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ABSTRACT

A program evaluation was undertaken at Southern Illinois University (Carbondale) to assess the broad, measurable effects of using computers to teach introductory college composition. Twenty-four classes were studied--twelve control classes and twelve experimental--with the experimental computer classes meeting in the lab for half of their instructional time. Data on the success of the program were collected from a range of sources: pre- and posttests of student writing under both impromptu and take-home conditions; pre- and posttests of writing anxiety; records on attendance, tardiness, withdrawals, and homework and essay assignment completion; end-of-term course evaluation by both teachers and students; and self-report data collected from teacher meetings and teacher logs. Results favored the use of computers, with computer students revising and improving their posttest essays (especially discourse-level features) at levels that are significantly better than regular students. Those students in experimental sections who chose to compose on computers at the end of the term outperformed the group as a whole and performed significantly better than those experimental students who chose to compose with pen and paper. Attitudinal data from both students and teachers also favored the use of computers. (Seven tables of statistical data are included and 20 references are appended, as well as handouts giving topics for pre- and posttests). (Author/ARH)

Teaching College Composition with Computers: A Program Evaluation Study

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ABSTRACT

Teaching College Composition with Computers:

A Program Evaluation Study

This program evaluation was undertaken at Southern Illinois University-Carbondale (SIU-C) to assess the broad, measureable effects of using computers to teach introductory college composition. Twenty-four classes were studied--twelve control classes and twelve experimental--with the experimental computer classes meeting in the lab for half of their instructional time. Data on the success of the program were collected from a range of sources: pre- and posttests of student writing under both impromptu and take-home conditions; pre- and posttests of writing anxiety; records on attendance, tardiness, withdrawals, and homework and essay assignment completion; end-of-term course evaluation by both teachers and students; and self-report data collected from teacher meetings and teacher logs. Results favored the use of computers, with computer students revising and improving their posttest essays (especially discourse-level features) at levels that are significantly better than regular students. Those students in experimental sections who chose to compose on computers at the end of the term outperformed the group as a whole and performed significantly better than those experimental students who chose to compose with pen and paper. Attitudinal data from both students and teachers also favored the use of computers.

Teaching College Composition with Computers:

A Program Evaluation Study

Many college English departments have begun using the microcomputer in composition classrooms with the hope that it will improve student writing (especially revision processes), encourage better attitudes toward writing, and perhaps stimulate a collaborative learning environment. We have a wealth of self-report data which suggests that the introduction of computers does lead to a range of benefits for student writers (Arkin & Gallagher, 1984; Feldman, 1984; Hunter, 1983; Moore, 1985; Nash & Schwartz, 1985; D. Rodrigues, 1985; Sommers & Collins, 1984; Womble, 1985). But researchers have only recently begun to investigate through controlled studies these claims for the benefits of using computers in writing classes.

Researchers who have attempted to document the effects of computers on student writers have produced evidence that is at best inconclusive. Etchison (1985) found that computer classes made greater gains than control classes, with the computer students writing longer, better papers at the end of the term, even though they started out the term with scores well below the control group. Cohen (1986) reports that students who used word processing made 34% more revisions on end-of-term essays than did the control students, even though the computer students were writing with pen and paper (which he interprets as an argument for transfer of effect from computers to pen-and-paper writing).

In a program evaluation at Miami University of Ohio, Storms (1986) reported no qualitative improvement in the essays of computer students as compared with control students; Storms does report a range of perceived benefits, including favorable teacher and student reactions, out-of-class computer use by students in

the experimental group, and more in-class writing in experimental sections. Hawisher (1987) reports no increase in revising activities for computer students; in fact, her pen and paper students actually revised somewhat more. She found no differences in quality between computer and paper-generated essays by her college students. Cross and Curey (1984) report inconsistent findings on measures of attitude, performance, process strategies, and grades across computer and regular groups.

We are left with repeated observations that both students and teachers appreciate using computers in their writing classes and believe such use results in improved writing and revising, but the findings from controlled studies are at best equivocal. (For a more complete review of the research, see Bernhardt and Wojahn, forthcoming.) Hawisher (1986) reviews the research and concludes that the inconsistency is a result of research designs that are either not well conceived or not comparable with other studies, making it difficult to generalize.

The present study is a program evaluation undertaken at Southern Illinois University-Carbondale (SIU-C) to assess the broad, measureable effects of using computers to teach introductory college composition. Twenty-four classes were studied--twelve control classes and twelve experimental--with the experimental computer classes meeting in the lab for half of their instructional time. Data on the success of the program were collected from a range of sources: pre- and posttests of student writing under both impromptu and take-home conditions; pre- and posttests of writing anxiety; records on attendance, tardiness, withdrawals, and homework and essay assignment completion; end-of-term course evaluation by both teachers and students; and self-report data collected from teacher meetings and teacher logs. (For discussion of writing program evaluation, see Davis, Scriven &

Thomas, 1981; and Witte & Faigley, 1983.)

