OEA Report 99-15

Fluency with Information Technology (CSE 100): Student Response

Nana Lowell and Larry Snyder
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OVERVIEW

In 1999, the National Research Council published a report titled *Being Fluent with Information Technology (FIT)* that defined the level of understanding of information technology sufficient for lifelong self-education. In contrast to traditional computer literacy classes which teach computing skills of short-lived currency, a *FITness* course would teach *skills*, *concepts* and *capabilities* to enable students to continuously adapt to the rapid changes in information technology. This report describes student reaction to a pilot course based on the *FITness* model, taught in spring quarter, 1999 at the University of Washington. Findings are based on student responses to pre- and post-course questionnaires, as well as post-course evaluation forms.

Students enrolled in the course were primarily freshmen, although there was also a fair number of seniors, and there were more men enrolled than women. Most students reported that they currently used a computer on a regular basis, either in their residence or on-campus, and the most common use was for word processing or to send email. A moderate number of students used spreadsheets, but relatively few were familiar with databases, presentation software or bibliographic software. Student self-rated ability to use software mirrored the reported frequency of use, and showed a significant increase over the course of the quarter. Post-course confidence in using various applications was significantly related to self-rated ability in using the same software, and was also related to the likelihood that students would try to solve problems in using unfamiliar applications by *clicking around*, and to a seven-item computer attitude scale. However, significant pre- and post-course differences were not found for student confidence, attitude toward computers (already very high at the beginning of the quarter), or open-ended problem-solving questions. Essentially all students who responded to the post-course questionnaire said that they would recommend the course to others, and responses to standard course evaluation forms were exceptionally high. However, it should be noted that almost 20% of the students who had initially enrolled in the course withdrew over the course of the quarter, and so would not be represented in the post-course responses. Various modifications have been made based on instructional experiences and student feedback, and the course will be offered again autumn quarter, 1999.

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INTRODUCTION

In response to a request from the National Science Foundation, the National Research Council prepared a report addressing the question *What should everyone know about Information Technology?*[1] That report, *Being Fluent with Information Technology*, has become known as the *FITness Report*, and presents the intellectual foundations of a new concept of computer literacy. *Fluency with Information Technology (FITness)* is defined to be a level of proficiency and understanding of information technology (IT) sufficient for lifelong self-education. Unlike a computer literacy class that typically teaches computing skills of short-lived currency, a *Fluency* class would teach students what they need to know to continuously adapt to the rapid changes in IT. *Fluency* is composed of three co-equal and interdependent components: contemporary computer **skills** (traditional computer literacy), foundational **concepts** and intellectual **capabilities**. Though the *FITness Report* described *Fluency* content, it did not present a college curriculum.

CSE100, *Fluency with Information Technology*, was an attempt to prototype a curriculum for the content recommended by the *FITness Report*. Offered spring quarter, 1999, the five-credit class included three 50-minute lectures and two 50-minute lab sessions each week. The goal was to present the three components of *Fluency*, integrated in a project-based teaching strategy. The course was specifically intended for students outside of the science and engineering track, and the lectures, assignments, projects and other course material are extensively described on the course website.

METHODOLOGY

Questionnaires

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At the beginning of spring quarter, 1999, students enrolled in CSE100 were asked to complete a questionnaire relating to their ability to use information technology. Questions addressed student experience with various software applications, their confidence in their own ability to work with technology, and a self-assessment of their ability in the basic areas of math, research skills and writing. The questionnaire also included two experimental open-ended questions to assess student problem solving in the context of information technology. Two pairs of experimental questions were created, and two versions of the questionnaire (AA and AB) were constructed differing only in the pair of questions included. Half of the students (Group 1) were given version AA, and half (Group 2) were give version AB.

