Computer Use and the Mathematics Curriculum

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The number of computers in the classroom setting has increased in the past few years. Reviews of software in mathematics reveal numerous deficiencies. Much needs to be done to increase the effectiveness of software and computer use in the teaching of mathematics. This article describes weaknesses in software for the mathematics curriculum and proposes remedies.

Diagnosis of Problems

Software emphasizing mathematics objectives should not stray from significant ends in this important academic area. If an integrated program is emphasized with another discipline, such as political science, significant learning in mathematics may be greatly minimized. Producers need to realize that software emphasizing content in mathematics needs to stress quality, scope and sequence. The student may lose sight of valuable goals in mathematics if an integrated curriculum is emphasized for its own sake.

Recommendations

1. Software stressing mathematics needs to contain vital learning for students. If an integrated curriculum is inherent, adequate emphasis must be placed on mathematics as being the core of the subject matter presented.
2. Other subject matter areas may then reflect the mathematics core learning. Appropriate breadth and depth of content in mathematics must be emphasized in the software.

A second deficiency in software content pertains to emphasizing trivia. When students are asked to find the value of 5/7 of 93 = _____, the viewer wonders if the programmer considered the concept of relevancy in program development. Many major goals and objectives can be selected for students to attain. Would 5/7 of 93 = ____ be of these? No. With the explosion of knowledge, it behooves the programmer to be highly knowledgeable of subject matter for students to acquire in mathematics. The age-old question arises, ''What knowledge is most worth?'' This problem still exists as it did with Herbert Spencer when in 1859 he wrote an essay on that exact title. Mathematicians and mathematics educators are stimulated to seek and evaluate the most significant ends for learners to achieve.

Recommendations

1. Engage in research to select vital goals and objectives for learner attainment. Basal textbooks comprising reputable series, filmstrips, films and research study results might well provide background information for the ensuing research proposals developed by teachers and supervisors.
2. Appraise current materials used in ongoing lessons and units. Objectives, learning activities and evaluation procedures need to be assessed in terms of desired criteria.

A third weakness in computer programs is that students must respond correctly the first time to a multiple-choice item pertaining to subject matter presented on the monitor. Certainly, students should have a second opportunity to enter the correct command on the keyboard. To be sure, students may merely guess at the first chance to respond. Also, the second opportunity to respond might involve a random guess. However, the printout or the monitor should show at the end of the program how many first-response items, as well as second-chance answers, a learner got correct or if a correct response was obtained rarely.

Recommendations

Software should

1. allow for a second opportunity for learners to respond correctly within each specific program involving drill and practice, as well as tutorial learning. Mathematics can be too technical to respond correctly initially on any given program. For example, in programmed items pertaining to decimal points, the 0.1, 0.01, 0.001 and 0.0001 demand precision and exactness. Even highly responsible students can make a mistake. When estimating is involved, a learner may well do more in-depth reasoning when given a second chance, as compared with only a single response;
2. emphasize clear subject matter in deductive or inductive presentations on the monitor, prior to learners responding to receive feedback on the response; and
3. generate new questions to present content in diverse ways rather than the same subject matter and the same questions asked in drill and practice or tutorial programs.

Excess loading time can be frustrating for students. Mathematics teachers need to evaluate if programs take too much time to load, whereby the students' time is wasted and subject matter lacks sequence. Also, how much time is wasted waiting for a program to present subject matter on the screen so that appropriate learner responses can be made?

Recommendations

1. Subject matter in basal textbooks, workbooks, work sheets and a laboratory approach in achieving may be more effective, as compared with programs with the loading problem in mathematics software.
2. Time on task research may well say that software must emphasize continual progress and achievement.

Weak software either fails to reward students for correct responses or the rewards may be repetitious. Rewards need to be adequate and different and should stimulate students to achieve at a more optimal rate. Rewards reinforce a correct response to encourage learners to achieve, attain and progress.

Recommendations

Rewards should be

1. encouraging and motivational. Loud, distracting, long and lavish rewards using peripherals should be discouraged; and
2. appropriate pertaining to the involved program. The rewards must be ample and sequential. They must be related to program content. A lavish display of clowns for each correct response is disruptive, time-consuming and unrelated to the task at hand.

Software that has timed tasks have inherent problems. Slow achievers may have difficulty responding because of the extremely limited amount of time. A program should emphasize what a student can achieve. If too little time is given to read the content on the monitor and to respond, the software is self-defeating. Reasonable specific time limits must be available for students' responses.

Recommendations

Software must be

1. field-tested adequately before it is marketed, and
2. judicious in time provided for learner responses. Let the student determine the time needed to respond on the keyboard.

Software must contain interesting subject matter. All things being equal in stated goals, the more interesting the program, the more likely students will achieve at a more optimal level in goal attainment. Interest is a powerful factor in learning. Boring content has no place in the mathematics curriculum. Subject matter needs to be stimulating and dynamic.

