Computing: Is it a better mousetrap?

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In the spring of 1983, Drexel University announced that all incoming freshmen the following fall would be required to have access to a personal computer being designed by Apple. This paper reports on the impact of that decision over the next 2 years.

For several years, speculation about the impact of computing on social interaction, self-esteem, and reasoning has appeared in the popular press. Recently, this speculation was the topic for an article in the *American Psychologist* (Lepper, 1985). After discussing the speculation, Lepper concluded that "at present, there is virtually no research concerning such issues" (p. 16). This paper goes a step beyond speculation, reporting information from the first two years of a longitudinal study of the social impact of computing.

The study began in the spring of 1983, shortly after Drexel University announced that all incoming freshmen the following fall would be required to have access to a personal computer then being designed by Apple. The vice president for academic affairs asked me to evaluate the project. Knowing there was little time to gather baseline information, I wrote a questionnaire, to be distributed to the faculty, to obtain information that could be useful in evaluating how the introduction of computers would affect our campus, and to gather faculty opinion about how computers might influence the educational community. The questionnaire requested information about experience with computers, knowledge of various computer languages, educational histories, teaching styles, and views about potential changes resulting from the microcomputer decision. Part-time faculty were asked to complete the questionnaire so that we could contrast their attitudes with those of the faculty who would be most affected by the decision.

The faculty's views about potential effects of the new computer policy, along with speculation in the popular press, provided a framework for the study of students. In the fall of 1983, before the arrival of the Macintosh, freshmen and juniors were asked to report on their values, use of time, exposure to crime, optimism, self-confidence, stress, and orientation toward people. The older students, who did not have the opportunity to purchase a Macintosh through Drexel, were asked to participate so that we could have a comparison group against which to evaluate the impact of computing.

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THE FACULTY AT BASELINE

Responses came from 310 (89.6%) of the 346 full-time members of the academic faculty. Seventy-six taught in the College of Engineering, 77 in the College of Science, 55 in the College of Business and Administration, and 102 were spread among three liberal arts colleges.¹ Their responses were compared with those from 212 (87.2%) of the 243 part-time faculty members to whom questionnaires were distributed.

The questionnaire listed 15 uses of computers. For each use, only a minority of the faculty reported having had extensive experience. In every discipline, younger faculty members had more experience in using computers. Both full-time and part-time faculty were more likely to have used computers for numerical computations than for word processing, data analyses, literature search, or computer games. Computer games, commonly believed to be a bridge to more sophisticated uses, had been played by less than 10% of the faculty. Table 1 shows the proportions of faculty who reported having considerable experience using computers in each of 15 possible ways.

Overall, full-time faculty were more likely than part-time faculty to have used computers. Full-time faculty had a statistically reliable edge (using $p < .05$ as criterion) in reading printouts; using computers for analysis of data-

Table 1
Percentages of Full- and Part-Time Faculty Reporting
Considerable Computing Experience

	Full-time (N = 310)	Part-time (N = 212)
Text (word) processing	27	21
Literature search	14	9
Management of education (e.g., grading)	11	8
Reading printouts of data*	44	26
Data analysis of data-rich bases†	21	12
Numerical computations	48	41
Using data analysis packages	21	15
Using computer-assisted instructional material	7	9
Financial analysis‡	5	15
Working with design problems	12	16
Writing in high-level language§	28	21
Writing in assembly or machine language	7	8
Playing computer games	9	8
Using as laboratory equipment interface§	11	6
Using application software (e.g., simulations)	25	24

* $p < .0001$. † $p < .01$. ‡ $p < .001$. § $p < .05$.

rich bases, such as were available in the social sciences; writing in high-level languages such as FORTRAN or BASIC; and using computer interfaces with laboratory equipment. On the other hand, part-time faculty were more likely to have used computers in financial analyses.

The questionnaire asked how much experience the respondent had in using computers for teaching, research, or consulting, and whether the respondent had experience with any of several classes of machines, ranging from minicomputers to supercomputers. Slightly more than half the full-time faculty (52.9%) had considerable experience with at least one class of machine or had used computers in teaching, research, or consulting. These members of the faculty were classified as computer competent.

The questionnaire also requested opinions about the microcomputer decision. Most of the faculty (68.4%) said they were "relatively pleased" or "delighted" (the alternatives were "upset," "worried," or "neutral"). Table 2 shows the proportion of faculty, divided by rank and computer competence, who were pleased with the computer decision.

As the university gained momentum in its commitment to computer-assisted education, many members of the faculty were caught between their expectations of providing leadership based on superior knowledge and the realistic possibility that students might be more experienced in the use of computers. One could reasonably expect to find that faculty satisfaction with the computer decision would be determined partly by whether expectations for new criteria of competence, including computing abilities, would tend to confirm or to undermine the legitimacy of their status.