A follow-up questionnaire was administered during the last class session of the quarter, and included questions similar to those asked previously. Again, two versions of the questionnaire were created differing only in the experimental questions, and each student was administered the pair of questions to which he or she had not responded previously. Each of the two versions of the pre- and post-course questionnaires is shown in PDF format below:

Questionnaire	Version	
Student Background and Preferences (pre-test)	AA	AB
Student Experiences (post-test)	AA	AB

Of the 43 students initially enrolled in the course, 40 (93.0%) completed the pretest. Eight (18.6%) students subsequently withdrew from the course, and 23 (65.7%) of the remaining 35 students completed the posttest. Pre-post comparisons were possible for the sixteen students who completed both pre- and post-course questionnaires, and who provided their student number. (Self-identification was optional.)

Course Evaluations

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At the end of the quarter, students were also asked to complete the standard course evaluation forms provided by the UW Office of Educational Assessment (OEA). The Instructional Assessment System (IAS) is used to evaluate 3-4,000 classes at the University of Washington each quarter, and comparative data are available for classes of various sizes and disciplines. Summary reports are created by the OEA and provided to instructors for the purpose of course improvement. IAS Form A, used to evaluate CSE100, is designed to be used with small lecture/discussion courses, and was completed by 22 (62.8%) of the 35 students enrolled at the end of the course.

ANALYSIS AND FINDINGS

Frequencies of response to the closed questions on the pre- and post-course questionnaires are provided in PDF format below, followed by a description of responses to both closed and open-ended questions, and a summary of the responses to course evaluation forms.

Student Background and Preferences (pre-test) Response Frequencies

Student Experiences (post-test) Response Frequencies

Demographics

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The largest percentage of students were freshmen or seniors (64.1% and 23.1%, respectively, Figure 1), and there were more males than females (65.0% vs. 35.0%, Figure 2). Men and women were proportionately distributed across all classes. Most of the students were academically well prepared for the course, in that the majority (80.0%) had previously taken precalculus or calculus and half (50.0%) reported having written three or more papers that required a significant amount of library or Internet research during the past year. The large majority of students said that they had enrolled in the course *to learn more about computers*.

There were very few instances in which responses to pre- and post-course questionnaires were influenced by either class or gender, probably no more than would be expected by chance. Differences are noted below, where they occurred, although in most cases, class differences were difficult to interpret because of the highly-disproportionate class distribution.

Previous Computer Experience

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As the course began, the majority of the students reported that they used a computer at least weekly, whether on campus or in their residence (Figure 3). The primary use was for word processing (80.0%, Figure 4) or email communications (92.5%, Figure 5). Most students had never used database or bibliographic software (70.0% and 85.0%, respectively), created a web page (69.2%) or written a computer program (85.0%).

Seniors seemed to spend more time using their home computers for coursework, researching topics using online library resources, or writing computer programs than did freshmen. Males spent more time than did females using their home computer to do their own projects or creative work.

Self-Rated Abilities

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Students' pre-course ratings of their ability to use various types of software mirrored their reported level of experience. The majority of students rated themselves as *Beginning Intermediate / Intermediate* or *Advanced Intermediate / Expert* in using a word processor (85.0%) or browser (74.4%), but as *Beginner* in using bibliographic (83.9%), database (69.7%) or presentation (62.2%) software. (See Figure 6.) With respect to general academics, students saw themselves as strongest on writing skills, intermediate in research skills and weakest in math (Figure 7).

Although students at all class levels gave fairly low ratings to their ability to use database software, seniors rated themselves as significantly more capable than did freshmen (means=2.1 and 1.2, respectively). Males rated their own capability higher than did females in using a word processor (means=3.2 and 2.5, respectively), and presentation software (means=1.8 and 1.1, respectively).

When asked to rate themselves on the same abilities at the end of the quarter, the sixteen students for whom both pre- and post-course scores were available rated themselves as significantly more capable in all areas, with the exception of math (Figure 8). Improved self-ratings with respect to software applications corresponded to instruction provided in lab sections (e.g., use of the resume wizard in MS Word), and the largest increase was found for self-rated ability in using databases. Instruction did not specifically target academic skills, but the increased self-ratings in writing and research skills may have resulted from student practice with these skills rather than direct instruction.