METHODS

Physical Setting

The study took place during Fall 1986, the second year after construction of two new IBM PC computer labs. The two adjacent labs each contained 32 PCs, with one lab set up as a classroom and the other as a drop-in lab. The computer classroom provided a PC for each student and software, including PC-Write (a word processing "shareware" program, which each student copied for personal use), spelling and grammar check programs, and a range of other general applications software. The lab (and the classroom when not scheduled for classes) was open long hours: from 8 a.m. until midnight during the first eight weeks of the term and from 8 a.m. until 2 a.m. during the last eight weeks of the term, as student demand on the PC labs increased. Throughout the term students had access to PCs, though during popular hours in mid-afternoon and early evening, there was often a wait of up to an hour. The lab and classroom were staffed by student workers and full-time staff hired by Computing Affairs. Whenever possible, the English Department assigned a graduate assistant to the classroom to help with classes.

Subjects

Twenty-four sections of approximately 22 students per section were studied: all were first semester, introductory composition classes in a two-semester sequence. We did not identify sections as computer classes in order to approach a random assignment of students to experimental and control groups. Twelve teachers each taught two sections, one computer and one regular. The time-table did not list teachers' names.

Each of the computer classes met in the computer classroom one day per week and in a regular classroom one day per week, with each meeting lasting 75 minutes. All classes met on a Tuesday/Thursday schedule, and insofar as possible, teachers taught both sections in either the morning or afternoon.

Instructional Setting

The computer and regular sections were in some ways the same course, having evolved within the same composition program. Instructors were generally expected to teach a process approach, with emphasis on revision through peer critiques and teacher commentary at various stages of writing. The recommended text was Scholes and Comley's The Practice of Writing, 2nd Edition; one teacher chose to use Moss' Composition by Logic. Through the composition training program and because of the general pedagogical orientation of the department, the teachers were encouraged to take a rhetorical approach to writing, stressing the importance of purpose and audience by having students experiment with a wide variety of writing tasks through a general course sequence: from personal, reflective writing; through more objective, factual reporting; toward more critical, analytic, academic registers. The expectation was that students would do frequent, informal writing in addition to 6 or 7 longer, more formal texts. All teachers kept office hours and were encouraged to schedule individual conferences with students. The teachers often worked in the PC lab themselves and provided informal conferences to their students on demand.

As a group, the teachers in the study were experienced writing teachers who received generally strong student evaluations, who displayed an interest in teaching with computers, and who were willing to be part of a study. Of the 12 teachers, 7 had taught in the computer classroom during the previous year; these 7 and an

additional 4 others had attended a weekly seminar the previous fall on word processing and the teaching of writing; the twelfth teacher had taught composition with computers on another campus. Five of the teachers were lecturers; 7 were experienced graduate student TAs.

We did not urge teachers to attempt to teach the two courses in parallel fashion, with computers being the only variable. We recognized that the instructional setting would influence teaching strategies: the nature and timing of assignments, the use of the textbooks, the use of small groups, the frequency of in-class writing, and so on. At a pre-term meeting, the twelve teachers discussed what they anticipated might be different in a lab setting, with those who had taught in the lab offering advice to the others. We agreed to meet voluntarily throughout the term to discuss the sections, compare notes, solve problems, and share insights. For the first few weeks, we met every week, and then every other week during the latter part of the term.

Evaluative Measures

Pre- and posttests of student writing. Samples of students' impromptu and revised writing were collected during the second and the fourteenth week of the sixteen week course. For the impromptu sample, students were given one of two assigned tasks, told that the assignment would count as part of their course grade, and given forty-five minutes to write in class. When they were finished, the impromptu drafts were collected and photocopied by the researchers, who then returned the photocopies with instructions to take the drafts home over the weekend and revise them. Students were again told the revisions would count toward their course grades. Students had from their Thursday class meeting to the following Tuesday to revise their essays.

The posttest followed the same procedures. Computer students were given the impromptu task in the computer classroom and told they had the option of composing on disk. The drafts of all the students were either copied onto disk or photocopied. Students were again asked on Thursday to rewrite, using what they had learned in the course to improve their essays, and to turn in their revised work on Tuesday. Computer students were told they could type or work with pen and paper if they chose. Revisions were collected on Tuesday, either on paper or disk.

Two writing tasks were used in a split-halves design, with half the classes writing on Topic 1 for their pretests, and half writing on Topic 2. Topics were then reversed on the posttest. The two writing tasks had been pilot tested during the previous term, with a third topic being discarded because some students had difficulty responding to the task. The two remaining topics were designed to be comparable: they were similarly worded; both called for analysis and use of data presented graphically; both were two-part questions, asking students to generalize from the data presented and also to suggest what other data might be useful in supporting further generalizations about each topic (see the Appendix for the two topics).

All full sets of two pretests and two posttests for each student were coded numerically for section, topic, student, and form. Complete sets included four samples from each of 146 computer students and 194 regular students. All essays were then keyed into disk files, with standard margins and spacing. Grammar, punctuation, paragraphing and spelling were left as written. Words or passages of text that had been deleted on the paper copy were not keyed. If students indicated insertions or transpositions, these moves were carried out. To the extent possible, the texts were copied to disk without enhancing them but reflecting the intentions

of the authors. All essays were then printed for a uniform appearance.

