Net knowledge: Performance of new college students on an Internet skills proficiency test

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Abstract
This article reviews recent data on computing and information literacy (research) skills of new college students and describes results from an Internet skills proficiency test administered to several groups of freshmen during the 2000 summer orientation at The Ohio State University. While students often self-report a high level of skill, tests as well as anecdotal evidence may not support this assertion. Further, technological preparedness varies by race, class, gender, and academic background. Only 9% of the Ohio State freshmen taking a three-part proficiency test achieved a passing score of 70% on the entire test. More of these students (30%) passed the first part on use of Internet tools; their performance was poorest (16%) on the second part, searching skills. College administrators must not assume student competence, but rather, should systematically assess incoming students and provide a variety of learning opportunities. Appendix provides most difficult test questions.

1. Introduction

The *National Survey of Computing and Information Technology in American Higher Education* provides compelling evidence of a growing reliance on Internet-related technology in the college classroom. The latest survey, which compiles data from 590 two- and four-year public and private colleges and universities, indicates that 64% of college courses use electronic mail, 47% use Web resources as a component of the syllabus, and 35% have a course Web page (Green, 2001, p. 7).

Is there an expectation on the part of faculty that entering college students will have the Internet skills necessary to participate in these ''wired'' courses? Further, what do we really know about the skill levels of incoming freshmen? Are they competent at using Internet tools for communication and research? Survey, anecdotal and other assessment data certainly provide mixed messages about the state of student computing skills. This article reviews recent data on this topic and reports results from an Internet skills proficiency test administered to several groups of new freshmen during the 2000 summer orientation at The Ohio State University.

2. Surveys of computer use and skills

A national study of freshmen, *The American Freshman: National Norms for* 2000, surveyed 269,413 students at 434 baccalaureate colleges and universities. This study reports that student use of personal computers is high, with 78.5% of college freshmen indicating that they used a personal computer frequently during the year prior to entering college. Despite reporting

similar levels of experience, young women respondents are much less confident of their computer skills than males. Only 23% of women rated their computer skills as ''above average'' or ''top 10%'' relative to their peers, versus 46% among men (Higher Education Research Institute, 2000).

How representative are these findings of the approximately 1.64 million freshman entering college in fall 2000? One cannot assume a uniform level of access to computers in school prior to entry into college. Sax, Ceja, and Teranishi (2001), examining data from the 1998 *American Freshman* survey, suggest that for entering freshmen, the level of technological preparedness varies by key factors such as race, class, gender, and academic background. The authors note that

> Further, racial/ethnic differences in experience with technology persist despite controls for key explanatory variables including parental income, parental education, and high school type. Institutional awareness of these inequities is critical at a time when colleges and universities are rapidly incorporating computers into nearly all aspects of the college experience, including admissions, the curriculum, class registration, and student life in general. (Sax et al., 2001, p. 363)

Another study of students at Arizona State University found that survey respondents at this urban university did not, in general, feel well prepared to use technology and that minority respondents felt less well prepared than others (Chisholm, Carey, & Hernandez, 1999, p. 5). The authors note that while universities expect entering students to be computer literate, they ''seldom stop to determine if required competencies exist uniformly across all students. Literature has shown that computer access and integration of computers into curricula have been significantly lower in student populations from ethnic minorities in K-12 public schools'' (Chisholm et al., 1999, Abstract).

Recent studies of computer and Internet access show that this ''digital divide'' is narrowing. The National Center for Education Statistics (NCES) reports that by fall 2000, 98% of public schools were connected to the Internet. For schools with at least 50% minority enrollment, the number with Internet access had risen to 96%. Ninety-four percent of schools with a high proportion of economically disadvantaged students had Internet access somewhere in the school in 2000 (NCES, 2001, p. 2).

However, another key measure of Internet access is the proportion of instructional rooms connected to the Internet. In schools with the highest concentration of students in poverty, a smaller percentage of instructional rooms were connected to the Internet (60%) than in other schools (77–82%). Similar patterns were noted by minority enrollment (NCES, 2001, p. 3).