Student Confidence

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Not unexpectedly, students' post-course ratings of their ability to use various types of software was strongly and significantly related to their confidence in being able to use the same software to complete class assignments. The strongest relationship found between ability and confidence was for bibliographic software (r=.71) and the weakest was for using a word processor (r=.59). (See Table 1.) Confidence in using software was in turn related to students' strategies for solving problems when using unfamiliar applications. Students who felt confident said they tended to *"click around" and try stuff until I figure it out,* whereas students who did not feel confident did not adopt this strategy. Two other strategies listed on the questionnaire (*ask someone for help*, and *use the online "help" facilities*) were not related to student confidence in using various types of software (Table 2).

Freshmen were more confident in their ability to use bibliographic software than were seniors (means=3.0 and 1.3, respectively).

Attitude Toward Computers

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A seven-item *computer attitude* scale was created to determine whether this variable, as described in the educational and psychological literature, might be related to student experiences in the course. The scale was made up of both positively and negatively worded items drawn from a variety of instruments,[2] and related primarily to feelings of anxiety or discomfort in working with computers. Scale scores were computed by reversing the direction of the negatively worded items and then averaging over all items. Thus, possible score values ranged from 1 to 5 (corresponding to the rating scale, *Strongly disagree* to *Strongly agree*), with higher scores reflecting a higher level of comfort. The reliability of the seven-item scale was found to be moderately high (KR-20 = .87 and .80 for the pre-test and post-test administrations, respectively), and support for the validity of the scale was provided by positive correlations between post-course scale scores and student confidence in their ability to use various types of software to complete coursework (Table 3).

Both pre- and post-course scale averages were high (pre- and post-course means = 4.1 and 4.2, respectively), and not statistically different. Because students were already comfortable working with computers at the beginning of the course, there was not much room for change.

Overall Reaction to Course

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Two open-ended questions on the post-course questionnaire asked for students' general assessment of the course. These questions were:

A. *Would you recommend this class to others? Why or why not?*

B. *What would you change about this course?*

As a group, students who completed the post-course questionnaire reacted positively to the course. Twenty-one (91.3%) of the students said *Yes*, they would recommend the course to others. They described the course as fun and as teaching important skills, and said that they learned a lot. The course seemed to be fairly demanding. The one student who would *not* recommend the course to others said *it's not an intro class at all*, and, as noted above, almost 20% of the students who initially enrolled in the course withdrew.

Recommendations for change centered around the required Visual Basic programming. Several students noted that the amount of VB programming was fairly high and suggested that more time be spent on applications or creating web pages. Others suggested introducing the material more gradually.

Problem-Solving

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Four open-ended questions were created as a first attempt to assess student problem-solving within the context of the use of instructional technology. The item text was as follows:

A. *A professor in one of your classes assigns a research project or paper. Describe the strategies and/or list the steps you would take to find information on your topic.*

B. *You are working on an important paper that you have to turn in next class period. The paper is finished and in your word processor but the printer won't print. Describe the strategies and/or list the steps you would take to trouble-shoot the problem and get the printer to work.*

C. *You are short of funds for the academic year and need to get a part-time job. Describe the strategies and/or list the steps you would take to find the right job for you.*

D. *You are given the web address for information you need for your next class, but when you try to go to that address, there is no such page. There is no one who can help you. Describe the strategies and/or list the steps you would take to find the correct address on your own.*

A team of three raters (two librarians and one of the graduate students who assisted in teaching the course[3]) developed a scoring protocol and individually scored responses from all students. Possible scores for each item ranged from 0 to 4, and an additional point was awarded for "technologically informed" answers to Items B and C. Agreement between raters was moderate to high, with inter-rater reliability (correlation) coefficients ranging from .76 to .96 (Table 4).

The four items were intended to assess students' general ability to solve the type of problems they might face using instructional technology, and item reliability was high enough to permit significant correlations between pairs of items. However, the inter-item correlations were low and non-significant (Table 5), suggesting that student response was governed more by the particular problems posed than by a broad understanding or capability.

