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ABSTRACT

The potential benefits of microcomputer adoption in education occur because of the low cost, ease of use, and versatility of microcomputers. The microcomputer has simplified the development of both computer-assisted and computer-managed instruction. Teaching computing is easier because the microcomputer becomes the object of instruction as well as the medium of instruction. Finally, since the microcomputer is a general purpose computing machine, it can be used for many functions. The effect of microcomputer implementation can occur along a continuum of supplementing, complementing, and supplanting instruction. Interaction with a microcomputer can affect students by developing confidence, knowledge, and a life skill. Use of the microcomputer will result in saving teachers' time and helping students advance from memorization to higher level skills. Issues and problems that may determine whether the potential of using microcomputers is ever realized include teacher adoption and the development of teacher skills, the availability of software, and the compatibility among hardware. A significant problem will be ensuring equity so that the disadvantaged have equal access to computer literacy. (Author/MLF)

WHAT'S SO DIFFERENT ABOUT MICROCOMPUTERS

by

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Much has been written recently about the instructional uses of the microcomputer and the promise which this technology holds for education. Papert (1981) has stated that computers will affect the ways in which people learn to such an extent that schools as we currently know them will be obsolete. Others make more modest proposals, preferring to discuss ways in which the microcomputer will facilitate and complement the instructional process (Watts, 1981; Stewart, 1982).

Many educators, however, are hesitant to become involved with microcomputers, not because they are unwilling to try something new, but because of their past experience with technology. The instructional uses of overhead projectors, calculators, instructional television, and video tape have all been explored, but with mixed success. Despite the fact that much of this technology has been around for thirty years it has failed to make a substantial impact on the fundamental instructional purposes or structures of education. One can still find many places where this hardware, costing hundreds of thousands of dollars, is still not fully used, or once tried, is now relegated to the corner of someone's classroom.

Teachers who have been bitten by technology before, now ask "What is so different about the microcomputer?" It is their way of saying they want some guarantees that their investment in this new technology will yield a more substantial pay off than similar investments in the past. This is certainly a valid question, one which shows that educators are becoming more sophisticated and responsible.

I believe that there is a fundamental difference in the potential of the microcomputer for education, than has been the case with other technologies in the past. The purpose of this paper is to describe some of the uniqueness of the microcomputer as an instructional technology. Although I am supportive of the microcomputer's potential, I am not naieve to the existence of certain issues and problems which must be addressed if its potential is to be realized and I will also attempt to deal with these.

What is a Microcomputer?

Before we explore its instructional potential, lets first define exactly what is this new type of hardware. A microcomputer is a small computing machine whose "brain" fits on a silicon chip less than one centimeter square. This brain allows the microcomputer to respond to messages given to in any language which it has been programmed to understand. The computer can respond to messages on a television screen and thus carry on a conversation with the user. Microcomputers can even remember conversations or other data by storing them in a memory bank known as a "floppy disk". If provided with a printer, the microcomputer can even produce hard copies of the information stored or records of the conversations in which it has engaged.

There are several important aspects of the microcomputer as a machine which differentiate it from other technology.

1. Cost. Microcomputers were first marketed as personal computers. This emphasis on individual use carried with it an attempt to keep hardware costs as reasonable as possible and well within the range of the average family or small business user.

Within the last few years the overall costs of the microcomputer have dropped dramatically. Some industry analyists see hardware costs continuing to decline between 20 to 30 percent a year for the next few years. Others, however, see costs becoming more stable, but predict dramatic increases in microcomputer sophistication, so that the user will get more machine capability for the same dollar value (Schadewald, 1981). With several hundred thousand microcomputers already in the public schools, costs do not seem to be a substantial barrier to their adoption.

2. Ease of Use. Most canned programs are developed to be "user firendly"; that is, designed so that the program itself gives clear instructions about how to use the program. For those interested in developing their own programs. There are several languages currently available which make programming the microcomputer relatively easy. Langauges such as BASIC and Applesoft were designed to be used by someone with no computing background. Other languages such as LOGO have been successfully used by elementary students to teach basic programming skills.