Differences may persist in how computers are used as well. One educator asserts, ''students in schools with predominantly minority enrollments are more likely to use their state-of-the-art technology for drill, practice, and test-taking skills. Meanwhile, white students in more affluent communities are creating Web sites and multimedia presentations'' (Reid, 2001, ''Digital Racism'' section).

3. Anecdotal reports of computing skills

In an article published in the Chronicle of Higher Education, Olsen (2000) asserts ''This fall, colleges saw at least half of their freshmen arrive with their own computers and proficient at

using Windows, word-processing software, the Internet, and electronic mail.'' Comments from computing administrators are offered to support this conclusion. Paul M. Hunt, Vice Provost for Libraries, Computing and Technology at Michigan State University, observes, ''The typical freshman is a pretty good Web surfer using Netscape Navigator or Microsoft Explorer.'' At Hamilton College, the Director of Information Technology Services states that he has ''noticed that a majority of freshman students don't attend voluntary computer training sessions. It may be that they find technology easy to use, or that they're getting help from friends. . . '' (Olsen, 2000, p. A39).

Based on comments to the author by information technology staff at The Ohio State University that help freshmen move into the dorms and connect their computers to the campus network, the latter seems more likely. IT staff perceptions, reinforced by other staff on campus and who work intensively with new students, indicate that many students arrive with computers that are still in their original boxes, unopened. The connection between students having a computer and knowing how to use it is tenuous.

The view from faculty in the trenches who are teaching online courses is less optimistic about student computing skills than that of administrators. Carlson and Repman (2000), instructors at Georgia Southern University, note: ''Students almost always overestimate their abilities. Computer literacy cannot be assumed for students'' (p. 12).

4. Information literacy assessment data

While ''computer literacy'' and ''information literacy'' are distinct concepts, they are intertwined.

> With the increase in access to the Internet, definitions of computer literacy have expanded to include the ability to use e-mail, graphical interfaces such as Netscape, online publishing and the ability to evaluate the content of online materials. The importance of locating and evaluating electronic information sources expands the definition of computer literacy to include information literacy as well. (Zeszotarski, 2000, ''Definition'' section)

McEuen (2001, p. 8) uses the term ''information fluency'' to represent this confluence of computer literacy, information literacy, and critical thinking skills. Librarians who provide research skills instruction have a vested interest in understanding the computing and Internet competencies of their college student clientele. Most research at the college level involves using Internet-connected computers, Web browsers, and group communication tools. Students cannot learn research skills if they are unable to manipulate these tools effectively. Thus, any assessment of information literacy must also take into account the student's computing skills.

Some results of tests of information literacy skills have appeared in the library science literature, but they assess college students' skills after instruction, rather than those of incoming freshmen. Cameron and Feind (2001), librarians at James Madison University, describe an information literacy assessment, the Information-Seeking Skills Test (ISST). This test is administered to freshmen after instruction has been provided, in part to assess the efficacy of that instruction. The 53-item ISST is comprised of four subtests covering reference sources, database searching, Internet searching, and ethics and attempts to test both knowledge and application of concepts. During academic year 1999–2000, most students (92%) passed the test. Of those who

passed, 81% accomplished this on the first attempt and 22% met ''advanced'' criteria by scoring in the 48–53 range (p. 4).

Since 1994, the Teaching Library at the University of California, Berkeley, has conducted a survey of information literacy competencies of graduating seniors in selected departments (Maughan, 2001) that is an interesting combination of survey (attitudinal) questions and more objective skills assessment. The Berkeley results support the view, expressed by Carlson and Repman, that students usually overestimate their abilities. Over the 5-year span of the study, in all but one group, over half of the respondents (and in some cases as high as 70–77% of the respondents) assessed their skills as either 'Excellent' or 'Pretty good.' When students' self-assessments were compared with their actual scores on the questions designed to measure their research skills, anywhere from 35.5% to 81% of respondents received poor or failing scores (65% or lower). (Maughan, 2001, p. 77) ''The most fundamental conclusion that can be drawn from this survey is that students think they know more about accessing information and conducting library research than they are able to demonstrate when put to the test'' (Maughan, 2001, p. 71).