As noted above, sixteen students completed both pre- and post-course questionnaires, half of whom (Group 1) responded to questions A and B on the pre-test and C and D on the post-test, and half of whom (Group 2) were given the questions in the opposite order. No significant differences were found between pre- and post-course means for either of the two groups, or for the two groups combined. This is not unexpected, first because the course was not directed at the specific abilities targeted by the four items. More importantly, the item validity was very low relative to assessing general student capabilities and the items were not able to detect changes that may have occurred over the course of the quarter.

Course Evaluations

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Student ratings of the course and instruction were exceptionally high. Average ratings for sixteen (59.2%) of 27 evaluative items fell in the 9th decile when compared to classes of the same size (21-50 students), discipline area (applied-hard), and level (lower division). That is, this class was rated higher on these items than were 90% of the comparison classes. Eight (29.6%) items received ratings within the 8th decile, and three (11.1%) items received ratings within the 7th decile.

Items 1-4 provide a general evaluation of the course. Using a six-point rating scale, students were asked to rate the course as a whole, the course content, the instructor's contribution to the course and the instructor's effectiveness in teaching the subject matter. In addition to controlling for type of comparison classes, ratings were adjusted for enrollment reason (elective vs. required course), class size (natural log of class size), and average grade expected (relatively higher or lower than other college courses taken). (See Adjusted Medians.) The "adjusted" decile-ranking of the items was lower than the "un-adjusted" rankings, but still higher than ratings given to the majority of comparison courses. In particular, the course as a whole was ranked in the 9th decile when compared to other similar classes, with an "adjusted" average rating in the 7th decile. The change in ranking was primarily due to the predominant enrollment reason (elective courses are generally rated higher than required courses), and expected grade (courses in which students expect to receive relatively high grades tend to receive more favorable ratings).

Item	**Unadjusted Decile**	**Adjusted Decile**
Item 1. *The course as a whole was*:	9	7
Item 2. *The course content was:*	8	6
Item 3. *The instructor's contribution to the course was*:	9	8
Item 4. *The instructor's effectiveness in teaching the subject matter was*:	7	5
Items 1-4 combined:	8	6

Students perceived the course as very demanding. Using a seven-point scale, five items asked the students to compare CSE100 with other college courses with respect to their expected grade, the intellectual challenge presented, the amount of effort they put into course, the amount of effort required to succeed, and their own involvement in course. The average ratings for all items fell into the 9th decile, with the exception of expected grade which was rated in the 8th decile.

COURSE MODIFICATIONS

Based on instructor observations and student feedback, several "positives" and "negatives" of this course prototype have been identified. Modifications are proposed for the next course offering in autumn quarter, 1999.

Positives

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Overall, the course was successful, if somewhat aggressive.

- The students learned a lot and rated the course highly.
- Students were not in the science/engineering track, but they come in with a modest degree of skill that can be relied upon.
- Heavy-weight concepts and capabilities, not just skills, can be taught.
- Students promote the course to their friends.
- The class is rewarding to teach and the material is rewarding (if tough) to learn.

Negatives

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The course is very demanding of both instructor and student.

- There is no good textbook available.
- The course is packed. There is little room for mistakes and few chances for "appreciation topics."
- Student study skills, diligence and discipline count to a greater degree than students may ordinarily expect.
- Students must commit a hugh amount of time to the projects.
- The course is resource intensive. Students require a much higher than average level of support (email communications, extra lab hours, longer office hours).

Changes in Course

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The basic structure, material and work load will be retained for the course offering autumn quarter, 1999, but several modifications will be made:

- Expectations of the students will be made clearer at the beginning of the quarter, including work habits and the importance of precision.
- Course notes will be provided to compensate for the lack of a textbook.
- Electronic turn-in of assignments, and e-grades will be used.
- The programming content will be introduced more gradually.
- A mechanism will be sought to help students get back up to speed if they have to miss a large segment of the coursework.

