

Designing Teacher In-service for the TI-92



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The use of graphing calculator technology in the teaching of mathematics is a relatively new phenomenon. While the computer and electronic computation has been around for much longer, it is only within the last two decades that these tools have been in the hands of teachers and learners (Kaput, 1992). We are only beginning to discover the ways in which this technology can enhance the instructional process. As the power of the medium increases, new functions will continue to develop. The technology is evolving rapidly.

Across the United States there have been calls for changes in the mathematics education of our nation's students. In this movement, no topic has been so prevalent of late as the impact of calculator and computer technology on the learning and teaching in mathematics, and there is continuing pressure from some mathematics educators to revise the curriculum to take advantage of the technology that is available. Graphing calculators and computers compel reexamination of priorities for mathematics (National Research Council, 1989). Electronic spreadsheets, numerical analysis, symbolic computer systems, and sophisticated computer graphics have become the power tools of mathematics in industry.

In their report, *Reshaping School Mathematics*, the Mathematical Sciences Education Board of the National Research Council (1990) cited changing conditions and outdated assumptions as a rationale for change. Most jobs now require analytical rather than just mechanical skills, and the types and variety of problems to which mathematics is applied have grown at an unprecedented rate. Computers and calculators have changed the world of mathematics. As the report stated "It is now possible to execute almost all of the

mathematical techniques taught from kindergarten through the first two years of college on hand-held calculators” (p. 2).

Computing devices provide the potential for a great impact on both the content and presentation in mathematics education. These devices will decrease the value of many manual skills traditionally taught in the school mathematics curriculum and increase the importance of many areas of mathematics that now are rarely taught (Mathematical Sciences Education Board, 1990). With less priority on the development of routine skill, more time can be spent developing understanding and reasoning with mathematical processes. By using machines for calculations, students can explore mathematics and engage in realistic applications using typical data and focus more on concepts. Weaknesses in algebraic skill need no longer prevent students from understanding ideas in more advanced mathematics.

Curriculum and Evaluation Standards for School Mathematics (NCTM, 1989) stated that methods of instruction should emphasize student exploration, investigation, reasoning and communication skills and that students should use the technology as a tool for processing information and performing calculations in order to investigate and solve problems.

There are a variety of arenas in which these methods of instruction can be addressed. One area that has received particular attention is that of calculator and computer function graphing tools incorporated with symbolic manipulators and computer algebra systems (CAS). These tools are suggested as a means to produce a richer mathematics curriculum and a deeper understanding of mathematics. The premise is that these tools allow students to explore “advanced” mathematical functions without having to master considerable algebraic

manipulation skills (Senk, 1992). Use of the technology can relieve students of much of the drudgery and tedium of necessary algebraic manipulation, thus freeing time for analysis and exploration. Many CAS, for example, have graphics and numerical analysis routines built in (Hosack, 1988); thus CAS allows for a unified approach to analysis using symbolic, numeric, and graphic methods.

There is considerable agreement that research or curriculum development projects should not infuse graphing technology into courses without changing some of the original curricular goals (Senk, 1992). Teaching the same curriculum with the new technology is not the intent of those who encourage use of these new technologies. In particular, there should be an increased emphasis on realistic applications of mathematics. Reformed courses should focus on problems that encourage exploration and conjecturing and decrease emphasis on many traditional manipulative skills.

What happens to these manipulative skills? According to Hembree and Dessart (1986),

Students who use calculators in concert with traditional instruction maintain their paper-and-pencil skills without apparent harm. Indeed, use of calculators can improve the average student's basic skills with paper and pencil, both in basic operations and in problem solving (p. 88).

Others argue that algorithmic skills are seldom remembered well and will be of little importance in future environments when graphics calculators and computer algebra systems will be common (Hosack, 1988). This argument further contends that the gain in conceptual understanding and problem solving skills is well worth the trade off.

The Mathematical Sciences Education Board (1990) posits several open issues that need careful study. Listed among these are organization for learning (changes in curriculum, in teaching practice, and in the educational role of computers and calculators), manipulative skills (reexamination of traditional priorities for arithmetic and algebraic skills), and instructional uses of technology.

There are many pieces of software that do much numeric, symbolic, and graphic manipulation. It must be determined how these tools should interact with and influence the mathematics curriculum. With these tools available, educators must consider the value of spending time teaching skills that the calculator or computer could perform with the touch of a button.

A Quick Look into the Future

The philosophies about using technology in mathematics courses vary from radical (total immersion into technology use) to casual (restricted use with mostly traditional curriculum) to strong opposition. Mathematics departments need to make a decision as to the level of technology use in their courses. Testing is one of the biggest challenges for those encouraging the technology use. As testing changes, so does the list of our expectations of students. Perhaps we need to think about how we can use the time that the graphics calculator has the potential of freeing to emphasize areas such as problem-solving, estimation, etc.

The future of computing and graphing technology in mathematics learning and teaching is promising; but it is difficult, at best, to predict or describe its impact. What is sure is that

mathematics educators are responsible and hold the power for shaping the roles of the new technologies in our curriculum. Increased power will continue to make new functionality possible.

Research has addressed many of the benefits of the use of calculator and computer technology which incorporates graphic and symbolic capabilities. The existing availability of hand-held, portable technology of this type seems to add to the likelihood that this technology will play a role in our mathematics classes, whether by choice or by force. The question to be answered is “Will the technology help us do better what we have been trying to do?” From many perspectives, the answer is yes; but educators must be prepared to meet the challenges that lie ahead: to change the way things have always been done, to look at both teaching and learning in ways different from the traditional, and to make use of the computing and graphing technologies as the powerful tools that they can be in the instructional process.

There is great opportunity in existing accessible hand-held technology. In particular, the TI-92 is a powerful tool that has the potential to dramatically change both *how* and *what* we teach in mathematics class. No potential can be realized or even realistically discussed, however, until classroom teachers come to know about the technology that is available and how it might impact upon their classrooms. What follows is a series of activities used for an in-service in which secondary mathematics teachers are introduced to, work extensively with, and address issues regarding the TI-92. Though this particular in-service was carried out with secondary mathematics teachers, the program is designed with pre-service teachers in mind as well, and the content could easily be adjusted for use with post-secondary teachers.

The primary purpose of the in-service activities is to introduce the TI-92 and offer specific examples of how the TI-92 can be integrated into the curriculum. Yet the intent is also to bring forth critical issues related to the use of such technology in hopes of generating discussion about the integration of powerful hand-held technology into mathematics teaching and learning. Some crucial questions might include:

- What aspects of the mathematics curriculum could be impacted by the use of graphing/symbolic manipulation technology?
 - What topics are enhanced?
 - What topics should receive increased attention and what topics should be de-emphasized?
 - What topics could be deleted?
 - Are some courses affected more than others? which courses?
- What concerns exist about the use of graphing/symbolic manipulation technology in mathematics?
 - What are some potential problems with implementation?
 - What are the drawbacks of using technology such as the TI-92?
 - Are there prerequisite skills for using the TI-92? What skills are needed?

These are but a few of the issues to consider, but they are a start.

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