5. The Internet skills proficiency test

The Internet skills proficiency test discussed here (and referred to in the following pages as the proficiency test) is a self-diagnostic tool developed by the author in 1999. It is intended to assess entry-level competencies prior to instruction and to support student enrollment in an online credit course, Internet Tools and Research Techniques. This course, now offered as USS 120, provides 4 weeks of instruction in three major areas related to computer and information literacy:

- Effective use of Internet tools (Web browser, e-mail, and discussion groups).
- Searching skills for online sources.
- Research techniques, including choosing the best research sources, evaluating Web sites, and citing sources used in research projects.

The proficiency test questions focus on major concepts in the three areas that are covered in course instructional materials. It was constructed by selecting questions at different levels of difficulty from the various tests that are used within the course. The test utilizes WebCT course management software and is available on demand to interested users who wish to determine whether the USS 120 course will teach new skills.

The proficiency test consists of 50 multiple choice questions and is divided into three parts:

- Part 1: Internet tools— 16 questions;
- Part 2: Search skills— 17 questions;
- Part 3: Research techniques— 17 questions.

Each question has a value of 2 points; the total score for all three parts is 100 points.

Since the test is available to anyone interested in taking the USS 120 course, not all test takers have been new students. However, during July 2000, the author administered the test in a campus computer lab to two separate groups of new freshmen that were on campus for summer

orientation preceding their entry into Ohio State.

Students in both orientation groups were planning to enter the College of the Arts at Ohio State. This College serves majors in visual and performing arts, including music. Administrators in this College were interested in learning more about the Internet skill levels of entering freshmen and agreed to provide time for testing several groups during their orientation period.

The first group of 21 Arts honor students took the proficiency test on July 12, 2000. The second group of 22 prospective Arts students (nonhonors) took the test on July 21, 2000. Test results are also available for a third, more heterogeneous group of individuals who elected to take the test on their own during fall quarter 2000. The 14 members of this latter group included three OSU staff (two later registered for the course), six students enrolled in various OSU colleges, and five others apparently not affiliated with Ohio State. Others who did not complete all three parts of the test were omitted from the results reported here.

Table 1
Overall test score (all parts)

Group	Lowest (%)	Highest (%)	Average (%)
Honors freshmen	42	74	60
Freshmen	32	68	53
Independent	46	92	66

The test results of the two orientation groups, as well as the third comparison group, are discussed below. Although testing was not performed as part of a research study (that is, test groups were not selected to be generally representative of the freshmen population), and the number of individuals tested was small, the performance of these groups may still contribute to the ongoing discussion of freshman skills.

6. Proficiency test results

Table 1 shows the low, high, and average scores for the entire test (all three parts combined) for each of the three groups discussed in this report. The best overall performance was achieved by the independent group (mean score 66%), followed by the honors freshmen, Group 1 (60%). The mean score of the other freshmen class, Group 2, was lowest at 53%.

The independent group's average scores were also highest on each part of the test, as shown in Table 2. Average scores for all three groups were highest for Part 1 (Internet tools) and declined by approximately 10 points for the other parts of the test.

Table 3 details the performance of the new freshmen as a whole (Groups 1 and 2 combined) on the test as well as subsections. Only 9% of the 43 new freshmen taking the test at orientation achieved a passing score of 70% on the entire test. None achieved the level normally defined as proficient (80%). More of these students (30%) passed the first part of the test; their performance was poorest (16%) on the second part.

The following sections of this report examine performance on parts of the test in more detail. The text of the most difficult questions (those with lowest overall correct response) in each part is provided in Appendix A.

