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ABSTRACT

These two serial issues are devoted to the impact of computers on education, and specifically their effects on developmental education programs. First "The Effects of Computer-Based Instruction" summarizes the literature on the impact of computer-based instruction, including a study by James and Chen-Lin Kulik and Peter Cohen, which found that: (1) of 54 studies reviewed, 37 concluded that students participating in computer-based courses obtained higher test scores than students in conventional courses, while 17 studies favored those participating in conventional courses; (2) only seven studies dealt with the correlation between aptitude and achievement, of which four showed a higher correlation between aptitude and achievement in conventional sections; (3) course completion was more likely in conventional courses according to seven studies, while six studies reached the opposite conclusion; (4) the studies that measured student attitudes found the difference in attitudes towards the two kinds of classes to be small; and (5) the average time an instructor spent with students was significantly lower in computer-based classes, according to eight studies. In the second issue, "Computerized Writing Instruction in Developmental Writing Programs," by Bill Broderick and David Caverly, focuses on the incorporation of computer-assisted instruction and word processing into developmental writing programs and offers suggestions on how such instruction can be used effectively to enhance student writing in basic and developmental writing programs at each stage of the writing process (i.e., pre-writing, writing, editing, and publishing). The benefits and drawbacks of this model are discussed. (JMC)

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Research in Developmental Education

The Effects of Computer - Based Instruction

Computer-Based Instruction:

What is its impact on students?

Does CAI help keep students in the classroom?

Does CAI save time?

AND MORE

Published by Appalachian State University

This issue of RESEARCH IN DEVELOPMENTAL EDUCATION is devoted to the effects of computer-based instruction in college level courses. This topic is important to developmental education and learning assistance practitioners for several reasons. First of all, many developmental and learning assistance programs are being asked to use computer-based instruction to assist underprepared students in the area of basic skill development. Practitioners in these programs and their supervisors need to know what they can reasonably expect from computer-based instruction. Secondly, like any other instructional technique, computer-based instruction has its strengths and its limitations. It would be beneficial to know what these strengths and limitations are before widespread adoption of computer-based instruction is undertaken. Finally, it would be useful to know what impact computer-based instruction might be expected to have on the specific population served by developmental and learning assistance programs.

While there has been an abundance of research on computer-based instruction during the past decade, much of the resulting data is unclear. As Glass notes (1976, p. 3) "In education (research) findings are fragile; they vary in confusing irregularity across contexts, classes of subjects, and countless other factors. Where ten studies might suffice to resolve a matter in biology, ten studies on computer assisted instruction.... may fail to show the same pattern of results twice."

Glass goes on to point out that conflicting findings in educational research are usually resolved by criticizing the design of all but a few studies and then advancing the information found in a handful of "acceptable" studies as the truth of the matter. Glass, however, believes that the data resulting from poorly-designed studies is probably not that much different from data resulting from well-designed studies. He contends that a major problem confronting educational researchers is to find a methodology for generating useful information through analysis of a wide variety of research studies -- regardless of the design strength of these studies. He proposes that a powerful tool for this sort of research is "meta-analysis" which applies the same statistical methods used in primary research to the analysis of large numbers of original studies. This type of analysis helps to give meaning to the variance in results typically found in educational research. It emphasizes the general trends of research findings rather than the variance in results between studies.

The technique of meta-analysis proposed by Glass was first described in a 1976 article appearing in THE EDUCATIONAL RESEARCHER (pp. 3-8). The technique has since been applied to a number of educational research questions with useful and informative results. One of the most important studies of computer-based instruction, for instance, was conducted by James and Chen-Lin Kulik and Peter Cohen using meta-analysis to assess the results from over 500 studies of computer-based instruction (1980).

Methodology

In designing this study, the authors reviewed the results from practically all the available research on computer-based instruction. Following this review, the vast majority of studies were disqualified from further consideration because they: 1) did not deal with college-level instruction, 2) did not provide quantitively measured outcomes, or 3) they suffered from "crippling methodological flaws (p. 528)." This provided a total of 180 acceptable studies for further review. When these were examined for the purpose of determining whether or not the information they contained was appropriate for meta-analysis, the number was further reduced to 59.

