15). A related remark stated, 'In my observation they [end-users] use Yahoo extensively and the other tools in the most basic and limited way. And do not seem to question exhaustive lists of irrelevant results' (Ref 16). Jessamyn West, Technology Project Coordinator for the City of Seattle (Washington, USA), a role that makes her a primary planner of teaching children and parents how to use computers and the Internet, stated, 'I think there still is the stigma of folks thinking the Internet is for play and therefore a dearth of instruction techniques' (Ref 17). To balance this misconception, she has a Web site document aimed to assist students in using search engines (Ref 18). Another declared, 'This is a special interest area of mine ... With the different interfaces I stress that people should be checking the help screens so that they can take full advantage of the searching capabilities of the search engine. And of course it is important to remind them that the search engines are not mutually exclusive. I recommend using a minimum of three' (Ref 19). Several additional respondents affirmed that they felt making end-users aware of the existence of Web search engines and of their proper usage was essential; they took the opportunity to edify in both formal bibliographic instruction formats as well as at point of use (Ref 20).

Search engines have been acclaimed as the panacea for end-user meandering (Ref 21). Engine providers imply that their services are user-friendly. For example, the top of the Lycos form presently reads, 'Search the Web for' followed by a fill-in box. If accessing Lycos via Netscape Navigator 2.01's NetSearch function, the Lycos form reads 'Find exactly what I want' followed by a fill-in box. The implication is that merely entering words will yield relevant information. InfoSeek's president and chief executive Robin Johnson takes a more explicit perspective. Commenting on a recent advertising campaign promoting his company's services, he said, 'The point of the advertising is that you don't have to be an information retrieval specialist because InfoSeek is like your personal information concierge' (Ref 22).

Information professionals, however, remain concerned that as with CD-ROMs, end-users are not optimally deploying the Web search engines. Is this concern warranted? Herb White commented that for end-users searching is a means to an end, not an end in itself. End-users simply want an answer (Ref 23). The investigators' *a priori* hypothesis was if end-users have historically resisted learning the eccentricities of searching online databases and CD-ROMs, they would probably perform unimpressively using the Web's search engines.

3. Purpose

This experiment attempted to ascertain the degree of success that undergraduates and graduate students, with varying levels of experience using the World Wide Web and Web search engines, and without librarian instruction or intervention, had in locating relevant material on specific topics furnished by the investigators.

4. Methodology

4.1. Selection of participants

The university's electronic bulletin board was used to recruit subjects for the experiment. This ensured that the subjects had some baseline knowledge of networks, electronic mail and computers (i.e. they were reading the notice and replying via computer). Individuals with extensive experience were rejected (e.g. the university's Webmaster had asked to participate and was not allowed). Thirty students requested information on the project. Ten students were recruited and completed the experiment.

4.2. Administration of participant survey and participant orientation

Each participant first completed a brief survey describing her or his previous experience using both traditional electronic library resources, as well as her or his previous experience using World Wide Web search engines. Students were advised of the following: 'A World Wide Web search engine generally refers to a searchable database of files available on the World Wide Web; depending on the coverage and strength of the search engine and the manner in which a search is entered, relevant items may be found at various locations on the World Wide Web. Hundreds of search engines exist; for the purposes of this experiment you will search the following engines: Open Text Index and AltaVista.'

Participants were also told that although the engines basically performed the same function, each may appear different and have its own special features. Investigators stated, 'It is up to you to try to discover some of those features and employ them to do a better search.' No other instruction or elucidation was provided.

Each participant was given seven topics to search. The seven topics were identical for each participant. Investigators mentioned that for each topic valid information existed on the World Wide Web. The investigators began the searching portion of the experiment by having the participant use the 'Open Text Index.' Students were instructed to try one topic at a time. They were further instructed to browse the results and revise their search strategy if they felt it was necessary. Because the investigators were interested in high relevance rather than high recall, the participants were asked to print only the first ten 'hits' from the search they were most satisfied with for each topic. They were reminded not to print the pages of any specific Web site; using an overhead transparency, the investigators illustrated exactly what information should be printed. If zero 'hits' were retrieved, the subjects were instructed to print the page that stated this fact in lieu of a list of sites.

Investigators met with each student individually. Each had a two hour time limit for the appointment. The first half hour was occupied by the orientation and survey. The remaining one and one-half hours could be used for searching.

4.3. Participant searching

Each student was allocated a maximum of 45 minutes to search seven topics on the 'Open Text Index.' Investigators then used a bookmark to switch participants to AltaVista. The same seven topics were searched. Students were again allowed to search for 45 minutes.

Printouts were collected and retained with each student's survey. Data was gathered from the surveys and the search results. Using the printouts, the investigators inspected the students' search strategies as well as their final results.