Table 2
Average scores for test parts

Group	Number	Part 1 (%)	Part 2 (%)	Part 3 (%)
Honors freshmen	21	66	58	57
Freshmen	22	61	50	49
Independent	14	72	61	64

Table 3
Combined results for freshmen

	70% or greater (%)	80% or greater (%)
Part 1: Internet tools	30	9
Part 2: Searching skills	16	0
Part 3: Research skills	19	0
Overall score	9	0

6.1. Part 1: Internet tools

This part of the test includes questions on using the Web browser (six questions), e-mail (six questions), and online discussion groups such as mailing lists, newsgroups, and Web forums (four questions). Table 4 shows high, low, and average scores for each group on Part 1 of the proficiency test.

The questions about discussion groups proved most challenging for students. Questions covered types of groups, software, format of addresses, and techniques for locating groups. Three of four questions were answered incorrectly by at least half of the respondents. Although most college students are familiar with Chat, they are apparently much less aware of asynchronous discussion tools.

Performance on the sections covering e-mail and the Web browser was significantly better. E-mail questions dealt with addresses, sending messages, signatures, filters, and attachments. Only one e-mail question related to attaching files proved difficult (24% correct). More than 70% of respondents selected correct answers on the remaining five e-mail questions as well as five of the six Web browser questions. The browser questions covered navigation techniques, bookmarks, printing, plug-ins, and security. The most difficult question on browsers concerned printing pages with frames (60% correct).

6.2. Part 2: Search skills

This portion of the proficiency test covers understanding of concepts related to databases (three questions), search techniques (eight questions), and various Web search tools (six questions). Table 5 shows high, low, and average scores for each group on this part of the proficiency test.

In general, respondents found these questions more challenging. Only three of the eight questions related to search techniques were answered correctly by 70% or more of respondents. These particular questions covered use of simple Boolean operators (AND, OR). Performance on other questions related to adjacency operators (ADJ, NEAR), phrase indicators, adjusting

Table 4
Test scores for Part 1: Internet tools

Group	Low (%)	High (%)	Average (%)
Honors freshmen	44	81	66
Freshmen	31	81	61
Independent	50	94	72

Table 5
Test scores for Part 2: Search skills

Group	Low (%)	High (%)	Average (%)
Honors freshmen	35	76	58
Freshmen	29	71	50
Independent	35	94	61

(limiting or expanding) search results, and controlled vocabulary/subject searching was poor (ranging from 23% to 66% correct). Similarly, response to four of six questions on best uses for various Web search tools (directories, indexes, meta-searchers) was below 70% (ranging from 33% to 49% correct).

6.3. Part 3: Research techniques

This final portion of the test presents questions related to evaluation of Web sources (eight questions), source selection and research strategy (four questions), and citing sources (five questions). Table 6 shows high, low, and average scores for each group on Part 3 of the proficiency test.

Respondents scored 70% or above on only two of the eight evaluation questions. Several of these questions linked to Web sites and asked students to determine the site's purpose (advocacy, reference/informational, commercial). While sites used were quite blatant examples of advocacy organizations, respondents were often unable to make this determination, especially if the site included reports, articles, and publications. Respondents were most successful with the questions related to source selection (Web vs. library databases and print), with three out of four questions scored above 80%. Conversely, performance on the group of five questions related to citing sources was uniformly poor (all below 50% correct). Students clearly need more instruction related to use of style manuals and copyright/intellectual property issues.

Table 6
Test scores for Part 3: Research techniques

Group	Low (%)	High (%)	Average (%)
Honors freshmen	35	76	57
Freshmen	24	76	49
Independent	47	88	64

7. Discussion

There are conflicting reports about the Internet experiences and proficiencies of students entering college today. Student computing abilities traverse a wide spectrum and the ''digital divide'' for minority and underserved populations seems to be closing somewhat, at least with regard to availability of computers in schools.