Compared with their colleagues who had little computing experience, full professors and associate professors who were computer competent were more likely to be pleased with the decision. Among the assistant professors, however, those who were computer competent were less likely to be pleased. The contrast between assistant professors and associate professors is marked. Among computer-competent faculty members, associate professors were most likely to be satisfied and assistant professors were least likely to be satisfied with the decision to require computing by freshmen. On the other hand, among faculty who had little experience using computers, associate professors were least likely to be satisfied, and assistant professors were most likely to be satisfied.

Table 2
Percentage of Faculty Pleased with the Decision

Rank	Not Computer Competent	Computer Competent
Full Professor	(N = 48) 66.7	(N = 63) 71.4
Associate Professor	(N = 52) 51.9	(N = 42) 81.0
Assistant Professor	(N = 46) 78.3	(N = 59) 64.4

Source	df	Chi-Square	Probability
Intercept	1	41.46	.0001
Rank	2	0.32	.8522
Competence	1	1.36	.2444
Rank*Competence	2	9.78	.0075

In the case of associate professors, these data can be interpreted as showing that faculty most likely to achieve high status through their knowledge of computing were most pleased, and, conversely, those who had the most to lose by a shift in criteria for evaluation were least pleased. Two plausible explanations for the responses of assistant professors can be suggested. First, cognitive consistency may have influenced their attitudes. Those who were not competent with computers might see justice in their low rank as assistant professors; the confirmation of rank could result in their satisfaction with the decision. On the other hand, the new emphasis on computing would suggest that those who were computer competent deserved a rank higher than assistant professor; their dissatisfaction would be increased by a sense of injustice. Second, assistant professors who were not computer competent may have particularly enjoyed the prospect of training, and those who had already learned may have resented losing an advantage.

STUDENTS AT BASELINE

In the fall of 1983, 1,859 freshmen and 1,218 juniors were asked to complete questionnaires. Among the freshmen, 1,452 (78%) responded; 642 (53%) of the juniors completed the questionnaire.

Students were asked about their experience in using computers. In each class, males were more likely than females to have taken courses in computing, to have played games using a computer, and to have used computers for data analysis and for writing. Class, sex, and the interaction of the two accounted for 18.9% of the variance in computing experience [$F(3,2085) = 161.64$, $p > .0001$]. From most to least experience with computers, as measured on this scale, the students ranked: male juniors (mean = 4.37), female juniors (mean = 3.70), male freshmen (mean = 2.99), and female freshmen (mean = 2.30).

Cluster analyses (SAS, 1982) suggested somewhat different behavior patterns for men and women. Compared with their classmates of the same sex, freshman males who had used computers went to movies, theater, concerts, or museums more often; junior males with the most computing experience tended to be more self-confident and optimistic, and to have less anxiety; freshman females who had used computers were more likely to take risks (as shown by their having witnessed crimes, having been victims of crimes, and having been relatively likely to be careless with their possessions); and junior females with computing experience tended to have stronger social interests (Crandall, 1980). Whether these differences were causally related to computing, of course, could not be ascertained by the cross-sectional analyses.

AFTER ARRIVAL OF THE MACINTOSH

Shortly after receiving their computers, in March of 1984, freshmen were asked to answer a second question-

naire. By June of 1984, 256 freshmen had withdrawn from school. Among the 1,603 remaining, 944 (59%) responded to this first post-Macintosh questionnaire. Those who answered the second questionnaire did not differ from those who had answered only the first in terms of computing experience, values, use of leisure time, or optimism (at least as measured in the baseline questionnaires). But the second group of respondents had higher grades, expressed less anxiety, were less likely to show anger, and gave higher priority to people.

Reports on young children had indicated that computers might increase student interaction. In the wake of the successful distribution of machines at Drexel, administrators began to notice clusters of students helping one another.

On the second questionnaire, students were asked where they turned for help when they ran into difficulty with the Macintosh and with their courses. Their answers showed that close friends were by far the most common source of help for problems with computing: 67% had asked a close friend, 26% had asked a student who was not a close friend, and less than 25% asked for professional help from sources provided through the university. Similarly, students turned to a close friend for help with course work. Only 39% had asked a professor for help, whereas 80% had asked a close friend.

Apparently, the student interaction being reported as consequence of computing was an artifact of observers' interest in learning about effects of the new technology. Slightly over half the respondents (52%) reported that other students had asked them for help in using computers. An even higher proportion, 80%, reported being asked for help in course work.

Students reported having little trouble learning how to use the Macintosh. About three out of four students indicated that they were pleased with owning the machine. Nevertheless, less than half were pleased with the amount of time they expected to spend using a computer during the coming term. Furthermore, students expressed less satisfaction with their first computing course than with their first math course, their first composition course, or their first research course.