Seven readers were trained to rank sample essays, using papers from students in the study who had not completed all four tasks. A detailed scoring guide with criteria for each scale was developed and used throughout the scoring process. Two readers then independently scored each of the 1360 essays using a combined holistic/analytic scale with four variables scored on a 1-6 scale and two variables scored on a 1-3 scale:

1 (low) to 6 (high)

Holistic: overall impression of quality

organization: presence and effectiveness of discourse level planning, structure, signalling

support: development of generalizations with supporting detail, examples, evidence, reasoned positions

fluency: use of various and clear sentences, effective subordination, coordination, and transition

1 (low) to 3 (high)

conventions: use of standard English syntax, spelling, punctuation

task: degree of response to writing task as stated

Where scores differed by more than a single point on a scale, a third reader scored the essay. The tie-breaking third score was used with the original score closest to it. Scores for each essay were averaged, producing a single score on each measure in a 1-6 range for the first four categories and a 1-3 range on conventions and task.

Daly-Miller Writing Apprehension Test. We administered the Daly-Miller Writing Apprehension Test during the second week and again during the fourteenth week of class.

Records of Withdrawals, Attendance, Tardiness, and Assignment Co. pletion. We collected data on withdrawals from university registrar reports. A team researcher collected bi-weekly reports from each teacher on attendance, tardiness, and completion of major assignments.

Student Evaluations. During the penultimate week of the course, students completed the short form of the "Instrument for Reporting Course and Teacher Effectiveness in College Writing Classes," a 21-item questionnaire using a five-point scale to assess both course and teacher (Witte, 1981). Six additional questions were pilot tested during the previous spring term, revised, and then appended to the Witte instrument. They concerned use of textbook and handbook, getting to know classmates, writing grammatically correct papers, becoming a better writer, and enjoying writing. These additional questions were scored separately from the Witte instrument, which underwent factor analysis during its development. Direct questions about computers were a part of neither the Witte evaluation nor our added items. No reference was made to computers.

An additional questionnaire was developed for the computer sections, with questions directly relevant to that experience. This questionnaire also used a five-point scale and was pilot tested during the previous spring term, with substantial revisions for wording and usefulness of the questions. A brief open-ended set of questions allowed for further student comments. All questionnaires were administered by researchers who made it clear to students that teachers would receive no student feedback until after grades were filed.

Teacher Evaluations. On going records were compiled from notes from the bi-weekly teacher meetings and on an ad hoc basis as teachers commented to the researchers on their courses. Teachers were encouraged to keep logs throughout the

term; four did so and these became a part of the data. At the end of the term, teachers completed a comparative evaluation of their two courses: 33 questions that had been developed through pilot testing the previous fall and spring. Additional written comments were also solicited.

Class Observations. Both classes of each of two teachers were observed continuously throughout the term, with a detailed timeline of minute-by-minute activities and an accompanying log of notes kept for each of the four sections. These data will be presented elsewhere as an observational study but are mentioned here because they did influence our sense of the program and discussions during teacher meetings.

Data Collection. Students in both regular and computer sections were told during the first week of class that writing samples, course evaluations, and measures of their attitudes about writing would be collected because the English Department was interested in learning how our programs were working and how they might be improved. It was stressed that our intention was not to evaluate individual students and that any data collected would be anonymous.

Research assistants, not the classroom teachers, administered all pre- and posttests, questionnaires, and end-of-term evaluations to ensure that all classes received the same instructions and were tested under the same conditions. Directions for testing and assessment were printed and read by the research assistants; they offered standard answers to any questions.

RESULTS

Pre- and posttests of student writing

Interrater reliabilities were calculated for the four 6-point scales using Pearson's r:

Holistic	.74
Organization	.72
Support	.71
Fluency	.66

With the two 3-point scales, conventions and task, percentage of exact agreement was calculated:

Conventions	63%
Task	96%

The high percentage of exact agreement on task was the result of sharply defined criteria. The two-part task entailed generalizing from a data set and suggesting what other data would be necessary to form a complete position. Students either responded to both parts of the task (3), to one but not the other (2), or did neither but responded in some way not called for by the task (1).

Table 1 presents regular and computer posttest means for Impromptu, Revision, and Improvement Scores (Improvement = Revision - Impromptu). The posttest scores were adjusted for pretest scores in order to eliminate the difference between the groups in their initial abilities. This allows us to simulate an experiment where treatments are applied to groups od equal abilities.

[Insert Table 1 about here]

On most measures, students in the computer sections performed slightly worse than the regular students on the impromptu portion of the posttest. But the computer

students then improved their scores on the take-home revision so that they ended up with revision scores somewhat higher than the regular students. In no case, however, is the difference between the groups on either impromptu or revision scores statistically significant.

The **improvement score** represents the difference between impromptu and revision, our measure of ability to improve a first draft through take-home revision. For the macro-level discourse features--holistic score, organization, and support--the computer students improved their essays to a greater extent than did the regular students. The two groups were comparable on their improvement of fluency and conventions; the computer group improved the task-responsiveness of their essays to bring them to almost the same level as the regular students.

Table 2 presents the results of six separate analyses of covariance, where variance in improvement scores for each of the six scaled variables served as the dependent variable. Three independent variables were defined in the model in addition to the error term: method (computer vs. regular), instructor, and interaction of instructor with method. The covariate pretest score was included in the model to reduce variability of the experimental error. The degrees of freedom for all error terms was 305.