Nonetheless, various assessments of student computing and research skills, along with feedback from instructors, indicate that students often overestimate their abilities. The results from the Internet skills proficiency test administered to several groups of new freshmen at The Ohio State University during summer 2000 demonstrate that these students still have much to learn about effective use of Internet tools and especially about searching and research techniques.

In a recent article, Weiler (2001) discusses the need for colleges to identify expected Internet research competencies and address skill deficiencies systematically. She suggests that an initial skills evaluation ''be followed by a multi-level technology skills training program disbursed across the curriculum'' to insure that students leave college with the information technology skills needed for success in careers or further study (p. 167). Hannon (2001) also asserts that one course is not enough to develop true competency, as students quickly lose the skills gained in a single course. He notes that ''information skills are subject to an even shorter half-life than first-year writing skills due to the speed with which the technologies that support information literacy . . . are either updated or replaced'' (p. 41). He recommends that colleges develop voluntary certification programs similar to those used in the corporate world.

College administrators must not assume that new students arrive with acceptable computing and research skills simply because students tell us that they are competent. Rather, they should assess entry-level skills and provide appropriate instruction in a variety of modes: in research skills courses, short seminars, and workshops, as well as integrated into required courses for various degree programs. As McEuen (2001, p. 16) notes, students are ''interested in information fluency skills . . . but they won't take the initiative. The university needs to present the challenges and create the opportunities or requirements.''

Appendix A. Most difficult test questions

A.1. Part 1: Internet tools

E-Mail— What should you consider when attaching a file to an e-mail message?

  A. Where the recipient is located
  B. What type of Web browser the recipient has
  C. How large the file is
  D. All of the above

Correct answer: C
Respondents answering correctly: 24%

Web Browser — When printing a Web page with frames, be sure to:

  A. Click in the frame you wish to print in order to select it
  B. Check the box for ''black text''
  C. Select Print Preview first

D. Close any frames you don't want to include in your print

Correct answer: A
Respondents answering correctly: 60%

Online Discussion Groups —Which software program below is used to manage mailing lists:

A. Listproc
B. Microsoft Access
C. PeopleSoft
D. ListManiac

Correct answer: A
Respondents answering correctly: 35%

A.2. Part 2: Search skills

Databases— In a database, if you are doing a ''subject heading'' search, you are searching:

A. Keywords
B. Controlled vocabulary
C. Scope of the database
D. Anything in a database

Correct answer: B
Respondents answering correctly: 30%

Boolean Operators — Which search statement below will find BOTH the phrase ''term limits'' as well as ''limits to Congressional terms''?

A. term? NEAR limit?
B. term? ADJ limit?
C. ''term limits''
D. ''limits to Congressional terms''

Correct answer: A
Respondents answering correctly: 23%

Web Search Tools — Which type of Web search tool is created by a software ''robot''?

A. Specialized database (such as the Internet Movie Database)
B. Web directory (such as LookSmart or Yahoo!)
C. Web index (such as AltaVista or Google)
D. None of the above

Correct answer: C
Respondents answering correctly: 33%

A.3. Part 3: Research techniques

Web Site Evaluation —One way of evaluating a site is to determine what other sites link to it. To look for sites that link to the one you are evaluating:

A. Use advanced search features in a Web index, like AltaVista

B. Use a Web agent
C. Use a Web directory, like LookSmart
D. There is no easy way to do this

Correct answer: A
Respondents answering correctly: 25%

Research Strategy — How can you MOST easily locate in-depth, scholarly analysis of a topic?

A. Use a Web directory, like Yahoo! or LookSmart
B. Use a Web index, like AltaVista or HotBot
C. Use a library catalog, like OSCAR
D. Use a meta-searcher, like MetaCrawler

Correct answer: C
Respondents answering correctly: 58%

Citing Sources — ''Fair use'' means:

A. You may use as much as you need of a copyrighted work in research
B. You may use a small portion of a copyrighted work for research purposes
C. You must pay fair market value to use copyrighted works
D. You may use whatever you need, as long as you cite the author

Correct answer: B
Respondents answering correctly: 13%

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