FIGURES AND TABLES

Figure 1

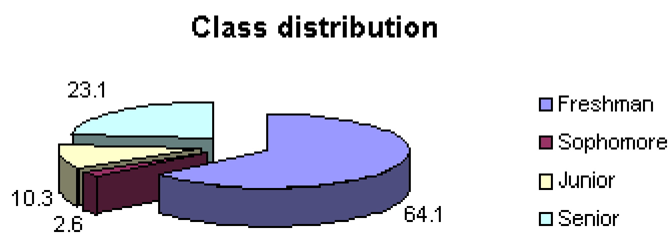

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Figure 2

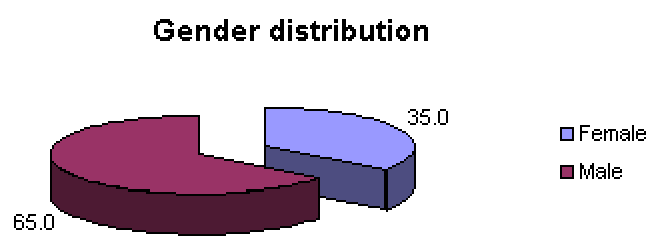

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Figure 3

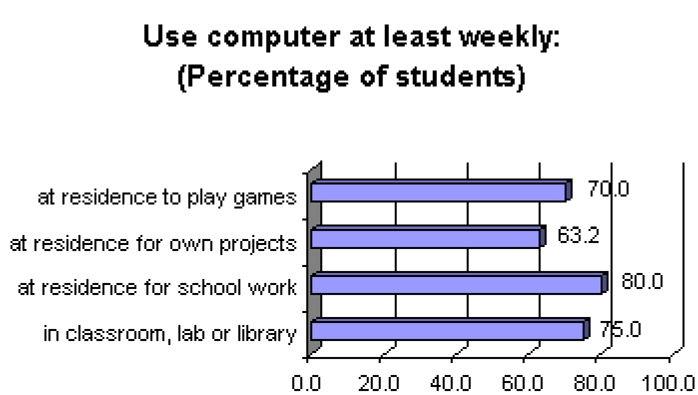

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Figure 4

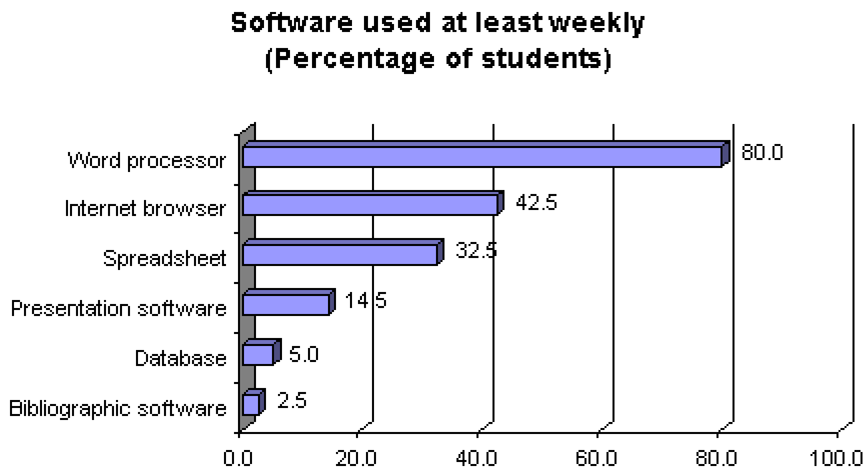

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Figure 5

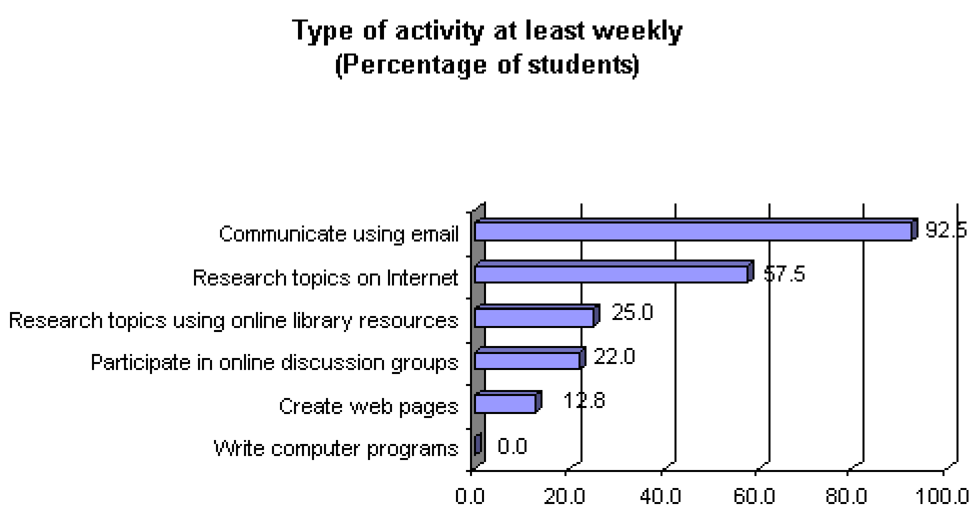

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Figure 6

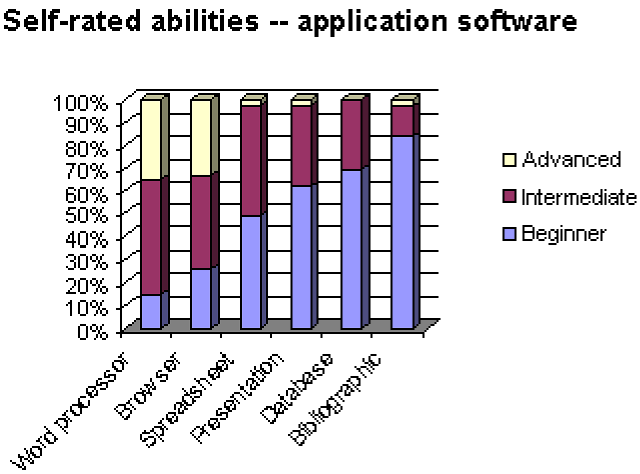