[Insert Table 2 about here]

The instructor is the strongest effect, followed by the interaction of instructor with method, with four of the six scales showing significant contributions at the .005 level (df=11). Even after accounting for the contributions of teacher and the interaction of teacher with method, method alone still contributes significantly to variance in posttest holistic improvement scores ($p < .05$; df=1), and in task-responsiveness ($p < .05$; df =1), while the F values for organization and support

approach significance. Improvement in fluency and conventions do not appear to be much affected by any of the factors in the model.

Note that the improvement scores on the pretest (students' abilities at th beginning of the term to revise and improve holistic scores, organization, etc.) do not appear to contribute significantly to the variance on posttest improvement scores, with the exceptions of support and task scales. Table 3 presents Pearson correlations for pretest improvement and posttest improvement scores.

[Insert Table 3 about here]

These low correlations suggest that ability to improve essays through revising at the beginning of the term is not highly correlated with ability to do so at the end of term. In other words, learning appears to take place.

When the computer students wrote their posttest essays, they had the option of using either pen and paper or the computer to draft and revise their work. Table 4 presents t-tests of differences in improvement scores for paper revisers and computer revisers within the experimental treatment.

[Insert Table 4 about here]

The computer revisers improved their impromptu drafts during revision more than the paper revisers in every category except task. Those students who chose to revise on the computer at the end of the term significantly improved (at the .05 level of confidence) the overall holistic quality, the organization, and the level of support as compared to those students who chose to revise on paper. The improvement scores of the computer revisers were larger, too, for fluency and conventions, though these measures did not achieve significance. The computer revisers' improvement scores were in every case larger than the average scores for the whole group of students in the study.

Daly-Miller Writing Apprehension Test

Results for the Daly-Miller Writing Apprehension Test are presented in Table 5. We used a response scale which reverses the normal orientation, so higher scores mean higher apprehension.

[Insert Table 5 about here]

Controlling for prescore differences and comparing least squares means yields an F value of 1.11 ($p > .29$; $df = 1$), a finding of no significant difference between computer and regular students on post anxiety scores. Both groups moved in the same direction at about the same magnitude, toward slightly increased anxiety.

Records of Withdrawals, Attendance, Tardiness, and Assignment Completion

Table 6 presents figures that compare regular and computer sections on withdrawals, attendance, tardiness, and assignment completion. Not all teachers kept complete records so there is some missing data.

[Insert Table 6 about here]

In all cases, the data on the computer sections are somewhat worse than those for the regular sections. Though more regular students withdrew during the first week, the number of computer students withdrawing was higher during weeks 2-5 and 6-9, for a larger overall percentage. Attendance, too, was worse in computer sections, as was tardiness. Finally, the percentage of computer students not completing major writing assignments was double that of the regular students. Regular students also completed more of their homework assignments than did the computer students.

Student Evaluations

The short form of the "Instrument for Reporting Course and Teacher Effectiveness in College Writing Classes" loads all 21 items on two broad factors--teaching and course effectiveness. Table 7 presents the means for regular and

computer groups.

[Insert Table 7 about here]

On average, the computer students rated their instructors slightly higher than did the regular students; the regular students responded slightly more favorably to questions concerning content. Neither difference was significant.

Evaluation of Teaching. For the twelve matched sections, six instructors were favored by their computer sections, six by their regular sections. Ten of 18 statements concerning the instructor were rated more positively by students in computer sections. The student responses most strongly favoring their computer teachers included items describing the teacher as 1) helpful, 2) good at using class time to help them as they wrote, 3) intellectually stimulating, 4) good at teaching how to support ideas with examples and details, 5) good at writing comments on papers that were easy to understand, and 6) a fair evaluator.

Students in regular sections responded more favorably to five of the 18 statements concerning their instructors. The student responses most strongly favoring their regular teachers included items describing the teacher as 1) good at trying to increase their confidence about writing, 2) good at teaching them to consider audience (responses were strong for both methods), and 3) good at teaching students to write different kinds of papers.

Evaluation of Course Content. A large majority of students in both computer and regular sections agreed that the course was currently useful to them, that what they learned in the course was valuable, and that the course would be useful to them in the future.

Students in regular sections appreciated their textbook and their grammar handbook more than students in computer sections, while more computer students

agreed that they learned to write grammatically correct papers.

Students in computer and regular sections responded similarly to the statement that they got to know and work with their classmates. Comparable numbers also agreed that they were better writers at the end of the course than they were at the beginning. To the statement that they enjoyed writing more at the end of the semester, responses were almost evenly divided for both computer and regular sections.

Responses of Computer Students to the Use of Computers. An additional questionnaire asked computer students to evaluate the usefulness of computers for writing. Overwhelmingly, the students thought computers were a good writing tool. About half agreed that they preferred composing at the computer, with a third reporting that they did not usually write pen and paper drafts prior to using the computer. Two-thirds preferred to revise on the computer rather than with pen and paper. By the end of the semester, 78% agreed that they felt comfortable working with the word processor.