4.4. Investigator searching

In preparation for the experiment, the investigators attempted to search numerous academic or popular topics sought on the World Wide Web using both engines. Seven topics were chosen. Each topic was adequately covered by both AltaVista and the Open Text Index. Students' retrieval would be compared with 'benchmark' retrieval located by the investigators. The investigators used the available special search features that each engine offered whenever necessary or appropriate to enhance retrieval.

4.5. Success criteria

Investigators determined that a student's search could be deemed successful if they had retrieved the benchmark site(s) that was(were) being used as the reference point(s), or if the retrieval included a site with equivalent or otherwise useful information on the topic, or if the site retrieved contained a hypertext link to one of the benchmark sites.

5. Search topics

The search topics consisted of:

- (1) locate the full text of the Magna Carta;
- (2) locate a listing of Royal Shakespeare Company productions;
- (3) locate Supreme Court Decisions — *but not* Canadian;
- (4) locate information on a press conference given in Madrid by John Major concerning the European Union;
- (5) locate a site containing pictures from the Hubble Space Telescope;
- (6) locate free stock quotes;
- (7) locate information on Poet's Corner in London's Westminster Abbey.

5.1. Benchmark sites and search success scoring

As of the time this paper was written the following sites were established as the 'benchmark sites' (i.e. those sites that had the best information on the topic). Other sites that participants located that had equivalent information were scored as though they were benchmark sites. Sites that mirrored the benchmark sites or had hypertext links to the benchmark sites were scored as benchmark sites. Sites retrieved that had incomplete or only moderately useful material were viewed by the investigators as 'marginal sites' and were scored as being one-half the value of the benchmark sites. If a participant failed to retrieve any sites, found only irrelevant sites or did not complete a search for a topic, a zero was recorded. 'Benchmark sites' were worth two points. 'Marginal sites' were worth one point. All other retrieval or lack thereof was worth zero points.

Full text of the Magna Carta

<http://www.let.rug.nl/~welling/usa/magna.html>

<http://www.traveler.com/~hrweb/legal/magnacr.html>

<http://www.cs.indiana.edu/statecraft/magna-carta.html> or equivalent sites, etc.

Royal Shakespeare Company productions

<http://www.uktw.co.uk/rsc.html> <http://www.hiway.co.uk/~ei/rsc.html> or equivalent sites, etc.

Supreme Court Decisions — but not Canadian

<http://www.law.cornell.edu/supct/>

<http://www.hplus.harvard.edu/alpha/supcrt.html> or equivalent sites, etc.

John Major's Press Conference on the European Union in Madrid

http://www.fco.gov.uk/current/1995/dec/16/major_pressconference_madrid-summit.txt or equivalent sites, etc.

Hubble Space Telescope pictures

<http://www.physics.carleton.ca/research/Hubble> or equivalent sites, etc.

Free Stock Quotes

<http://www.westergaard.com:8080/goquote.html>

<http://www.li.net/~stanh/stocks.html> or equivalent sites, etc.

Poet's Corner at Westminster Abbey

http://www.demon.co.uk/webguides/london/tourist/to_visit/list.html

<http://trinket.crocker.com/living/berkeley/london/chapter2/westm.html> or equivalent sites, etc.

6. Results

Two points was the maximum score for a successful search. Seven topics were assigned and they were to be searched on two engines. A perfect score equalled twenty-eight points.

6.1. Participants scores compared to self-report of computer use/search experience

All but one participant had used Microsoft Windows. Five participants reported using the World Wide Web 'once in awhile,' four had no experience and one used it 'frequently.' Out of the five that used the Web 'once in awhile' two had found the search engines frustrating while three reported 'sometimes find what I want.' Table 1 shows the scores for all participants as well as their responses to the survey questions. It is interesting to note that the second lowest score was made by a participant who claimed to 'usually find what I want' and stated 'frequently' using the World Wide Web and the search engines.

Table 1: Participants' responses to survey.

Subject	I have used Microsoft Windows	I have used the library's traditional electronic databases (CD-ROM, OPAC, etc.)	I have used the World Wide Web	I have used World Wide Web "search engines" (Yahoo, Infoseek, etc.)	To date, my experience using World Wide Web search engines has usually been:	Search Success Score note: max score possible = 28 (Success % in brackets cf. Table 2)
A grad student	5	1	3	3	3	19 (68%)
B undergrad	2	4	1	1	1	22 (79%)
C grad student	3	2	4	4	4	16 (57%)
D undergrad	5	4	3	3	3	26 (93%)
E undergrad	4	2	3	2	3	22 (79%)
F undergrad	1	3	1	1	1	20 (71%)
G undergrad	4	3	1	1	1	23 (82%)
H undergrad	4	4	3	3	3	20 (71%)
I undergrad	3	2	3	2	2	23 (82%)
J grad student	3	4	1	1	1	14 (50%)