3. Versatility. Microcomputers are extremely versatile. They can be used to run predeveloped or canned programs or can be used to help someone develop new programs. Nor are microcomputers limited to verbal interaction. Most of them also can calculate, produce sounds, and draw pictures or other graphics. They are also capable of linking up with other technology such as videotape, video disc, television, information systems, and even other computers. These linkings may serve to complement the uses of the other technology or, by virtue of being interfaced with the other

forms of technology, may in fact create a new form of instructional medium. Such is the case with computer directed instruction which combines video taped instruction to produce a more sophisticated form of stand alone instruction.

For What Can the Microcomputer be Used?

The key difference between microcomputers and other instructional technologies is its flexibility. The instructional uses of this machine are as limitless as the creativity of the educator-user. This flexibility can be described in several ways.

1. Instructing. Computer assisted instruction (CAI) has been with us for many years. However, early CAI programs required expensive main frame computers and a great deal of development expertise. The microcomputer has simplified the development of CAI and has made such programs more accessible. Although good CAI programs require a great deal of development time, it is now possible for almost any teacher to develop simple programs specifically related into his or her curriculum. New, commercially developed programs are now more readily available and cover the wide range of applications from drill and practice to simulation.

2. Managing Instruction. Computer managed instruction (CMI) has also been with us for quite some time. Like its CAI counterpart, CMI has heretofore required larger computers or time sharing systems. The microcomputer now makes student data management and instructional management more available to more teachers. There are many examples of micro-based IEP management systems, grades scoring systems, and student instructional progress monitoring systems.

3. Teaching Computing. The ability to make it easier to teach computing and programming skills to the masses of students is quite a unique advantage of the microcomputer. In this instructional application the microcomputer becomes the object of instruction as well as the medium of instruction. This dual instructional focus of the microcomputer truly separates it from other instructional technology (Luehrmann, 1981). As I mentioned earlier, there are several easy to learn programming languages with which almost any child at any level of ability can learn basic programming skills.

4. General Applicability. Although microcomputers can be used in the variety of ways just discussed, it is important to remember that the microcomputer is a general purpose computing machine. This general applicability does not limit its use to any one area of instruction, level of instruction, category of learner, nor any one mode of instruction. Both the teacher and the student can use the microcomputer for either teaching or learning, while working together or while working alone. Further one can find micro-based curriculum being developed for almost every content area of instruction.

How Does the Microcomputer Affect the Learner?

A fundamental difference between the microcomputer and other instructional technology is its effect on the learner. Earlier technology was basically passive and did not interact with the learner nor did it require the learner to interact with it for learning to take place. The microcomputer is different in that

it is basically a dumb machine, the microcomputer has the capacity to behave in intelligent ways. However, its behavior is always dependent upon humans who must turn it on, interact with it and teach it. This essential relationship between the individual and the microcomputer is quite important and can have a profound effect upon the user, especially when that person is a student learner. Let us examine some of the ways in which interaction with a microcomputer can affect students.

1. Developing Confidence. Since the microcomputer does not behave unless it is told what to do, students soon develop an excitment in being able to control a machine and get it to do what they want it to do. This is not a pernicious sense of power, but a sense of self worth which comes with being able to exercise personal control over some aspect of one's life. So often students see themselves as being controlled by some other, a teacher, a parent, or even other students, that they begin to doubt their own ability. It is always a joy to see the expressions of accomplishment, even among the very young, after they have successfully run their first microcomputer program.

2. Developing Knowledge. In order for a student to develop a program, he must first understand the content of the subject area which will serve as the basis for the program. More specifically, programming requires the student to know the answer to his question before he can program the computer to ask the question. The student must understand the subject matter well enough to be able to organize it into a logical sequence, and then translate this information into a language which can be readily understood by

machine. In essence, for a student to write a program he must teach that subject matter to the computer. As we have heard so often before, one does not truly know a subject area until he has taught it. This principle is applied in programming. Therefore, by getting students involved in writing their own programs we are also providing them an incentive to master subject matter.

