ED309050 1988-00-00 Microcomputers in the Science Classroom. ERIC/SMEAC Science Education Digest No. 3, 1988.

ERIC Development Team

www.eric.ed.gov

Table of Contents

If you're viewing this document online, you can click any of the topics below to link directly to that section.

ERIC Digests

ERIC Identifier: ED309050
Publication Date: 1988-00-00
Author: Helgeson, Stanley L.
Source: ERIC Clearinghouse for Science Mathematics and Environmental Education Columbus OH.

Microcomputers in the Science Classroom. ERIC/SMEAC Science Education Digest No. 3, 1988.

This digest presents a brief description of some selection of information representative of recent activities.

USES OF MICROCOMPUTERS

In considering current and potential uses of microcomputers, Tamir (1985/86) examines three modes of microcomputer applications: tutorial, tool, and tutee. In the tutorial mode, drill and practice is the most common use, although the tutorial function may also appear in the form of remedial programs. Tamir also includes testing as a part of the tutorial function because it is such an integral part of the science curriculum. Homework tasks similar to those described under remediation and testing represent another form of tutorial use if the homework is systematically evaluated and feedback provided (Tamir, 1985/86).
The microcomputer as a tool can serve many management, administrative, and instructional functions. In calculations and statistical analysis, an important function of microcomputers is in performing time-consuming or complex calculations, especially in those cases involving relationships of two or more variables over time. Microcomputers can also be used to perform standard statistical analyses such as frequency distributions, t-tests, Chi squares, regressions, analyses of variance and the like (Tamir 1985/86). Word processing is another important tool function of the microcomputer that represents a major time savings to both students and teacher. Not only can science reports be produced in less time, but reports generated with a word processor have been found to be better written as rated by independent raters in five categories: spelling and punctuation, organization and design, sentence structure, clarity, and overall quality (O'Brien and Pizzini, 1986). Drawing and graphics display capabilities involving the microcomputer as a sophisticated visual aid incorporating color, animation, and sound still need much exploration. The potential for combining such graphic cues with other forms of instruction would seem to be promising.

Data accumulation and processing represent still other tool functions. The microcomputer can be used to collect, analyze and display data in the form of graphs and charts, showing relationships that change as the values of the variables change. The interactive capability of the microcomputer makes possible problem solving and decision making applications. In some programs students identify variables, define hypotheses, determine methods of measurement, treatments, procedures, and proposed techniques of data analyses. Data drawn from research can be stored in the computer's memory so that students can process and examine the data, test predictions, and draw conclusions. Simulations and games can allow the students to examine models and relationships of the real world under controlled conditions, to study variables which might otherwise be inaccessible. This capability of the microcomputer to provide models of scientific phenomena or systems has significant potential for science teaching (Tamir, 1985/86).

The microcomputer as tutee is different in both kind and emphasis from the tutorial and tool functions. In the latter cases, the student uses the microcomputer as an aid to learning, with communication in the student's language. In the tutee function, the student "teaches" the microcomputer, using the computer's language. Perhaps a more important difference is in the nature of the task. In the tutorial and tool modes, the student is attempting to learn by using existing programs. In the tutee mode, the student attempts to clarify a problem in order to communicate it effectively to the computer. To be successful, then, requires that the student come to understand the problem that is to be "taught" to the computer. Much more work is needed on the effect and potential of this mode (Tamir 1985/86).

EFFECTIVENESS OF MICROCOMPUTERS

Some examples of recent research on the effectiveness of the microcomputer in the science classroom will be briefly summarized. The effects of alternative ways of using microcomputer simulations on the achievement and attitudes of sixth- and seventh-grade science students were studied by Shaw and Okey (1985). Nine classes were randomly assigned to one of four treatments: (1) microcomputer simulations, (2) laboratory activities, (3) a combination of simulations and laboratory activities (simulations presented first), and (4) conventional instruction. Topics covered during lessons included the process skills of observing, hypothesizing, testing, classifying, and recording data. Results showed that laboratory activities, simulations, and a combination of these two strategies yielded higher achievement than did conventional instruction; there were no significant differences in achievement among the non-conventional treatment groups; and there was no attitude differences among the four groups. It was also found that students at middle and high levels of logical reasoning outachieved students at the low level of logical reasoning ability.
Hands-on activities and computer simulation methods in chemistry were examined by Bourque and Carlson (1987) to compare the cognitive effectiveness of a traditional hands-on laboratory exercise with a computer-simulated program on the same topic, and to determine if coupling these formats into a specific sequence would provide optimum student comprehension. Three laboratory experiments (acid-base titration, determination of the equilibration constant of a weak acid, and determination of Avogadro's number) were designed to correspond to three computer simulations. The data indicated that the hands-on activities produced higher scores for the acid-base titration and for the ionization constant, and no significant difference for the determination of Avogadro's number. The results further showed, however, that the highest cumulative scores were achieved for the format of hands-on experience followed by the computer simulation for the first two experiments, but there was no apparent advantage in sequence of performance for the derivation of Avogadro's number.