Responses showed that most students were not new to computers, with 43% saying they had used word processing prior to the course. Most students took advantage of their word processing skills for other courses and a third reported teaching others to use PC-Write.

Supporting software was available to all students, yet the majority of students regularly chose to rely on the word processor alone. Not quite half used the spell checker often. Far fewer took advantage of the grammar software.

Many students (52%) felt that they spent more time on the course than their friends in regular sections. But about half also believed that they made a better grade because of the word processor.

Although some people fear that the computer may de-humanize the writing classroom, the students in computer sections reported otherwise. Only 11% agreed that having computers in the classroom created a barrier between teachers and students. Only 16% felt that having computers in the classroom placed too much emphasis on machines and not enough on people.

Despite the distractions inherent in computer classroom settings, many students found the microlab a comfortable place to write; a third disagreed. Nevertheless, two-thirds agreed that they liked having their class meet in the microlab.

Responses of Students to Open Ended Questions. Students' responses to open-ended questions were overwhelmingly positive. They liked the ease of revising, editing, and proofreading; the time they saved; tne neatness of their papers at all stages; and the increased freedom in organizing. Most stated that using the computer caused them to change the way the planned, organized, wrote, revised, and edited their papers. They said that they now took more time to seriously consider their writing and more time to take their papers through various drafts. Many mentioned that spending extra time was worth it.

Access to the computers and lack of familiarity with function keys were the two problems or frustrations mentioned most frequently. Students overwhelmingly s..ted that lack of access to computers was the worst thing about writing with the computer. The second major problem was losing files. Students also complained that papers look different on screen than they do on paper, that it takes those who don't know how to type extra time to write papers, and that the lab is not the ideal place to concentrate on ideas.

The most typical advice students offered to their teachers or lab assistants was that they should better help students learn how to use the various commands and the

available software. Other advice was to use the microlab solely as a workshop environment, with no lecture time. Students also requested that not all minor assignments be done on computer since access to computers was a problem.

Most felt the English Department should continue using computers, with some stating that all writing classes should meet in the lab. Students recognized the importance of computers in their futures: 83% said that would continue to use word processing.

Teacher Evaluations

Responses of the twelve teachers to an end-of-term questionnaire are ranked in Table 7, beginning with items reflecting highest agreement and moving to lowest. To simplify presentation, "strongly agree" and "agree" are collapsed under "agree" and similarly for "disagree." Possible means range from 5 (strongly agree) to 1 (strongly disagree).

[Insert Table 8 about here]

Most teachers indicated they preferred to teach in the computer classroom and all would like to do so again, feeling comfortable and in control of their classes. Most noted that student attitude was better and that the computer classroom was more conducive for helping students with their writing while it was still in progress. Teachers felt closer to their students and appreciated the workshop setting. The teachers felt strongly that a lab assistant was necessary and that more machine access would help.

In the computer sections, teachers required more in-class writing, slightly more prewriting, and more daily assignments. Teachers tended to agree that students were doing more revising, even though they were close to neutral on the question of whether they were requiring more revising. In the teachers' judgement, the students

were comfortable using the word processor and actually did so for most assignments.

DISCUSSION

In general, our results favor the use of computers in teaching composition. The pre- and posttest comparisons of impromptu writing show that the computer students did not perform quite as well as the regular students at the end of the term when asked to write an impromptu essay. But after revising, the scores of the computer group were higher than those of the regular group. The computer group revised their work to make significantly greater improvements during revision when compared to the control students. While significantly greater improvement was found for holistic scores, the computer students also improved their essays during revision (at levels approaching significance) on the high-level discourse features of organization and support. Significantly better task responsiveness was also characteristic of the revising of the computer students--during revision, they were more likely to bring their essays into accord with the assigned task. Very little effect was apparent for low level features--sentence fluency and conventions. These findings suggest that the computer, considered by itself, does have a positive effect on student revising skills, especially discourse level skills.

One reason the computer students were able to improve their essays more than the regular students was because their impromptus were generally poorer than those of the regular students. Perhaps becoming familiar with the machine's usefulness as a revising tool encouraged students to write quick, rough drafts, which they knew they could revise later. Whatever the explanation, the computer did help the students revise their work to the point where it was a little better than that of the

regular students.

As a natural consequence of the experimental design, the computer students self-selected into two groups at the end of the term, those who chose to do their revising on screen and those who chose to revise on paper. Striking differences characterize these two groups' abilities to improve their essays on revision, with the computer revisers significantly outperforming the paper revisers on every measure except task responsiveness. All improvement scores for the computer revisers--including the holistic evaluation and the five analytic scales--were well above the average for all students in the study.

These findings suggest differences in adaptation to the technology, with some students (112 of 146, or 77%) becoming comfortable with the computer and finding ways to make it work as a revising tool. The important gains for this successful group would be obscured were their scores simply averaged with those of the smaller group who chose not to revise with the computer on the posttests. These findings echo Herrmann's findings with high school students (1987); she identified three groups who adapted with varying success to writing on the computer. There does not seem to be a simple relation of machine to improvement; instead one group takes ownership of the computer and uses it to good purpose, while a second group does not.