The authors then assigned information from each study to one of five categories:

1. effects on students' achievement

2. correlations between student aptitude and achievement

3. effects on students' rates of course completion

4. effects on students' attitudes

5. effects on time required for instruction.

A variety of statistical techniques was used to assess each of these categories. General trends in the research were then calculated and reported for each category of data.

Results

Student Achievement

Of the studies reviewed, 54 considered the effects of computer-based instruction on student achievement. The measure of achievement used was student examination scores. Of the studies reviewed, 37 indicated that students participating in computer-based courses obtained higher examination scores than students participating in conventional courses. In 17 studies, the results favored those participating in conventional courses.

Using more detailed statistical analysis, the authors found a slight but significant difference in examination scores between those enrolled in computer-based courses and those enrolled in conventional courses. The average examination score in computer-based courses was 60.6 percent while the average examination score in the conventional courses was 57.6 percent (p. 534). While this amounts to a difference of only 3 percentage points, the difference is statistically significant at a .01 level. Essentially, the computer-based instruction courses had the effect of raising student examination scores by about one quarter of a standard deviation from the norm.

The authors point out that, while this difference in effect is clearly due to the difference in technique employed (i.e., computer-based vs. conventional instruction), the positive effect of computer-based instruction is modest (p. 538). Research assessing the impact of such techniques as Keller's PSI for instance, showed a much greater positive impact on performance than the use of computer-based instruction (Kulik, Kulik, and Cohen, 1979 and Hursh, 1976).

Aptitude-Achievement

The authors found only 7 studies dealing with the correlation between aptitude and achievement in computer-based instruction. Three of the studies showed a higher correlation between aptitude and achievement for those enrolled in computer-based courses. Four of the studies showed a higher correlation between aptitude and achievement in the conventional sections. The authors also calculated the average correlation between aptitude and achievement for all conventional and computer-based instruction courses where such correlations were reported. They found that the average correlation coefficient for computer-based courses was .41 and the average for conventional courses was .51 (p. 537).

Insofar as developmental students are concerned, the use of computer-based instruction does not seem to improve their performance any more or less than any other type of student. As the authors point out, the slight increase in examination performance attributed to computer-based instruction was "...about as noticeable in high and low-aptitude students as it was in average students (p. 538)."

Course Completion

A total of 13 studies were found investigating

Resourcery

COMPUTER - BASED INSTRUCTION

SOFTWARE RESOURCES

The following organizations and publications are recommended as sources of additional information on educational software appropriate for computer-based instruction.

ASSOCIATION FOR EDUCATIONAL DATA SYSTEMS (AEDS) -- provides both a journal and a monthly bulletin. Additional information may be obtained by contacting AEDS, 1201 16th Street, NW, Suite 506, Washington, D.C. 20036 (202) 833-4100.

ASSOCIATION FOR THE DEVELOPMENT OF COMPUTER-BASED INSTRUCTION (ADCIS) -- provides both the Journal of Computer-Based Instruction and the ADCIS Newsletter. Additional information may be obtained by contacting the Computer Center, Western Washington University, Bellingham, WA 98225.

CONDUIT -- a resource center and clearinghouse for educational computing. Additional information may be obtained by contacting James W. Johnson, Director, CONDUIT, P. O. Box 388, Iowa City, IA 52244.

BOSTON COMPUTER SOCIETY -- publishes a bi-monthly journal entitled Boston Computer Update and coordinates several user information sharing groups. Additional information may be obtained by contacting the Boston Computer Society, 17 Chestnut Street, Boston, MA 02108. Membership cost is $15 per year.

COMPUTER RESOURCE CENTER -- a resource clearinghouse and demonstration center sponsored by the Technical Education Research Center. Additional information may be obtained by contacting the Director, Richard Kane, 8 Elliot Street, Cambridge, MA 02138 (617) 547-3890.

MICROCOMPUTER RESOURCE CENTER -- sponsored by Teacher's College of Columbia University. The center features demonstration stations for educational hardware and a resource collection of books, articles and technical bulletins. Additional information may be obtained by contacting the Center, Room 655G, Thorndike Hall, Columbia University, 525 West 120th Street, New York, NY 10027 (212) 678-3740.