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Figure 7

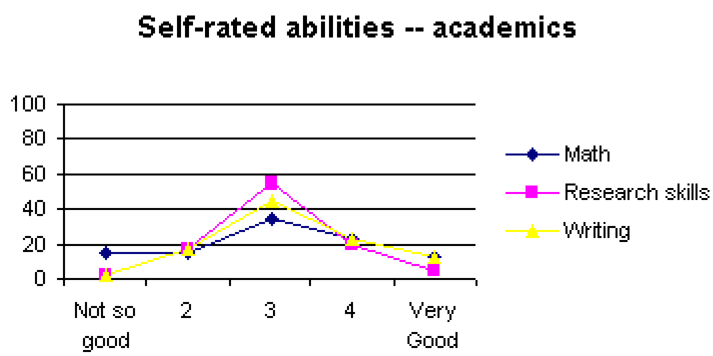

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Figure 8

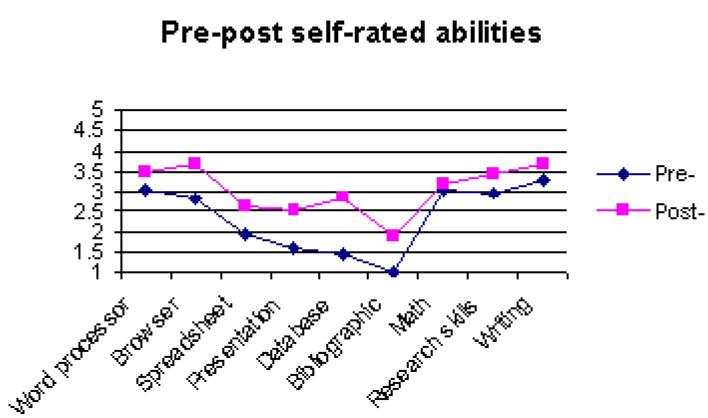

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Table 1. Post-course correlations (Pearson's *r*) between self-rated ability in using software and confidence in using it to complete coursework

Software Type	Correlation Coefficient
Word Processing	.59 *
Spreadsheet	.77 *
Presentation	.62 *
Database	.62 *
Bibliographic	.88 *
Browser	.71 *

* p<.005.