Though the data favored the use of computers considered in isolation, the covariate analysis showed stronger effects for teacher and for the interaction of the teacher with the method of using computers. The teacher had a very strong effect on whether the students improved. If our goal were simply improved student writing, we would probably get better results from choosing talented teachers or from training our teachers than from introducing computers into the classroom. If

we do introduce computers, we need to work with the teachers to encourage adaptation to the technology. As other researchers have noted, we cannot simply put computers in a room and expect to see dramatic improvement in student writing and revising. Teachers, not machines, have the strongest effects on student writing improvement.

The attitudinal data suggest that both teachers and students viewed their experiences in the computer classroom positively. Few considered the computer a barrier between teachers and students, and few found the computer a hindrance to learning. Students seemed to appreciate learning both writing and word processing, skills they immediately applied both in and outside the composition classroom.

The teachers received slightly higher ratings from their computer sections than from their regular sections. This may reflect the teaching situation in a lab, where students receive more individual attention as they write--teachers can move about more freely, reading and discussing the student's writing as it is displayed on the screen. More positive student responses to instructors of computer sections may reflect the more intimate classroom interaction, with students and instructors working together more directly, allowing them to know and understand one another. Though the teachers felt the computer classes took longer to come together as learning groups, in the end, many instructors felt closer to their computer students. Teachers were certainly physically closer as they helped students write, sometimes offering a pat on the back, sometimes kneeling to make eye contact.

Teachers noted that students in their computer sections seemed to have better attitudes. Most believed that this was due to the ease of writing with a computer--students were able to locate problems in their writing and make changes quickly and neatly. Instructors also found students in computer sections more willing to revise

and believed that the computer students did more prewriting and revising--even when it was not formally required. In spite of some negative feelings--about limited access to machines, about having to spend more time working on their essays, and about learning to use word processing (and invariably losing files)--the majority stated that they liked meeting in the computer classroom and that they liked using the computer to write.

There are certainly drawbacks to meeting in a lab environment. The students spend more time writing, but receive fewer lectures. Less lecture time in their computer classes caused instructors to feel rushed; some felt that the students in computer sections missed important material. However, the need to focus and organize their lecture or discussion time might actually be viewed positively--many teachers reconsidered and streamlined their practiced lectures and usual assignments. And the quality of the students' writing did not appear to suffer from having less lecture time.

Further drawbacks are indicated by the consistently poorer showing of the computer students on measures of course withdrawal, attendance, tardiness, and assignment completion. From our pilot studies and from the reports of other researchers, we know that students enjoy meeting in the lab. We had often observed students arriving early and staying late, with some even staying through two full classes. So we were not prepared for data which showed that student attendance and tardiness were worse for the computer classes.

The instructors felt that the workshop atmosphere of the computer classroom affected student attitudes toward coming on time, or indeed, toward coming at all. While our teachers readily endorsed the value of a workshop classroom that focused on work in progress, students seemed slower to perceive the value. Many students

preferred to write on their own time and viewed a workshop as "nothing being taught." Students also found they could easily enter the lab late and sit down at a computer, with little or no disturbance to others in the room.

Among those students who were in attendance, teachers repeatedly noted reluctance to engage in discussion or structured activities. In the lab, students expected to work on their texts with as little interference as possible. They did not want to discuss writing, do exercises, or answer questions on their reading. The computers exerted a strong draw on student attention, making it difficult for teachers to do anything except allow students to work individually.

The instructors noted in their logs and in weekly round-table discussions that their students often lost patience because of the long waiting period to gain access to computers. Some assignments may not have been completed because of limited time on the computers. Teachers and students agreed that free access to machines is important.

Some of the results of our study were surprising. We expected students in computer sections to see their class as more valuable and more useful to their futures, yet the responses to the evaluation questionnaire did not confirm this expectation. Likewise, we expected students in the computer sections to rank their classes higher for its interactive aspect--working with other students--but such was not the perception. Again, students simply may not share our teacherly perceptions of the value of a collaborative class.

These results on student attitudes differ from our pilot study results, which indicated that students overwhelmingly preferred having their composition classes meet in a computer classroom. Pilot study students in computer sections had much more positive attitudes toward writing, toward their course and toward their

teachers, than did the students in regular sections, giving both course and teacher more favorable ratings on every item but one. (The regular students in the pilot study found their handbook and textbook to be more useful than did the computer students.)

We believe the differences between the pilot study and the present study can largely be accounted for by the control of assigning each teacher to matched sections. Student evaluations appear overwhelmingly dependent on the teacher--the same teacher, even when methods are very different, receives approximately the same evaluation. This might suggest that we should view the glowing reports from other studies with caution--the more positive attitudes of students using computers in composition classrooms might largely be due to the teachers themselves, even when teachers in control sections are teaching from the same syllabus, using the same teaching approach, and so on. We might also assume a halo effect, with the initial enthusiasm among computer students and teachers giving way to more neutral attitudes after several terms.