NARDSPE -- ADVISORY TASK FORCE ON COMPUTERS IN EDUCATION -- a resource and advisory body sponsored by the National Association for Remedial/Developmental Education. Additional information may be obtained by contacting Curtis Miles, Piedmont Technical College, P. O. Drawer 1467, Greenwood, S.C. 29646 (803) 223-8357.

SOCIETY FOR MICROCOMPUTER APPLICATIONS IN LANGUAGE AND LITERATURE -- publishes a quarterly newsletter emphasizing computer usage for English instruction. Additional information may be obtained by contacting the Society, Wendell Hall, University Station, Box 7134, Provo, UT 84602.

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ning conventional instruction.

Computer-based instruction also appears to have at least two potential weaknesses. The technique does not appear to be much more effective than other individualized instructional technqiues. In fact, the amount of improvement in student performance appears to be greater in individualized courses using PSI or autotutorial techniques (Kulik, Kulik, & Cohen, 1980, p. 539). The decision to use computer-based instruction, therefore, may involve a compromise between the amount of improvement to be expected in student performance and the amount of instructional time to be saved by using computer-based instruction.

A second potential weakness, based in part upon the compromise noted above, is that too much may be expected of computer-based instruction. It is, indeed, an effective instructional technique. It will not, however, bring about any miraculous change in student performance and attitudes.

Fir there is no evide. o suggest that compu based instruction is particularly well or poorly-suited to the needs of students who participate in developmental or learning assistance programs Developmental and learning assistance program personnel should base the decision to use computer-based instruction on the same criteria they would use to select any other form of instruction -- i.e., does the program have the time, resources, and expertise to utilize this technique adequately. While computer-based instruction is a perfectly useful and valid instructional technique, it is not going to resolve the problems of underprepared college students to a greater or lesser degree than any other form of instruction.

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Kulik, J. A., Kulik, C. C. and Cohen, P. A., "Effectiveness of Computer-Based College Teaching: A Meta-analysis of Findings," Review of Educational Research, Winter, 1980, pp. 525-544.

Kulik, J. A., Kulik, C. C. and Cohen, P. A., "A Meta-analysis of Outcome Studies of Keller's Personalized System of Instruction," American Psychologist, Fall, 1979, pp. 307-318.

Murhpy, R. T. and Apel, L. R., "Evaluation of the PLATO IV Computer-based Education System in the Community College," Princeton, NJ, ETS, 1977.

the effects of computer-based instruction on course completion. Seven of these showed the withdrawal rate to be higher in the computer-based sections while 6 showed the withdrawal rate to be higher in conventional sections.

Using reported withdrawal rates from all sections, the authors calculated averages and used various tests of significance to determine if any differences existed between computer-based and conventional sections. No significant differences were found between the withdrawal rates of students in computer-based versus conventional courses. Also, no evidence was found to suggest that withdrawal rates for low-aptitude students were any different than for high-aptitude or average students. Apparently, the use of computer-based instruction has no measureable effect on the likelihood that a given student will complete the course.

Student Attitudes

A total of 11 studies were found comparing the attitudes of students in computer-based versus conventional courses. Four of the studies showed that students had more favorable attitudes towards the computer-based courses. One study indicated that students had more favorable attitudes toward the conventional course. Although the general direction of the findings favored computer-based instruction, the actual amount of difference in attitudes towards courses was small. Using a 1 to 5 rating scale (with 1 being the lowest rating and 5 being the highest rating, to compare students' attitudes toward course quality, the students enrolled in computer-based courses rated their courses at an average of 3.77. Those enrolled in conventional courses rated theirs at an average of 3.5 (p. 537).

The authors also attempted to determine whether or not the use of computer-based instruction had any effect on student attitudes towards the subject matter. Seven of the studies reviewed dealt with this issue. Five studies showed a slightly positive change in attitude towards the subject matter for students enrolled in computer-based courses. In two of the studies, students expressed a more favorable attitude towards the subject matter in the conventional courses. When the actual amounts of difference were calculated, however, the differences were quite small in all the studies reviewed. The authors concluded that there was no statistically reliable difference in attitude towards the subject matter for students enrolled in computer-based courses versus those enrolled in conventional courses (p. 537).

