Learning About Computers and Mathematics: A Student Perspective

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We are living in an "information age," and it seems that the technology of computers is here to stay. For many, including me, the computer has become an essential tool for information storage, manipulation and output. In the last couple of years, following the purchase of my own computer, I too have been caught up in our technological era. As an educator of the future, the question then becomes, How can I integrate this technology into my profession so that it can aid in my teaching endeavors? In my research, I quickly discovered that many people before me have pondered this question. Winzer (1990, 112) says, "Computers cannot replace classroom teachers, but they are patient, consistent and accurate teaching tools that possess unlimited appeal and motivational value for students." These ideas first surfaced over 20 years ago when the computer was being billed as the educational utensil of tomorrow. In this light, the technology was proposed largely in the field of mathematics.

In our modern society, literacy refers to language, as well as mathematics (Mendoza 1989 in Winzer 1989). Bangs (1982, in Winzer 1989) reveals very specifically that mathematics is indeed itself a language. In comparison with instruction in language, mathematics has received little attention when it comes to diagnosis, instruction and remediation (Winzer 1989). Mathematics has been a domain in which I have not had a great deal of success. Therefore, when I saw a chance to learn about new ways to teach and explore mathematics in an area where I do have a great interest, computers, I obviously accepted the challenge. This becomes increasingly important when one realizes that in our rapidly changing technocratic society, people will use their arithmetic skills more than ever (Winzer 1989). Those of us lacking in this burgeoning domain will find survival even more difficult than it already is and inevitably will be left behind.

Inherent in my discussion will be the use of computers in mathematics instruction for "students" in general, although I will point out where the computer can enhance the learning of exceptional students. Lerner (1981, in Winzer 1989, 319) describes certain principles that are applicable to all forms of mathematical learning and are key ingredients to effective teaching:

> Students understand concepts best when they move from the concrete to the abstract. They need plenty of drill and practice to develop automaticity about facts and operations. Finally, they need the opportunity to see mathematics as part of the real world.

Mendoza (1989, in Winzer 1989) describes mathematics as hierarchical in nature. Thus, gaps in learners' backgrounds will go on to hinder their future successes. Drill and practice therefore become important components to mathematics teaching to promote the acquisition of fundamental facts and concepts. Many contemporaries in mathematics education would no doubt debate this, but this point still holds true for some, especially when dealing with learning disabled students. In attempting to gain a certain functional level of mathematics savvy, this traditional approach seems essential for special learners (Winzer 1989). One benefit of computers emerges with their ability to perform repetitive tasks with immediate user feedback. This can help students, especially in mathematics, who require repetition of facts and concepts. Modern computers also allow for other minor alterations that will assist special learners. For example, font sizes can be enlarged, and braille printouts can be made for visually impaired students. The speed of the presentation of material can also be altered to meet learners' needs. Some computer programs are based on "real-life" situations, making the content more functional than otherwise possible. Making education functional is vitally important to effective teaching. The graphics that modern computers offer enable users to manipulate seemingly concrete objects, making learning more genuine. On the other side of the spectrum, computer technology can help gifted students who wish to pursue more complex learning. Gifted students need expanded and enriched curricula that will

stimulate higher-level thinking and will allow them to apply their skills in a variety of contexts (National Council 1986 in Winzer 1989). With this in mind, modern software is moving toward allowing the user to simulate certain ideas and concepts; opening new avenues of trial and error, exploration and higher-level learning.

In trying to understand computers and their use as an educational tool, I wanted to obtain a certain breadth of research. I chose to look at 11 different journal articles. In doing so, I obtained work from a variety of publications and from different time periods to represent as many perspectives as possible. The first article goes back to when computers were just being explored and their potential was only beginning to be forecast. The rest of the articles reflect more modern ideas and represent a transition from the computer "boom" of the 1980s to the present. The articles reflect several standpoints and highlight the computer as an increasingly important, if not controversial, instructional tool in education.

My bibliography also includes research that I have done outside of the 11 chosen articles. The concluding portion of the paper discusses the pieces in a more comparative light, recognizing that each article represents a certain aspect of computers in mathematics instruction. Finally, and in a much broader context, I have addressed whether or not the computer has lived up to mathematics teachers' expectations and to the expectations of educators as a whole.

Discussion

The research that I have read constitutes somewhat of a "jarring" experience to my previous conceptions. My appreciation of the computer had been pedestaled largely because of my own perceptions of the technology. Despite the area of mathematics benefiting most from the advent of the computer, it too has not lived up to the early expectations beset on it in the field of education.

The computer was first conceived in terms of its value to educators in the late 1960s (Zinn 1969). From that time, the technology has advanced and experienced a large amount of growth through the 1980s to the present. The focus on computer education has itself seen a shift, one I have experienced. When I was in junior high school in the early 1980s, the emphasis in computing science, as the subject was called, was on programming. We focused on learning how to program the computer to meet our problem solving needs. Today, the computer is used as a practical tool, where large innovative software designers provide us with the programs. In these modern software packages, for the most part, we are limited within the confines of the program. Demarin (1991) also sees this transgression, but from a feminist perspective. She argues that the software is somewhat limiting and suggests how software designed from the feminist standpoint, based on certain "feminine" characteristics, could eliminate many problems associated with present-day computer software.