Survey Questions

- I have used Microsoft Windows:
1 = Never, 2 = Rarely, 3 = Once in a while, 4 = Frequently, 5 = Several times each week
- I have used the library's traditional electronic databases (CD-ROMs, OPACs):
1 = Never, 2 = Rarely, 3 = Once in a while, 4 = Frequently, 5 = Several times each week
- I have used the World Wide Web:
1 = Never, 2 = Rarely, 3 = Once in a while, 4 = Frequently, 5 = Several times each week
- I have used World Wide Web "search engines" (Yahoo, Infoseek, etc.):
1 = Never, 2 = Rarely, 3 = Once in a while, 4 = Frequently, 5 = Several times each week
- To date, my experience using World Wide Web search engines has usually been:
1 = I have no experience, 2 = Frustrating, 3 = I sometimes find what I want, 4 = I usually find what I want, 5 = I always find what I want

6.2. Web search engine disparity not a significant factor in results

The differences and similarities of the Open Text Index and AltaVista have been reported (Ref 24). Both provide excellent search capabilities but neither is mutually exclusive with regard to content or search features. Both engines, however, listed the benchmark sites. AltaVista's search protocol is closer to the traditional online or CD-ROM databases. It allows truncation (not automatically but optionally). It allows nested searching. AltaVista's online documentation is comprehensive. But having inspected the printouts, the investigators determined that participants of this study did not capitalise on most of these advantages. Open Text Index is a powerful engine that ignores no stop words. It is extremely straightforward in its presentation.

For either engine, the possible total points that could be scored if all participants had a perfect score on every topic was 140. Participants scored a total of 105 points using AltaVista; a 75% total success rate. They scored 100 total points using Open Text Index; a 71% total success rate.

Ironically, participants who mentioned a preference liked Open Text Index's interface compared to AltaVista's. Although these engines' search screens are dissimilar and have unique features, this was not a significant factor in relevant retrieval.

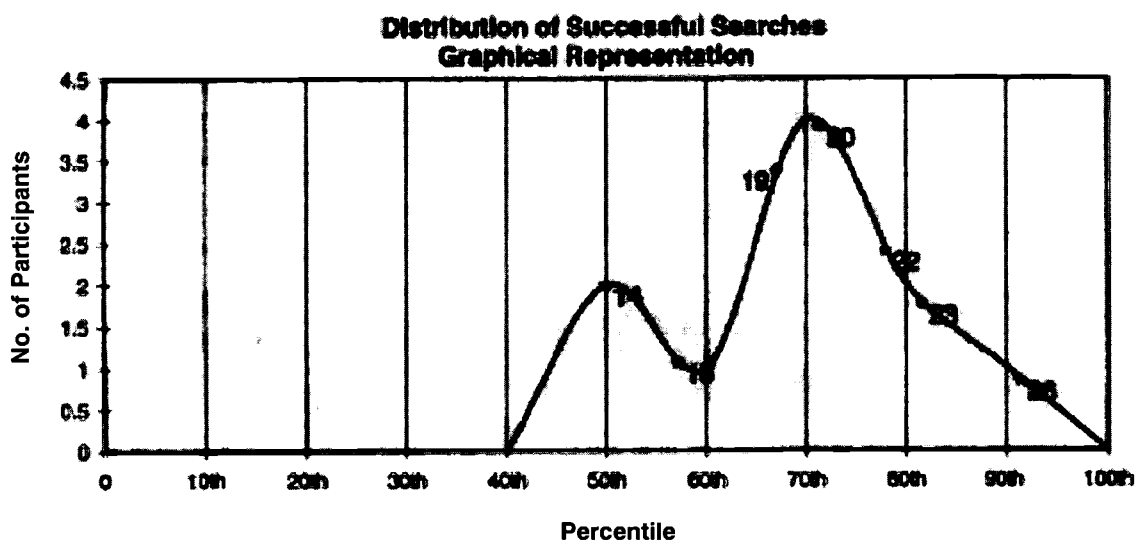
7. Discussion and conclusions

Experience or lack of experience with the World Wide Web or its search engines did not seem to affect the majority of participants' performance. Lack of instruction or unfamiliarity with search protocols generally had a negligible affect on the overall outcome of the end-users' efforts (Table 2). Search engine appearance and disparities in the

search engine's forms had little effect. Notwithstanding the small sample size, the results indicate that end-users of varying experience could use Web search engines reasonably well. The lowest total score was produced by Subject J who accrued fourteen points. Subject J reported having never used the Web and consequently had no experience using search engines. Earning 16 total points, Subject C had the next lowest score. Ironically Subject C reported frequently using the Web, including frequently using its search engines, and 'I usually find what I want.' Aside from these two scores, participants scored acceptably or well, particularly considering they had no instruction and, as evidenced by the printouts, had not used many advanced techniques.