3. Developing a Life Skill. Much has been written about the importance of reading and writing as basic skills. However, in the information rich society of the not too distant future, computer awareness and computer literacy will also become basic skills. The difference between computer awareness and computer literacy is important. In order to be able to survive in an information rich society it will not be sufficient only to know about computers (awareness) and what they are capable of. Those who are computer advantaged will also be able to manipulate data with computers and be able to write their own programs. They will have developed skills such as logical thinking, organization, and ability to experiment which are essential to programming (Scollon, 1981). These skills comprise computer literacy. Therefore, in helping students to become computer literate we are also helping them to develop a truly necessary life skill.

How Does the Microcomputer Affect Instruction?

The effect of the microcomputer on instruction will depend upon how it is used in the instructional process. This, of course, depends on the availability of software and the interest of the teacher using the software. It will also depend upon the

commitment of the district to use the microcomputer and its willingness to alter traditional instructional roles. It is possible to describe microcomputer implementation along a continuum of three levels, where each level represents and increased use of the micro in the instructional process.

1. Supplementing Instruction. It is possible to use the microcomputer to supplement classroom instruction. Examples of such applications are drill and practice, record keeping, test scoring, and testing. This type of use frees up the teacher from some of the tedious and time consuming tasks which occupy his or her day. Students enjoy working with the computer in this mode for several reasons. The most significant reason is the patience and non-threatening attitude of the computer. The computer will work with the student for as long as the student wishes and will withhold judgement about the student's ability to perform well. Furthermore, students like the opportunity to work with someone other than their teacher for certain periods of the day. This change of pace also helps the teacher.

One should carefully examine the cost benefit of micros if one decides to use the microcomputer for only this type of activity. Although there are many fine drill and practice programs for basic math facts, this drill and practice function can be offered more cost effectively by using a programmable calculator or the "Little Professor" machine where the school could afford to have enough for an entire class to use rather than require many students to share one comparatively expensive microcomputer.

2. Complementing Instruction. In this mode the microcomputer makes it possible for the teacher to involve the students in an instructional experience which they might not otherwise be able to have. Simulations are potent examples of this type of activity. Through simulation the student is able to experience something which the teacher has described, as is the case with a program which simulates the eruption of a volcano, or to explore an instructional concept, as in a simulation of the decision making process. These simulations enhance the instructional process and make it possible for the teacher to explore content with greater breadth and in greater depth.

3. Supplanting Instruction. Although some educators would argue to the contrary, it is possible for the microcomputer to become a substitute for certain types of instruction. For example at the University of Arkansas we are currently developing microcomputer based courseare for all of the basic, and some of the advanced courses, in a typical high school curriculum." The intent of this project is to make this type of instruction available to rural schools where they may not have sufficient funds to hire teachers in the advanced subject matter areas. Although these programs are not easy to write, we are finding that they are successful, especially in their ability to present the essential information required to master most subject matter areas.

Our initial reaction to this potential of the microcomputer is often one of fear and apprehension. We are most concerned about the security of teaching positions and even about the

richness of the child's education. However, I believe that we must realistically consider the potential of the microcomputer to alter the purposes of education and the nature of the instructional process and then determine how educators can adapt their skills. Let me discuss two examples to illustrate the types of adaptations which might evolve. Much of what we do throughout the instructional process involves simple transmission of facts or other forms of information, such as formulas or instructional protocols. Computer programs are uniquely capable of teaching fact oriented or formula based information. If we were to alter our notions of the teacher role so as to allow children to learn these types of curricula with the microcomputer, than we would probably be able to free up substantial time throughout the twelve years of the school experiences for professionally trained teachers to do new, different, and more exciting thing with children.

This fact oriented nature of our curriculum has even greater educational implications as we look toward the end of this century. Our society is generating information faster than any of us can personally assimilate it or can possibly make use of, even with the assistance of electronic means which are currently available. There will soon come a time when we as individuals will have to give up our compulsion to memorize everything, and transfer that memory function to a personal computer based data bank. When this happens, education will have to shift its emphasis from helping children memorize facts to helping them become wise consumers of and manipulators of data from external information

sources. Such skills might consist of the ability to access data, decide which data are important and relevant, use data to formulate hypotheses, validate the appropriateness of the decision and store those decision data for future use. These are truly higher level skills than the simple transmission of information to memory, but they are based upon the student's ability understand the importance of information and be able to use it. If education and educators are to adapt to this type of microcomputer based future they will have to develop a healthy respect for man's eventual interdependence with the machine and be willing to alter their notions about the purpose of education, the role of the teacher in the instructional process, and the capability of the child as a learner.