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Table 2. Post-course correlations (Pearson's *r*) between self-rated condidence in using software and problem solving strategies

Software Type	Ask for Help	Use Help Screens	"Click Around"
Word Processing	.01	.37	.66 *
Spreadsheet	-.02	.03	.57 *
Presentation	.13	.16	.61 *
Database	.20	.32	.63 *
Bibliographic	.25	-.13	.17
Browser	-.07	.36	.63 *

* p<.005

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Table 3. Post-course correlations (Pearson's *r*) between self-rated confidence in using software to complete coursework and seven-item computer attitude scale

Software Type	Correlation Coefficient
Word processing	.68 *
Spreadsheet	.34
Presentation	.49 *
Database	.47 *
Bibliographic	.06
Browser	.58 *

* p<.05.

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Table 4. Inter-rater reliability coefficients (Pearson's *r*) for problem-solving items

	Item A		Item B	
Rater	1	2	1	2
2	.80 *		.77 *	
3	.76 *	.78 *	.82 *	.93 *

	Item C		Item D	
Rater	1	2	1	2
2	.88 *		.90 *	
3	.90 *	.96 *	.87 *	.85 *

* p<.001

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Table 5. Inter-item correlations for problem-solving items *

Item	A	B	C
B	.20		
C	.38	.21	
D	.10	-.19	.26

* None of the coefficients are significant.

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[1] Larry Snyder, professor of computer science and engineering at the University of Washington, chaired the seven-person committee responsible for creating the report. Input was solicited from the community at large regarding "What everyone should know about information technology," and national leaders were invited to present at a workshop held January 14 and 15, 1998. The report is the outgrowth of that workshop, and the preceding communications.

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[2] The following scales were reviewed for applicable items:

Heinssen, Jr., R.K., Glass, C.R., & Knight, L.A. (1987) Assessing computer anxiety: Development and validation of the computer anxiety rating scale. *Computers in Human Behavior*, *2*, 49-59.

Houle, P.A. (1996) Toward understanding student differences in a computer skills course. *Journal of Educational Computing Research*, *14*(1), 25-48.

Murphy, C.A., Coover, D., & Owen, S.V. (1989) Development and validation of the Computer Self-Efficacy Scale. *Educational and Psychological Measurement*, *49*, 893-899.

Nash, J.B., & Moroz, P.A. (1997) An examination of the factor structures of the computer attitude scale. *Educational Computing Research*, *17*(4), 341-356.

Nickell, G.S., & Pinto, J.N. (1986) The Computer Attitude Scale. *Computers in Human Behavior*, *2*, 301-306.

Mahar, D., Henderson, R., & Deane, F. (1997) The effects of computer anxiety, state anxiety, and computer experience on users' performance of computer based tasks. *Personality and Individual Differences*, *22*(5), 683-692.

Rainer, Jr., R.K., & Miller, M.D. (1995) An assessment of the psychometric properties of the Computer Attitude Scale. *Computers in Human Behavior*, *12*(1), 93-105.

Torkzadeh, G., & Koufteros, X. (1994) Factorial validity of a computer self-efficacy scale and the impact of computer training. *Educational and Psycological Measurement*, *54*(3), 813-821.

Whitley, Jr., B.E. (1996) Gender differences in computer-related attitudes: It depends on what you ask. *Computers in Human Behavior*, *12*(2), 275-289.

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[3] We would like to extend very special thanks to Anne Zald, Geography and UWired Librarian, Pamela Zilius, Engineering Information Services/Instruction Librarian, and Ken Yasuhara for the time and thought they brought to coding these open-ended questions.

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