While we think that matching teachers with sections successfully controlled for teacher effect, this control also exerted strong and unintended effects on the whole experience of computer classrooms. For the most part, instructors struggled to keep their computer sections parallel with their regular sections. Given a choice, most busy teacher/scholars prefer teaching one preparation twice, rather than preparing for two different classes. If teachers had taught two computer sections. we believe we would have seen even more changes in strategies, assignments, and course requirements, and, we imagine, stronger effects on writing and attitudes. Instead, teachers worked to keep the students doing the same work on the same schedule. We saw a real change from the pilot study, when computer teachers talked about

how they needed to reduce the number of assignments, change their strategies to fit the microlab environment, and design assignments to take advantage of the collaborative possibilities of the computer classroom. During the study itself, we watched teachers do everything they could to make the classes the same, in spite of our urgings to adapt as necessary.

This study provides important support for using computers to teach college composition, and future studies should incorporate several features of this study. Students should be tested for revision skills as well as impromptu skills, since this is where we should expect to see the most benefits of the technology. Students also should be allowed to compose on computers for evaluation. While we should continue to recognize the importance of attitudes, we should also continue to collect data from writing evaluation and unobtrusive measures of course success (such as attendance or assignment completion).

Future studies should test systematically for the unintended results from this study. Specific studies should be designed to distinguish subgroups among students using computers to tease out the differences between those who adapt well to the technology and those who do not. Likewise, we should study and attempt to isolate what it is that determines how well individual teachers adapt to a lab environment, recognizing that we should not expect all teachers to be comfortable and successful in a lab setting. We should study how teachers change their strategies when they are free to adapt instruction to a lab setting by removing the constraint of double preparation. This suggests open, naturalistic investigation of teachers in lab settings to hypothesize and define variation and adaptation.

Finally, we need to acknowledge that we may not be able to measure confidently the effects of such a powerful writing tool on such a complex skill as

writing ability. The literature on testing for student learning over the space of a term--whatever the experimental treatment and whatever skill is considered the dependent variable--is equivocal at best. The effects of computers on writing ability may not be a matter of quick transfer, but of subtle and incremental evolution over the life of a writer (See Perkins, 1985). The real results of introducing student writers to computers may be realized over the long term, as students continue to grow as writers and become increasingly proficient at using the machine to enhance their writing processes and products.

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Appendix
Topics for Pre- and Posttests

Topic #1

The World Almanac and Book of Facts 1985 (p. 113) presented the following information about various U. S. cities:

Quality of Life in U.S. Metropolitan Areas: A Comparative Table*

City	Per Capita Personal Income 1982	% Job-less Apr. 1984	Pro-jected Annual % Growth in jobs 1979-1993	Pro-jected Annual growth in income 1979-1993	Mean # days clear-cloudy	Mean # days below 32 F	Nor-mal daily temp. Aug. F
Atlanta, Ga.	11,590	4.3	3.1	3.5	108-149	58	86.4
Buffalo, N.Y.	11,160	8.5	—	1.0	55-208	132	77.6
Chicago, Il.	13,069	8.7	0.6	1.6	86-173	99	82.3
Dallas-Ft.Worth, Tx.	13,846	3.9	2.7	3.6	138-132	41	96.1
Denver-Boulder, Co.	13,964	4.1	2.5	3.2	11?-120	157	85.8
Honolulu, Ha.	12,130	4.7	1.8	2.4	86-100	0	87.4
Milwaukee, Wis.	12,597	6.6	0.7	1.6	94-172	144	79.7
Phoenix, Ariz.	11,086	3.9	2.9	3.6	213-071	10	102.2
Salt Lake City-Odgen Ut.	9,670	6.1	1.7	2.6	127-135	128	90.2
San Francisco, Ca.	17,131	6.2	1.4	2.3	162-104	0	68.2
Seattle-Everett, Wa.	13.239	8.4	1.5	3.0	71-201	16	74.0

The chart above summarizes information that could be used to determine which cities are the best places to live. Using the information given, discuss in an essay how these factors (such as per capita personal income) might relate to the quality of life. Also include suggestions concerning what additional factors are important in comparing the quality of various cities.

Topic #2

USA Today (May 5, 1986) asked American families about their vacation plans. They responded as follows:

How much will you spend?

500 or less	32%
501-1,000	25%
1,001-1,500	11%
1,501-2,500	13%
2,501-or more	12%
Don't know or wouldn't say	7%

How will you travel?*

airplane	53%
our car	50%
rental car	23%
train or bus	10%
camper or RV	8%

*more than one answer in some cases

What will you do?

Sightseeing	41%
rest, relax	28%
swim, water sports sunbathe, beach	19%
visit friends/ relatives socialize	14%
play sports	10%
fishing, hunting	10%
camping/hiking	9%

Where will you go?

Florida	13%
California	10%
Texas	5%
Bahamas	5%
Europe	5%
Canada	4%
Hawaii	3%
Michigan	3%
New York	3%

The chart above summarizes information about family vacations. Using the information given, discuss in an essay what seems to be the typical family vacation. Also include suggestions concerning what additional information is necessary to give a complete description of a typical family vacation.