Issues and Problems.

Although I have described many of the potential benefits of microcomputer adoption in education, it is only fair that I give equal time to some of the issues and problems which may determine whether that potential is ever realized. We have had to deal with some of these notions as we attempted to use earlier forms of technology. However other challenges are new to us.

1. Teacher Adoption. The adoption of any new instructional innovation in education is a decentralized process whereby each teacher makes an individual decision about whether to incorporate the innovation into his or her teaching repertorie (Podemski, 1981). Even though the initial decision to adopt may be made by the Board of Education or the Superintendent, it will be up to each teacher to help the district produce the desired instructional

changes. Many teachers are threatened by microcomputers more than they have been by other technology. This is true for a variety of reasons, not the least of which is the fact that there is more pressure from outside of education, than within education, to include this technology in the instructional. More and more, children have their first experiences with microcomputers at home. Parents are demanding that computer literacy become part of the curriculum. This pressure from without, although potentially a vital ally in the adoption process, may cause many teachers to become overly defensive, especially if it requires them to develop markedly new skills.

The development of teacher skills itself is also an important barrier to the adoption of microcomputers. Even when teachers are very enthuiastic about microcomputers, they soon learn that a simple awareness of the capabilities of this machine is not sufficient to incorporate it into the instructional process. Teachers need to develop literacy skills which involve the ability to program and develop their own courseware. Literacy instruction is not easy to deliver to the masses of educators. No simple "inservice session" at the district level can teach teachers what they really need to know (Townsend and Hale, 1981). Abolishing teacher literacy in this area will require a combined effort by willing teachers, knowledgeable administrators, and responsive colleges of education. There is enough to be done at both the pre-service and inservice level to keep all of our teacher trainers at every level busy for quite some time.

2. Availability of Software. Although I have already mentioned that a wide variety of software is available, it does not

take one long to come to the realization that there is not enough software and much of what is available is not of superior quality (Steffin, 1982). Business representatives are quick to point out that there is not much of a profit to be made in the public schools until there is more wide scale adoption of microcomputers in education. Furthermore, they are quite concerned about computer piracy and theft which makes it difficult for them to recoup the rather large costs of developing quality software. Until such time as more of the major companies, possibly even the textbook companies, get into the market, teachers may have to be content with developing their own software or improving on those programs available commercially.

3. Compatibility Among Hardware. Currently there is no compatibility among the various microcomputer machines. What this means is that a program which will run on one brand of microcomputer may not run on another brand. This places schools in the financially difficult position of having to buy several different brands of microcomputer in order to be able to use different types of software. Schools will not be able to live with the financial implications of this situation for very long. Hardware should be judged on its own merits, not on the software which it will run. There are currently underway various efforts among several of the major educational professional associations, as well as by several state departments of education, to advocate and require compatibility standards for microcomputer hardware.

4. Equity. Educators have struggled for many years with issues of equity and the ability of the disadvantaged to master

the basic skills. It is estimated that by the end of this decade more than 50% of all of the jobs in the U.S. will in the information processing area and may will require the ability to work with electronic information processing media. If such is the case than computer literacy may soon become as basic a skill as reading. Will we be able to deal with the equity issues raised by this? Will those who are disadvantaged have equal access to this skill, especially with the cost implications involved in the purchase of the hardware alone as well as the fact that current pressure for computer literacy in schools is coming from middle class and upper class segments of society (Podemski, 1982).

Conclusion

I believe that there is a bright future for the microcomputer in education. The fact that this machine is so versatile and so easy to use highlights its usefulness as an instructional tool, more so than has even been the case previously with any one other piece of hardware. The degree to which we allow this micrb revolution to take place will certainly require the support, encouragement and efforts of educators. It will force us to reexamine what we believe to be the purpose of education and will require that we alter our instructional methods and practices. If professional education does not accept this challenge than others will. Our ability to integrate this new technology into the curriculum in an orderly and meaningful fashion may well affect public education's ability to meet the challenges of the not too distant future.

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