Table 2: Distribution of successful searches.

Percentile	Frequency	Scores
0	0	n/a
10th	0	n/a
20th	0	n/a
30th	0	n/a
40th	0	n/a
50th	2	14,16
60th	1	19
70th	4	20,20,22,22
80th	2	23,23
90th	1	26
100th	0	n/a



On the WEB4LIB discussion list Paul Hollands, Internet Information Officer at Loughborough University, commented that 'The Holy Grail of electronic information retrieval is precision natural language searching.' He qualified this, however, by remarking, 'Unfortunately, having tested Natural Language engines in my previous job which could handle questions like "Give me reports about airbag crash tests that failed," we still found that standard Boolean searching gave much greater precision' (Ref 25). Quint has written that it is natural for end-users to want to search without applying difficult command languages; natural language searching must be realised if end-users are to have the best possible access to information (Ref 26). Within the context of this experiment, natural language searching apparently works as well, in many cases, as the more precise methods that the investigators employed. The scores of the student participants in this experiment bear this out. Students who invoked any of the hints provided by the search engines were in the minority. The search aid most used was AltaVista's asterisk as a truncation symbol. Professional searchers familiar with AltaVista will recall that with each new search a different 'tip' is posted at the top of the AltaVista page. The tips on the use of the asterisk, use of quotation marks for entering phrases and the use of the + (plus) sign to restrict retrieval are frequently rotated. Otherwise students simply picked out the main concepts of the topic and entered them. In several cases, unfortunately, students did not select enough keywords. For example, in some cases students merely entered 'John Major' and clicked the 'Search' button. The investigators had assigned a very specific topic and this strategy was far too broad.

Notwithstanding the overall acceptable outcome of these searches, deficiency in formulating search strategies is a subject warranting comment. In the experimental searches students were provided topics that

were articulated in precise terms. Even this advantage proved insufficient to guide some of their attempts. Omitting keywords (e.g. Westminster, Madrid, European Union) was an apparent problem. Typographical/spelling errors (e.g. Westminster, Abby) hampered retrieval but were never caught or corrected. Consider the student with an imperfect understanding of a topic. In this situation many students may falter in locating useful information. Oberman peripherally supports this: 'A growing number of studies of students and their interactions with electronic databases clearly illustrates the dismal abilities of students, even at the most basic level, of being able to match their subject needs with appropriate computer retrieval systems' (Ref 27). Her comment reflects the idea that the search instruction process must begin at a much more basic level than some information professionals may assume.

Other authors have stated that end-users continue to desire the information specialist's intervention when searching complex topics (Refs 28,29). These authors, however, have not focused their comments on end-users searching the World Wide Web. Many end-users have mounted their own home pages. The Web is available in many homes. Students explore the Web without trepidation. While the Web may be called a database, it is certainly not a database in the same way Chemical Abstracts, Medline, Psycinfo or the electronic Science Citation Index are databases.

We recognise the dynamic nature of the World Wide Web. Its contents constantly change. (Open Text Index altered its 'Simple Search' form midway through this experiment!) P. Steven Thomas, Coordinator of Library Instruction at Illinois State University (Normal, Illinois, USA) stated during the 'teaching students Web search engines' thread on the WEB4LIB discussion list: 'Search engines are evolving as we speak ... Expert systems are going to increasingly take over the online search logic many of us have learned through training and experience. These systems aren't going to replace us (i.e. librarians) but they will greatly simplify the search complexities that have characterised mediated online searching in the past' (Ref 30). As information professionals consider teaching end-users to manipulate Web search engines efficiently, perhaps only the basics require emphasis. End-users should be apprised of the valuable information contained in the hints, help, tips and FAQs that are available for many engines. Information professionals more wisely may choose as their primary goals the satisfactory formulation and refinement of search queries along with the need to choose sufficient, valid keywords. This being done, many end-users may need be led no further than Netscape Navigator's 'NetSearch' button or to a site containing links to Web search engines. Compared with earlier electronic information formats, for example CD-ROMs and 'value-added' online databases offered by various vendors, the efficient nature of World Wide Web search software, with its ability to handle natural language queries, is apparent.

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 EXPERT SYSTEM: Please input your search question or phrase...
 USER INPUT: What are the advantages of a flat tax?
 EXPERT SYSTEM: Do you wish to limit your search topic to the United States? Y/N
 USER INPUT: Yes
 EXPERT SYSTEM: Would you accept disadvantages as well as advantages? Y/N
 USER INPUT: Yes
 EXPERT SYSTEM: Your search on 'flat tax' and 'United States' and 'advantages or disadvantages' produces 156 results. View them now or save them to a file?
 USER INPUT: View
 ...
 ...'
 (Note: Mr. Thomas's e-mail address is sthomas@rs6000.cmp.ilstu.edu)



U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement (OERI)
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