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ABSTRACT

This study investigated the types of tactics and strategies students used in working with computer simulations and examined if the skills acquired when using the computer simulation could be applied in other settings. Sixth grade students (N=50) from three different schools participated in the study and were observed over a period of six weeks. Tape recordings were made of the groups working with the computer simulation and individual interviews were conducted. Four test measures were completed by each student (one prior to the computer work and three afterward). The prior measure tested the logical thinking ability of students and the three measures which followed the use of the simulation measured attitudes toward computing, knowledge of the procedure and skills in using the simulation, and the ability to transfer simulation skills to new topics. It was found that as the students used the computer simulation more they acquired more of the knowledge needed and appeared to be able to solve paper and pencil problems like those found in the simulation. Attitudes were also more favorable for students using the computer simulation the most. The program gains, however, did not translate into greater ability to transfer skills to new, non-computer tasks. (ML)

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Learning from Computer Simulations

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LEARNING FROM COMPUTER SIMULATIONS

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The role that simulations of all kinds have in instruction is to present some simplified model of reality that can be observed and altered. The simulation provides a means of experimenting with the world. A student with a computer simulation can, for example, try wide ranging temperatures to determine their effect on reactions or determine successive generations of fruit flies in a matter of minutes. Computer simulations are important because they allow interaction with difficult, dangerous, expensive, or time-consuming events.

In addition to the pedagogic value of computer simulations (i.e., compressing time, reducing dangers, etc.), they promise some significant advantages in learning as well. Because computer simulations allow students to make choices and observe and act on consequences, they provide a way to study cause and effect relationships, to make predictions, to test hypotheses, to gather data, and to draw conclusions. It is these outcomes that constitute higher level thinking and problem solving that are frequently mentioned among the important objectives of schools but not so frequently found in the daily activities of classrooms.

Publishers, through the materials that accompany computer simulations, are not timid in setting forth the high level objectives to which their simulations apply. A problem with computer simulations however is not that the objectives are outlandish or that claims are distorted or excessive. Rather the problem is one of face validity -- what students do while using the simulation doesn't involve obvious school tasks and thus the link between using the simulation and achieving the high level objectives is not clear.

Because simulation tasks such as building rafts or managing buffalo herds are not obvious school tasks, the value of the simulation must be sought in what it helps students learn beyond the simulation itself. Thus the simulation skills themselves are not as important as showing that they can be applied or transferred to other tasks of more obvious value. The computer simulation becomes important not for what students do while using it but rather what other things they can now do because of some generalizable skills they have acquired.

Two major questions arise when evaluating computer simulations.

1. Can students successfully engage in the simulation tasks?
2. Can the simulation skills be transferred or applied in other situations?

Purpose of the Study

The purpose of this study was twofold. First, means of acquiring skills using a computer simulation were studied. The study alternatives were each examples of ways that schools presently organize computer study. Secondly, the purpose was to see if the skills acquired when using the computer simulation could be applied in other settings.

Procedures

Sixth grade students (n=50) in three different schools used a computer simulation in three different ways. In the first school the students worked in pairs each sitting in front of the terminal and alternatively taking turns in responding to the simulation tasks. At the second school students worked in groups of four. Students in the third school were directed as pairs to work at the computer terminal as space and time permitted. In this instance only a single computer was used over a number of school days so that all students had an opportunity to interact with the computer simulation. In the first two schools, the students were taken to a computing laboratory on a nearby campus where all students in the class simultaneously worked on the simulation.

The simulation used, called Raft Away River (Jacaranda Wiley, 1984), places students in a river valley following an accident on a rafting trip. The accident leaves them stranded with no way to safety unless they can build another raft from available trees. During the process of building the raft they must feed themselves by catching and cooking fish or eating berries. Periodic rains and bad food occasionally cause illness and suspend work on the raft. Because each participant has specific tools (an axe, rope, fishing line, or matches) they must cooperate in the cooking, eating, tree cutting, and raft building. According to the literature provided with the computer program, it provides students "an opportunity to develop skills in reading comprehension, communication, cooperative behavior, and problem solving."

Students in the three groups worked with the computer simulation over a period of six weeks. The two groups that used the computers in the laboratory setting were each scheduled for five sessions lasting 45 minutes to an hour. Computer use by the third group of students was considerably less systematic. A single computer was available in the classroom for one half day each week. During this half day the teacher directed pairs of students to use the computer. The sessions for these students were shorter (usually about 15 minutes) and were less frequent (2 to 4 sessions for each student compared to 5 for the other groups). In terms of total time for computing, students in this latter group had approximataely 25 to 30 percent as much time working with the simulation as students in the other two groups.

Four measures were completed by each student--one prior to the computer work and three afterward. The prior measure was a test to determine the logical thinking ability of students. The three measures following use of the simulation measured attitudes toward computing, knowledge of the procedures and skills involved in using the simulation, and ability to transfer simulation skills to new topics.<

Tape recordings were made of selected student groups working with the computer simulation in the computer laboratory. The purpose of these was to examine the tactics and strategies students adopted and to determine how much conflict or cooperation occured in the groups. Individual interviews were also held with some students and tape recorded.

Results

Students working in pairs at the computers had the most favorable attitudes toward computing and the highest scores indicating the most knowledge of the simulation but they still had the lowest scores on the transfer measure. Their logical thinking scores were also lowest.

Students in the school that used the computer simulation the least had the least favorable attitudes and knew the least about the simulation itself but still scored highest on the transfer measure. These students also had the highest logical thinking scores of all students. Students from the school who worked in groups of four had the intermediate scores on all measures.

Because the students differed in their logical thinking ability it was used as a covariate in an analysis of the several outcomes used in the study. Significant differences were found in attitudes toward computing and knowledge of the simulation itself. In each case students working with the laboratory computers significantly outscored the third group that used the computer less frequently. But the transfer of learning scores show no significant differences among the groups. Logical thinking ability correlates strongly with transfer ability ($r=.71$).

Analysis of the tape recordings revealed a variety of behaviors associated with group work and strategies in carrying out the simulations.

Over the several class periods that students worked with the simulation it appeared that cooperative behavior increased. At the outset, students were more concerned with their own turn then how their actions affected accomplishing the task. As time went on students seemed to cooperate more as it became clear that differentiation of roles and sharing of work was essential.

One observation of students that stands out during the simulation was that they were always on task -- sometimes boisterously, occasionally argumentatively, and usually excitedly, but always on task. Interest never flagged. Certainly there was novelty in use of the computer although these students all had some prior experience with computers in their schools. But the interactive, problem-oriented nature of the task completely captured their attention.

Conclusions

As students used the computer simulation more they clearly acquired more of the knowledge needed and appeared to be able to solve paper and pencil problems like those found in the simulation. Attitudes toward computing were also a bit more favorable for students using the computer simulation the most. But these program gains did not translate into greater ability to transfer skills to new, non-computer tasks. Students in the group with the least knowledge concerning the simulation scored the highest on the transfer test.

No formal measures of cooperative behavior were used -- only informal observations of students as they worked together. It appeared that some of the initial individuality and authoritarianism gave way to more cooperative behavior as students realized how success depended on working together.