SECOND YEAR OF THE STUDY

The primary focus of this study is on change. During the spring and summer of 1984, 285 members (85%) of the full-time faculty answered a second faculty questionnaire. Of those who had not been users of computers the year before ($N = 115$), half had acquired quite a bit of experience with computers in such activities as writing text (word processing), financial analyses, or grading. Among those who a year before had little experience with computing, 58% reported now having a computer at home. Among the more experienced users of the year before, 83% now had a computer at home. About three quarters of the faculty believed that, compared with the year before, they used time more efficiently and had be-

come more productive, that their teaching had improved, and that their students were more interested in learning.

Among the 1,806 freshmen who entered Drexel in 1984, 1,202 (67%) responded to a questionnaire similar to the one given in 1983. Their answers, compared with those of freshmen from the previous year, indicate some of the changes occurring at Drexel and, more generally, in society.

Students who had participated in the study during the 1983-84 academic year were asked to respond to another questionnaire the following year. These second-year respondents were now seniors (423 students—42% of those who had not dropped out) and sophomores (580—30% of those who had not dropped out).

After a year of experience with the Macintosh, 84% of the faculty believed the policy had been helpful in recruiting good students. We tested this idea by examining the students' reasons for choosing Drexel. In 1983, just after the computer policy had been announced, 27% of the freshmen considered the Drexel computer policy a very important reason for coming. The employment co-op program (considered very important by 79%), Drexel's academic reputation (73%), availability of specific courses (65%), and financial aid (34%) were counted as more important than the computer policy by many freshmen.

The freshmen of 1984, reflecting the increased importance of computing to society at large, were more likely to see the emphasis on computing as an important attraction. The proportion of freshmen who considered the Drexel computer policy a very important reason for coming had risen to 37%. The computer policy had become more important than financial aid (considered very important by 29%). The co-op program (considered very important by 79%), Drexel's academic reputation (74%), and availability of specific academic courses (66%), however, continued to attract even higher proportions of freshmen.

Over half the faculty (63%) reported noticing improvements in the reputation of Drexel since the arrival of the Macintosh. Apparently, students shared this perception, because freshmen's anticipated satisfaction with Drexel increased between 1983 and 1984. For example, 67% of the 1983 freshmen and 82% of the 1984 freshmen reported that they expected to be "delighted" or "generally pleased" with their work; 66% of the 1983 freshmen and 79% of the 1984 freshmen reported that they expected to be "delighted" or "generally pleased" with the equipment and assistance available to them.

More men than women reported having used computers before entering Drexel. While at Drexel, however, men and women were about equally likely to use computers for writing and for course assignments other than writing. Among sophomores, about 80% used computers for writing papers and about 67% used computers for other course assignments.

Students who came to Drexel with computer experience used computers at Drexel in more ways than did their

classmates. Men reported spending more time using computers; men also were more likely than women to use computers for data analysis, playing games, obtaining information outside of course assignments, and drawing. Yet for both males and females, a statistically significant negative correlation between prior use of computers and changes in use suggests that Drexel has been successful in introducing the inexperienced computer user to computing.

Contrary to some widely aired opinions, computing appears to have no influence on students' desires to affiliate with other people. Nor does there seem to be a relationship between the amount of computing and either eye pains or backaches.

In their choice of career, students who had been the most frequent users of computers over the last year were those most likely to value variety and learning. Students who used computers frequently were more likely than their classmates to rate working with things rather than people as very important (10% vs. 5%), although both groups were more likely to consider it very important to work with people rather than things. Slightly less than half of each group said that it was important to them to work with people rather than things.

The second faculty questionnaire asked about changes that their teaching had improved. Evidence from the student questionnaires seemed to reflect these improvements. Students were asked whether, on the whole, their freshman computing, mathematics, composition, and research courses had been valuable. Between 1983 and 1984, freshmen's satisfaction with their computer programming courses had risen from 39% to 55%; with mathematics

courses, from 66% to 75%; with composition courses, from 64% to 74%, and with research courses, from 56% to 62%.

In the spring of 1984, 50% of the freshmen reported that none of their courses, other than those in computing, had benefited from the use of computers. In the spring of 1985, only 8% reported that computers had not contributed to the value of any of their courses.

CONCLUSION

In sum, the evidence suggests that the education students receive at Drexel has been improving. Whether the use of computers contributes to further improvement will become clearer as the study progresses. Meanwhile, a tentative judgment is warranted. The computer has had no negative impact and it appears to be an effective catalyst for change.

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NOTE

1. Humanities and Social Sciences; the School of Information Sciences, formerly the Graduate School of Library Science; and Nesbitt College of Nutrition, Design, and Human Development.