Instructional Time

The one area in which the authors found a major and consistent difference between computer-based and conventional courses was that of instructional time. Eight of the studies reviewed investigated the amount of instructional time involved in teaching computer-based versus conventional courses. Each of these studies suggested that the use of computer based instruction saved a substantial amount of instructor time.

When converted to average amounts of instructional time per week, the data from all 8 studies indicated that instructors spent 3.5 hours per week in the teaching of conventional courses and only 2.25 hours per week teaching computer-based courses. As the authors note, "This is a substantial and highly significant difference between methods (p. 539)."

SUMMARY & CONCLUSIONS

While the Kulik, Kulik, and Cohen study may not be "the last word" on this topic, it is certainly one of the most extensive pieces of research yet to appear on the effects of computer-based instruction. Of course, there have been other major efforts to assess the impact of computer-based instruction. The Educational Testing Service (ETS) sponsored two major studies of computer-based instruction using the PLATO (Murphy & Appel, 1977) and the TICCIT systems (Alderman, 1978). Data from both studies were, however, included in the Kulik, Kulik, and Cohen study. As the authors note (p. 539), the data from these studies was not weighted even though they were the largest in terms of numbers of students and courses. The results of the ETS studies were, for the most part, consistent with the findings of Kulik, Kulik, and Cohen. The only difference was that the ETS studies found withdrawal rates in computer-assisted courses to be higher than conventional courses. They also found student attitudes toward computer-based courses to be slightly more negative.

Granted the weight and the modest differences in findings between these studies, it is still possible to draw several conclusions about computer-based courses.

1. Computer-based instruction appears to have a very modest positive impact on student academic performance.

2. There is no apparent correlation between aptitude and achievement in computer-based courses.

3. Computer-based instruction does not appear to reduce classroom attrition. The evidence is not sufficient to indicate whether or not it increases classroom attrition.

4. The use of computer-based instruction does not appear to have much effect on student attitudes toward courses or subject matter.

5. The amount of instructor time required for computer-based instruction is less than that required for conventional instruction.

At the beginning of this issue of RESEARCH IN DEVELOPMENTAL EDUCATION, it was stated that developmental and learning assistance practitioners need to know what can be expected from computer-based instruction, what its strong and weak points are, and what types of students might best be served by computer-based instruction. The research suggests answers to each of these questions.

In essence, practitioners can expect computer-based instruction to produce about the same outcomes as conventional instruction. Computer-based instruction should be at least as effective as conventional instruction and, in some cases, may be related to a slight improvement in student academic performance.

The major strength of computer-based instruction is that it appears to reduce the amount of time required by the instructor. It should be noted, however, that time is reduced only <u>after</u> the computer-based instructional program has been designed; software packages have been selected or developed; and course procedures have been developed. These items will consume <u>more</u> time than is typically consumed in plan-

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Computerized Writing Instruction in Developmental Writing Programs

by Bill Broderick and David Caverly

While it is clear that microcomputers have achieved a general level of acceptance in education and that their use in such areas as spreadsheet design, graphics, communication, and word-processing has facilitated innumerable teaching tasks, questions remain regarding the value of computers in basic and developmental writing settings. Some view them as a threat to basic writers, believing, as do Nichols (1986) and Collier (1983), that if students have to learn how to manipulate a computer while learning how to write, the experience can be stressful and can interfere with the writing process. Herrmann (1984, 1985) concurs, and suggests that, if one wants students to use computers in the writing process, a word-processing course should be taught separate from composition. Others, including Rodrigues (1985) do not agree, arguing that learning word processing before being permitted to write poses another obstacle for the basic writer to overcome. She and Arkin and Gallagher (1984) contend that if students are given a minimum number of commands, just enough so they can operate a word-processing program, they can benefit from using a computer to learn to write. Hunter (1983) concurs, and provides her students with a simplified set of instructions as they compose.