Table 1

Adjusted Posttest Means

Regular vs. Computer

		Impromptu	Revision	Improvement
Holistic	Regular	3.29	3.70	.41
	Computer	3.17	3.78	.61
Organization	Reg	3.31	3.65	.34
	Comp	3.19	3.68	.49
Support	Reg	3.31	3.70	.39
	Comp	3.26	3.84	.58
Fluency	Reg	3.27	3.70	.43
	Comp	3.29	3.71	.42
Conventions	Reg	2.24	2.35	.11
	Comp	2.26	2.38	.12
Task	Reg	2.4	2.50	.03
	Comp	2.37	2.52	.15

Table 2

F Values for Analysis of Variance

Using Improvement from Posttest Impromptu to

Posttest Revision with Pretest Scores Controlled

	Method (DF=1)	Instructor/ Method (DF=11)	Instructor (DF=11)	Pretest (DF=1)
Holistic	4.59*	2.64**	3.71**	1.15
Organization	2.38	2.86**	4.10**	.16
Support	3.64	2.71**	3.79**	6.81**
Fluency	.00	1.15	1.11	.79
Conventions	.02	1.35	1.78	.27
Task	5.23*	1.92*	3.49**	4.23*

* $p < .05$

** $p < .005$

Table 3

Pearson Correlations for Improvement Scores on Pre- and Posttests

n = 330

Holistic	.07
Organization	.02
Support	.12
Fluency	.06
Conventions	.01
Task	.04

Table 4

T-Tests for Between-Group

Differences in Improvement Scores:

Paper vs. Computer Revisers

	All Subjects (n=330)	Paper Revisers (n=34)	Computer Revisers (n=112)	t
Holistic	.48	.?4	.69	-2.38*
Organization	.41	.15	.58	-2.22*
Support	.47	.22	.66	-2.31*
Fluency	.42	.26	.45	-.98
Conventions	.12	.00	.16	-1.36
Task	.09	.24	.12	1.18

* $p < .05$

Assuming unequal variances

Table 5

Test of Writing Apprehension

	(n)	Pre	Post
Computer Students	182	84.2	86.6
Regular Students	207	78.8	81.3

Note: Higher score = higher apprehension

Table 6

Withdrawals, Attendance, Tardiness, and Assignment Completion

Withdrawals

(12 regular; 12 computer classes)

	Regular	Computer
Total	33 (11.5%)	40 (14%)
First week	17	11
Weeks 2-5	5	12
Weeks 6-9	11	17

Attendance

(10 regular; 10 computer classes)

Average % absent	9.02	9.51
First half term	8.15	8.62
Second half term	9.89	10.40

Tardiness

(10 regular; 10 computer classes)

Average % tardy	3.12	4.39
First half term	2.36	3.78
Second half term	3.88	5.00

Non-Completion of Writing Assignments

Percentage of students not turning in work:

	Regular	Computer
Major Assignments	4.18	8.45
(11 regular; 11 computer classes)		
Homework assignments	9.87	14.62
(7 regular; 7 computer classes)		

Table 7

Results of Course Evaluation

Teacher effectiveness	Mean
Computer	2.52
Regular	2.55

Course effectiveness	Mean
Computer	2.21
Regular	2.17

Note: These are grouped means for all items relating to teacher and all items relating to course effectiveness, calculated from a 1 to 5 scale, where 1 is strongly agree and 5 is strongly disagree. Polarity has been reversed on negatively worded items. Lower means indicate more positive evaluation.

Table 8

Responses of Teachers to the Use of Computers

		Mean	Agree	Neutral	Disagree
1.	Students had problems getting to a machine:	4.67	12	0	0
2.	I'd like to teach in the lab again:	4.58	10	2	0
3.	I walked around the room more:	4.58	11	1	0
4.	Students did all their assignments on the microcomputer:	4.42	5	7	0
5.	I had to streamline and focus my lectures/discussions	4.42	11	1	0
6.	The setting allowed for more interaction between me and the students	4.25	11	0	1
7.	The setting allowed for more interaction among students	4.25	10	2	0
8.	I required more in-class writing:	4.08	11	0	1
9.	I made specific assignments that required the use of the microcomputer:	4.08	9	3	0
10.	A lab assistant is necessary:	4.08	8	2	2
11.	I enjoyed teaching this section more:	4.00	9	0	3
12.	I lectured less:	4.00	8	3	1
13.	Students revised more:	3.92	9	3	0
14.	Students were more confident writing on the computer as opposed to pen and paper by the end of the course:	3.83	7	5	0
15.	I checked the student writing more:	3.75	8	3	1
16.	Students did more prewriting:	3.75	8	3	1

17. Students needed more instruction on the machine:	3.67	6	4	2
18. Student attitude was better:	3.58	8	2	2
19. I touched the students more:	3.50	6	5	1
20. I was stricter about the appearance of the papers:	3.50	6	4	2
21. I felt more in control of the class:	3.42	6	4	2
22. I felt closer to these students:	3.42	7	2	3
23. Grading was easier:	3.42	7	2	3
24. Students received less information about writing:	3.33	7	2	3
25. I required more prewriting:	3.25	5	4	3
26. I assigned more daily writing	3.17	5	4	3
27. Students felt more anxious:	3.17	4	6	2
28 I felt more comfortable:	3.08	3	5	4
29. I created assignments on disk and transferred them to student disks:	3.08	6	0	6
30. I required more revising:	2.92	4	4	4
31. Student ideas were better:	2.75	0	10	2
32. Students turned in fewer late papers:	2.33	1	6	5
33. I required fewer major themes:	2.00	2	1	9