Contradictory to the previous paragraph, proponents to certain software packages are out there. Within certain software applications, users can manipulate programs in a variety of ways and, unknowingly or not, emerse themselves in the traditional parameters of academia, including mathematics. Burnett (1987, 1988), Hoyles and Noss (1987), and Parker and Widmer (1989) have found computer applications to meet their own and, more important, their students' educational needs. These programs are the most useful and yet the most simple. Seymour Papert's Logo language as described in Burnett (1987), Land and Turner (1988), and Hoyles and Noss (1987) and the development and use of the spreadsheet as highlighted in Burnett (1987, 1988) and in Parker and Widmer (1989), are two such programs. Logo is said to be an environment that promotes "mathematizing," while the spreadsheet is billed as a notational system for exploring ideas. These authors are perhaps more optimistic about the technology than the other researchers and have worked to find feasible uses for what is available.

Johnson (1988) claims that the research is too general and that it does not reflect the problems that students encounter in their work with computers. Other research proposes remedies for the situation. Zehavi (1988) argues that we need to design software for our students' specific needs. Backing this point up, MacGregor and Shapiro (1988) reveal that we must concentrate on individual learning and cognitive styles. This is something that most computer and software technology has failed to do. Land and Turner (1988) conclude that using certain programs only reveals that they help students with higher cognitive levels. In other words, students who do well in most areas are also going to succeed in the computer environment. Researchers also discovered that low-achieving students eventually reach a certain plateau in understanding mathematical concepts with a

computer program helping them. This research would support the evidence that technology can help some students, but certain people need more than just "fancy" technology. The computer can be an effective tool for some students in specific situations, but to tap into its true effectiveness, more emphasis needs to be placed on computer use with "individual" needs in mind. Computers and computer programs cannot be seen as generic, no more so than can individual students in any given classroom. Parker and Widmer (1989) stress the importance of the teacher in the computer equation. They argue that the teacher must be responsible to students by identifying and selecting appropriate applications to be used in the classroom. Johnson (1988) outlines an additional concern about the use of computers by pointing out a situation where he saw the computer become an educational crutch to a student. Some educators are really concerned that students might become dependent on the technology, robbing them of their own intuitions and problem solving abilities (Zehavi 1988; Demana and Waits 1992).

Using computers does not come without costs. Zinn (1969) forecasted problems surrounding the cost of computer technology. Demana and Waits (1992) highlight similar modern-day concerns. They argue that there is too much pressure on students and educators alike to purchase and implement expensive computer systems. They go on to suggest that other forms of technology are much cheaper while still meeting the same instructional needs. For example, graphing calculators can aid secondary students with more complex mathematical concepts and related exercises. Today's students live in a society filled with innovation and technical gadgetry. Most students are engulfed in worlds of multimedia presentation (for example, television and videos) and video games. I fear that the novelty of the computer and computer software will eventually fade in the eyes of students. Many students gain motivation from using technology, and it is therefore up to the teacher, not the computer, to keep student interest and involvement (Johnson 1988; Demarin 1991 and Zehavi 1988).

Duguet (1989) discusses the problem that the education field has faced with computer applicability; an obvious gap has existed between the hardware and the software. The main argument is that educators do not know enough about how students learn or exactly what they learn when they interact with computer-based materials. A review board or an organization needs to be established to study and screen software. The market is flooded with computer technology, and teachers cannot be expected to keep on top of it all. The international Organization for Cooperation and Economic Development (OCED) has started to set up such educational review centres. Statistics presented by OCED reveal that in mathematics only 49 percent of the software was recommended for use by teachers. Of the 457 software packages reviewed, only 223 were recommended (Duguet 1989). This presents an obvious problem for teachers *and* their students.

Two other articles of interest relate directly to the use of computers and computer software for special learners. Eiser (1986) discovered that few, if any, software titles are labeled as special education. This does not mean that the technology cannot be used for this portion of the population, but rather, modifications need to be made. Special educators need to look for two things in computer software. First, the programs need to be flexible and modifiable, and second, the software needs to have a record keeping option so that teachers can monitor student progress. These software attributes are a good indicator of software effectiveness in all realms, not just for special learners. Perhaps the most encouraging research that I discovered, in terms of special education, came from Divoky (1987). The Apple Computer Company announced the establishment of a National Special Education Alliance (NSEA). This organization provides resources and information about computers and other technology to the disabled population. Apple has also established an awareness program in its development of hardware and software. Serious efforts are being made to eliminate any obstacles to special learners. Little things like making the repeat key optional with an on-off switch, which will help students with motor skill disabilities. Divoky (1987) lists the standard and special features offered to computer buyers.

Three main points contribute to the apparent dilemma that educators face regarding the use of computers in education:

1. Computers are a rapidly changing area of technology. Today's hardware and software will almost inevitably be obsolete in five years. This begs the question, Why get involved in an obviously unstable situation?
2. The expense of computer technology is staggering, especially in light of the rapidly changing nature of the industry. Personal and/or school involvement demands a great deal of time and money, in terms of training and in hardware and software purchases.

3. Computers pose that threat of the unknown and symbolize "change," which many veteran professionals and laymen alike are weary of. Not understanding something can make people avoid and ignore it, creating "computer anxiety." The computer is another stepping stone we have yet to conquer in everyday life, as well as in education.

Computers are indeed going to be part of my educational career. Too much valuable technology exists out there that has yet to reach its full potential. There are of course concerns as with anything innovative, especially in such an important facet of society. We must remember though that education is the pathway to our future. Technology has began to take over and navigate our journey. In 15 or 20 years, I will look back and laugh at the archaism of the instrument on which I composed this article. Change is inevitable; the real choice is whether or not you decide to jump on and enjoy the ride.

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