Recommendations

1. Programmers must be aware of the principles of learning from educational psychology and incorporate desired criteria therefrom, such as interest in student learning.
2. Software must have prior testing in classrooms to determine if learners' interest has been secured. A psychological curriculum in mathematics is

evident if, from the learner's (not the programmer's) viewpoint, a program provides set establishment.

Criteria for Selecting Software

Principles of learning from educational psychology have much to offer in guiding teachers to select objectives, learning activities and appraisal procedures. These criteria may well be used for choosing software in the mathematics curriculum.

As a first principle of learning, students need to experience interesting subject matter in computer activities. Software needs to secure the learners' attention. Boring content will not facilitate the student in attaining desired mathematics objectives. Establishing the set or getting learners to attend to ongoing lessons and units is vital. Mathematics teachers need to try out software, prior to purchasing it, to notice if involved students are interested and to achieve vital goals.

A second principle of learning advocates that students be actively involved in a program. Each student needs involvement in making sequential responses to a stimulus. If learners merely absorb information from the monitor, passivity in learning is involved. Rather, students individually need to respond to subject matter presented on the monitor. After acquiring content, the learner must answer questions pertaining to ideas attained. Feedback may then be inherent in providing students with information about the correctness of the response. Thus, learners need to respond frequently to subject matter presented in each program. Based on the response, feedback to the learner is a must.

Meaningful content needs to be presented to students. With meaning attached to subject matter being pursued, students understand what has been taught. It is indeed unfortunate if a student does not attach meaning to content being read on a monitor. Certainly, to be useful, subject matter must be on the understanding levels of students. Success in learning comes about when the learner understands what has been learned and is able to achieve sequentially.

Success on the part of each student is important when pursuing a software program. With carefully prepared programs tested in pilot studies, learners should succeed in approximately 90 percent of the program's responses. Quality attitudes within learners may well be enhanced with successful experiences in the mathematics curriculum. Developing an adequate self-concept is important on the part of each student.

Students also need to perceive a purpose for learning. Reasons should be inherent when pursuing a program. A lack of motivation for achieving may accrue when a student fails to sense reasons for participating in a mathematics program. Reasons for students to participate need to be stressed in any one of the following kinds of programs:

- Drill and practice. Reasons for experiencing drill and practice need to be explained to the learner. A deductive approach is then emphasized. Or, the teacher may wish to use an inductive procedure to have learners perceive values in experiencing drill and practice programs.
- Tutorial. New sequential subject matter in mathematics is emphasized with tutorial programs. Success in learning here is enhanced when content is based on previously acquired subject matter.
- Games. Selected students may be stimulated to achieve more optimally in mathematics through enjoyment. Two to four pupils generally can be involved in computerized games. Wholesome competition needs to be evident among participants. Easier items in mathematics to respond to earn fewer points per item as compared with increasingly difficult questions. Thus, four levels of complexity of responses to questions pertaining to mathematics content could exist. Easy items answered correctly could receive five points. Increasing complex items may receive 10, 15 and 20 points sequentially. If students are evenly matched for the game, much learning can accrue within a quality learning environment.
- Simulations. With life-like experiences, problem solving and higher levels of cognition can truly be evident within the framework of simulated content in software. Several learners generally will be involved in simulation or role-play activities. Feedback to each decision made by a learner must appear on the monitor.
- Diagnosis and remediation. Quality software in diagnosis should specifically pinpoint the kind of errors a student makes. Models on the screen should show what the correct procedure would be to remedy the identified deficiency.
- Computer-managed instruction (CMI). Checking answers on computerized answer sheets is a useful, time-saving approach for teachers to use to appraise learner progress. The printout should clearly point out how many students missed each test item. Feedback might then be given to the teacher in terms of the quality of each test item,

as well as success in learning by pupils. Students' grades can also be stored on a computer. CMI has many practical uses for the mathematics teacher.

In Closing

Software and microcomputers have a significant role to play in assisting students to achieve in mathematics. Weaknesses in software and computers need to be identified and remedied. Technology must assist learners to achieve optimally on an individual basis. Computers and software, as audiovisual aids, should be used to guide each student to achieve as much as possible in mathematics.

Positive headway has been made in attempting to develop quality software for students in mathematics. Long strides still have to be made to analyze and remedy the identified deficiencies. Mathematics educators, educational psychologists as well as programmers must harmonize efforts to secure the best programs for learners. Software should not be developed for the sake of doing so. Rather, each program must assist students to achieve mathematics proficiency. Drill and practice, tutorial, games, simulations or remedial programs need field testing and necessary modifications prior to their use in the classroom. Problem solving in school and in society needs to be an ultimate goal in the teaching of mathematics. Life consists of identifying and solving problems.