Research by Saunders (1986), Huard and Malinowsky (1986), Engen-Widen and Collins (1986), and Schwartz and Bridwell (1984) show that there is a clear trend toward the incorporation of computerized writing instruction (the integration of computer-assisted instruction and word processing) into developmental writing programs. This article will look at how this integration is being accomplished and will offer suggestions on how such instruction can be used effectively to enhance student writing in basic and developmental writing programs.

A Cognitive-based Model for Composition

A number of different models for composition are in use today (Hubert, 1985). Among the most widely used is one described by Flower and Hayes (1981), consisting of these stages:

1. The pre-writing stage;
2. The writing stage;
3. The editing stage;
4. The publishing stage.

What follows is a description of each of these stages, and a look at how the computer can be used to enhance instruction within each phase of the writing process.

1. The pre-writing stage. This stage consists of gathering information, defining the purpose of the writing, and planning how to best present it. Students research, create, brainstorm, probe, and invent in an effort to find a general topic, narrow their focus to a more specific topic, determine their goals for writing, and choose the appropriate form to convey their ideas to their intended audience.

The computer can assist with this process in a number of ways. First, if we think of part of this stage as being a free-wheeling, brainstorming session, the computer can be invaluable, since it works so quickly. It can follow and copy thoughts as fast as they come to the writer's mind, and, once the thoughts are down, they can be expanded, deleted, or organized in virtually any way the writer chooses. Second, computers can involve other students in this inventing process. Schwartz (1984) suggests an activity in which an individual student chooses a topic and other students respond to this topic anonymously, using the computer to store comments which would advise, suggest alternatives, and provide both useful and continuous feedback and the human interaction so many basic writers need. Third, the computer itself can be used to interact with the writer, providing structured assistance by asking the student for examples of a particular topic, or by probing for the history of the topic, or suggesting that the student look for causes or comparisons, or by branching into areas tangential to the chosen topic. Software programs such as *Quest, Seen, TOPOI, TAGI* (part of *Writer's Helper*) and *Wordsworth II* can assist students in this stage by helping them choose a topic, by keeping the brainstorming going, by probing, and by looking at different perspectives. Finally, as Rodrigues and Rodrigues (1984) point out, programs such as the ones listed above also provide the computer with the capability to adjust to the individual writing style of the student through a systematic question-based heuristic. Thus, the novice writer does not have to conform to a specific style, but can use one with which he/she is comfortable. The computer is seen here as a catalyst to individualizing instruction, and since it is both infinitely patient and entertaining, can serve as a motivator as well.

2. The writing stage. During this stage, the student takes ideas gathered in the pre-writing stage and organizes them. The focus is on getting ideas down on paper, or in print, in a structured way. This process requires different tasks including choosing and trying out different words and phrases, revising or discarding ideas which don't meet the goals set during the pre-writing stage, and, sometimes, changing those goals. At the end of this stage, the student should have a workable, coherent draft.

As the student composes, a good word-processing program can free the basic writer from the constraints inherent in either paper and pencil or typewriters, both of which are not only slower than a computer, but are also linear in nature. Newton (1985) suggests that any program with sophisticated features permitting effortless manipulation of material makes this stage easier and more meaningful. Word-processing programs which allow the writer to embed (print comments on the screen but not on the printed copy); work on different sections of a paper at one time by opening windows or split screens; move blocks of material from one point in the paper to another; delete material quickly; enhance print with automatic underlining and boldfacing; and quickly move the cursor to any point in the paper are features which can make this stage of the composing process less frustrating.

Daiute (1985) points out one problem of relying on computers during this stage of writing. She says that because of the computer's speed, the writing that is done simulates speech, and that computer drafts often contain errors of spelling and syntax that approximate speech. Standard word-processing commands cannot correct these errors, and writers need to be advised to move on to the next stage, not to just stop with their computer draft.

3. **The editing stage.** When the student is satisfied that the ideas he has created are presented in the way he had intended, he is ready to proofread the work. This part of the process is used to make sure that the draft conforms to the goals established in earlier stages and to polish the work by looking for grammatical, syntactical, or textual errors.