Mokros and Tinker (1987) reported on the impact of microcomputer-based labs (MBL) on children's ability to interpret graphs. In a longitudinal study, seventh- and eight-grade students worked with MBL units on illusions, heat and temperature, sound, and motion for a minimum of 20 class sessions. The data indicated that there was a significant change in students' ability to interpret and use graphs (an effect size of 81 percent). Brasell (1987) studied the effect of a very brief MBL treatment with a kinematics unit on high school physics students' ability to translate between a physical event and the graphic representation of it, and the effect of real-time graphing as opposed to delayed graphing of data. Overall posttest scores form the treatment in which the graphs were displayed in real-time were significantly higher than scores from all other treatment groups. The evidence showed that a single class period was sufficient for high school physics students to improve their comprehension of distance and velocity graphs when compared with a paper-and-pencil control treatment. Most of the improvement (90 percent) was attributable to real-time graphing. A delay of only 20-30 seconds in displaying the graphed data inhibited nearly all the learning.

Computer simulations used by high school biology students in attempts to enhance their problem solving skills were studied by Rivers and Vockell (1987). The simulations were administered under two conditions: guided discovery, and unguided discovery; a control group received no simulations. The results indicated that: (a) students using the simulations met the unit objectives at least as well as the control students, and (b) the students using the guided simulations surpassed the other students on subsequent simulation pretests, on tests of scientific thinking, and on a test of critical thinking. The evidence suggested that students using the computerized simulations were developing generalizable problem solving strategies which transferred to novel settings.

SUMMARY

The microcomputer clearly has many possible applications in the science classroom. It is equally clear that we have just begun to tap the potential of the microcomputer in education. Recognizing the tentative nature of the research findings in the field, some implications for science instruction emerge. It appears that microcomputer simulations are at least as effective as hands-on experiences for some cognitive outcomes and may in fact enhance these outcomes when the simulations are sequenced to follow hand-on instruction. Skills such as graphing appear to be positively influenced by microcomputer-based experiences, although the apparently critical nature of a delay between the input of data and its corresponding graphic display should be noted. While sex differences in achievement may not have been eliminated by the use of the microcomputer, instances of equal performance have been noted; this bears further investigation. In the affective domain, both student attitudes and interest seem to be positive regarding the use of microcomputers in science instruction. There are many encouraging indicators but much remains to be understood.

SELECTED REFERENCES

Bourque, Donald R. and Gaylen R. Carlson. "Hands-On Versus Computer Simulation Methods in Chemistry. "JOURNAL OF CHEMICAL EDUCATION, 64(3): 232-234,

March, 1987.
Brasell, Heather. "The Effect of Real-Time Laboratory Graphing on Learning Graphic Representations of Distance and Velocity." JOURNAL OF RESEARCH IN SCIENCE TEACHING, 24(4): 385-395, April, 1987.

Mokros, Janice R. and Robert F. Tinker. "The Impact of Microcomputer-Based Labs on Children's Ability to Interpret Graphs." JOURNAL OF RESEARCH IN SCIENCE TEACHING, 24(4): 369-383, April, 1987.

O'Brien, George E. and Edward L. Pizzini. "Righting Research Writing With a Word Processor." THE SCIENCE TEACHER, 53(3): 26-28, 1986.

Rivers, Robert H. and Edward Vockell. "Computer Simulations to Stimulate Scientific Problem Solving." JOURNAL OF RESEARCH IN SCIENCE TEACHING, 24(5): 403-415, May, 1987.

Shaw, Edward L., Jr., and James R. Okey. "Effects of Microcomputer Simulations on Achievement and Attitudes of Middle School Students. Paper presented at the 58th Annual Meeting of the National Association for Research in Science Teaching, French Lick Springs, IN, April 15-18, 1985. ED 255 389.

Tamir, Pinchas. "Current and Potential Uses of Microcomputers in Science Education." JOURNAL OF COMPUTERS IN MATHEMATICS AND SCIENCE TEACHING, V(2):18-28, Winter, 1985/86. Prepared by Stanley L. Helgeson Associate Director, Science Education -- This digest was funded by the Office of Educational Research and Improvement, U.S. Department of Education under contract no. RI-88062006. Opinions expressed in this digest do not necessarily reflect the positions or policies of OERI or the Department of Education.

Title: Microcomputers in the Science Classroom. ERIC/SMEAC Science Education Digest No. 3, 1988.
Note: For other 1988 science digests see SE 050 697-698.
Document Type: Information Analyses---ERIC Information Analysis Products (IAPs) (071); Information Analyses---ERIC Digests (Selected) in Full Text (073);
Target Audience: Teachers, Practitioners
Available From: ERIC/SMEAC, The Ohio State University, 1200 Chambers Road, 3rd Floor, Columbus, OH 43212 ($1.00 single copy; ordered in sets by year and area, $3.00).
Descriptors: Computer Assisted Instruction, Computer Graphics, Computer Oriented Programs, Computer Simulation, Computer Uses in Education, Elementary Secondary Education, Laboratories, Microcomputers, Science Activities, Science Curriculum, Science Equipment, Science Experiments, Science Instruction, Secondary Education, Secondary School Science, Sex Differences, Student Attitudes
Identifiers:

###

—

[Return to ERIC Digest Search Page]