This is the most tedious stage in the entire process, and as Rosenbaum (1984) points out, students often pay too little attention to this stage. In fact, research by Shaughnessey (1977) and Bereiter and Scardamalia (1982) suggest that basic writers may not even know how to revise. Computerized writing instruction can facilitate this process in different ways. First, sophisticated word-processing programs now have features such as spelling checkers which can correct the spelling of individual words and ensure that the spelling is consistent throughout the work. Second, there are a number of on-line dictionaries and thesauruses available, permitting a writer to look up words for definition, part of speech, etc., or to provide synonyms for words. Third, text-analysis programs such as *The Random House Proofreader, Grammatik II, Homer*, and *Writer's Workbench* can conduct global searches to check for repetitions of words, errors in usage, sentence length and type, and can offer suggestions for improvements. Daiute (1985) points out the importance of such programs to this revision/editing phase, observing that they go beyond looking at surface features and probe for the depth of understanding and total organizational sense that can make an instructional impact.

4. **The publishing stage.** With this stage, students present their completed products to an audience beyond the instructor. Publishing activities can range from simply posting work on the bulletin board to printing work in a school newspaper or a publication devoted to student writing. They are designed to give an added purpose to the writer's work, and can be an important motivational tool to use with basic writers. With the onset of desktop publishing, computers now have the capability to assist in and enhance this process. Powerful yet easy to use programs such as *MicrosoftWord, Pagemaker*, and *Ventura publisher* can give a professional look to a student's work, can add dimensions such as specialized fonts and graphics (Kleper, 1987), and can make publication, even on a small scale, possible.

Conclusion

There is evidence to suggest that providing computerized writing instruction to basic writers can improve student writing (Kurth & Stromberg, 1984; Hunter, 1983, 1984; Rosenbaum, 1984). Nonetheless, there are cautions which must be heeded:

1. Saunders (1986) tells us that the traditional use of computers in a developmental writing setting has been to diagnose the student's "ability," focusing on a model based upon rules of grammar and spelling. This has been followed with a prescription based on the same premise: if a student shows a need for work on run-on sentences, he is given drill and practice courseware until the deficiency is "corrected." This specific skills approach ignores the obvious: Students in a writing class should be writing as much as possible.

2. It would be just as fallacious to think of the stages presented in the Cognitive-based Model for Composition above as being mutually exclusive. Indeed, if we treat the writing process as a series of distinct entities, there is a likelihood that the computer will be used in a lockstep approach which does not improve writing (Daiute, 1985). We need to understand that writing is a dynamic and a recursive process (Schwartz, 1984), and that, for computerized writing instruction to work with developmental students, our focus must be on the computer as a tool to facilitate the writing process, and, as Herrmann (1983) and Saunders (1986) point out, this process must be seen as a holistic one.

3. Selfe and Wahlstrom (1986) suggest that we look at the failure of other machines which have been introduced to the teaching field and learn from our mistakes so the computer doesn't follow the same path as the controlled reader, tachistoscope, and other mechanical marvels collecting dust in some storeroom.

So, where does the computer fit into the developmental writing class? Happily, we are to the point where no one is even suggesting that this collection of silicon, switches, and circuit boards can replace teachers. Rather, we should look at prudent use of the computer. Such use would recognize it as a pedagogical tool which can enhance sound, well-planned developmental writing instruction. Computerized writing programs which require students to interact and which allow students to explore and experiment, have a place in basic writing classes and developmental writing labs. Anything less is unacceptable.

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EDITOR'S NOTE

Recently, Kellogg Institute alumni were surveyed to learn the symposium topic that would interest them most. Although the response level was modest, the most frequently mentioned area of interest could be restated as follows: "Research: What works and what doesn't work in Developmental and Learning Assistance Programs." Interestingly, this topic is consistent with *RRiDE's* mission. In order to select more specific vital areas for research, we are asking *RRiDE's* readers to submit to the editor research topics that they would like to see treated in future issues of the publication. Reviewing your responses will enable us to concentrate our attention on developing studies that will best serve the developmental profession.

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