

# **MATH WARS**

The Politics of Curriculum

Presidential Scholars Senior Thesis by

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## **Introduction**

There is an ongoing battle in mathematics education, a battle sometimes so fierce that some people call it the “math wars”. Americans have seen many changes and proposed changes in their educational system in the last fifty years, but few have stirred such debate, publicity, and criticism as have the changes in mathematics education. We will first look at the history of the math wars and take time to examine previous attempts to change mathematics education in America. Second, we will assess the more recent efforts in mathematics education reform. Lastly, we will make some predictions for the future of the math wars and the new directions mathematics education may take.

## **History of the Math Wars**

The beginnings of the math wars date back to another war, World War II. World War II caused many Americans to adapt to new situations, and as men went off to war it was quickly found that few had the mathematical skills necessary for math-intensive tasks like radar and navigation. Following the war there was a widespread call for changes in mathematics education. Although there are many variables that affect the success of a student, the groups who pushed for reform quickly concentrated their efforts on the mathematics curriculum. Curriculum up until that time had been very “traditional” with emphasis placed mostly on arithmetic and computation. Some students had excelled, but most found the curriculum uninteresting and therefore not worth the effort necessary to gain anything but the most basic mathematical skills.

In 1952 the University of Illinois created the Committee on School Mathematics. Headed by Professor Max Beberman, the Committee’s goal was to create a “modern” mathematics curriculum. It was the goal of “modern” curriculum to incorporate some of the newer

mathematical concepts, such as set theory, abstract algebra, symbolic logic, and Boolean algebra. Max Beberman was a 25-year-old teacher at the university's laboratory school. He not only saw the need for a new curriculum, but he also realized that current teachers would have to be taught how to teach the new mathematics. Beberman organized summer teaching institutes where teachers could be retrained with new methods.

While Beberman was preparing his first set of high school texts, in 1955 the College Entrance Examination Board formed a commission who issued a report called the *Program for College Preparatory Mathematics*. *The Program* was a set of guidelines that recommended topics to be covered by the college-bound. During the late 50's members of this commission (which included Max Beberman) toured the country encouraging educators to adopt the ideas of "modern" mathematics.

In 1957 the Soviet Union launched Sputnik into orbit. With the Russians seemingly ahead of the United States in mathematics and science, the American government not only called for immediate action but also accompanied their requests with large grants and other funding. With this money available, many other groups began to develop new mathematics curricula. In 1958 the American Mathematical Society organized a group called The School Mathematics Study Group. This group was headed by Edward Begle, a Yale University professor who would later move with the group to Stanford. Other groups included The Secondary School Curriculum Committee, formed by the National Council of Teachers of Mathematics (NCTM), and assorted groups formed by colleges and universities around the country. As more groups appeared some of the proposed changes to mathematics curriculum became more radical.

Beberman and Begle stood apart from their colleagues and were recognized as the leaders of the new math. Not only did Beberman stand out, but his methods stood out as well. His

group at Illinois was the only significant group to actually experiment and test their new curriculum and teaching methods. As America prepared to enter the 1960's, however, the acceptance of the new curriculum was so widespread that selling curriculum became more important than testing it. Other groups with their untested curricula sought to gain leadership, causing even Beberman to focus his efforts away from experimentation and towards campaigning to keep his own curriculum alive.

In 1960 criticisms of the new mathematics began to surface. Some criticisms were based on early test scores, but surprisingly some of the most notable critiques came from Beberman and Begle themselves. At a November conference in Pittsburgh Beberman admitted he shouldn't have made rigorous proof part of his geometry curriculum. Professor Begle said, "in our work on curriculum we did not consider the pedagogy."<sup>1</sup> Two years later at a symposium Beberman stated "...in effect we have answered our own questions and resolved our own doubts as adults and teachers, but these were not the doubts and questions of the children."<sup>2</sup> To Beberman, it appeared the new curriculum had been poorly implemented and certain fundamentals were carelessly forgotten. "We're in danger of raising a generation of kids who can't do computational arithmetic."<sup>3</sup>

By the mid 1960's more than half of American high schools were using curricula based on the new modern mathematics.<sup>4</sup> Many of those 1.2 million had simply jumped on the new math bandwagon (or were put on the bandwagon by their administrators) with little to no training. In 1966 Professor Begle announced his intention to begin work on an entirely new curriculum for grades seven through twelve. Although some parts of the curriculum were fundamentally similar to the previous new math texts, Begle's School Mathematics Study Group promised to do more experimentation and testing before releasing the curriculum. Over the next

several years some texts were produced but as America entered the 1970's the SMSG project eventually faded away.

The new math movement took another blow in 1966 as Professor Beberman underwent surgery to repair a heart ailment. His work and efforts continued, but unfortunately Beberman died in 1971 while studying curriculum ideas in England. Meanwhile, Begle suffered greatly from emphysema. He fought for more research on the teaching of mathematics, but a new mathematical movement would take center stage before his own death in 1978.

Professor Morris Kline of New York University changed the attitudes of many mathematics educators with his book Why Johnny Can't Add: The Failure of the New Math. Published in 1973, this book described the history of the new math movement and detailed many of its faults. Kline called for a new curriculum that worked to integrate math with science, therefore reflecting the historical development of many mathematical ideas. He believed that this would provide a coherent view of mathematics for students to comprehend and would also provide more motivation for learning certain mathematical topics.

Mathematics Education faculty, those professors who specialize in the teaching of mathematics, were scarce before the 1970's. Kline made some harsh criticisms of the "pure" mathematicians who had provided much of the input behind the new math movement. Kline claimed that "because they [mathematics professors] have no idea of the role that mathematics has played in history they are ignorant as mathematicians and certainly as educated human beings"<sup>5</sup> and "most mathematicians are not at all interested in the psychology of learning."<sup>6</sup> Statements like this rallied anti-new math advocates. The anti-new math advocates called for a "back to basics" movement, an effort to improve students' arithmetic and computational skills. Morris Kline makes many detailed suggestions for the future of mathematics curriculum, but a

“back to basics” movement was not one of them. Despite this, many of the “back to basics” advocates used his book as a rallying point against new math and towards a new curriculum.

The back to basics movement had one great appeal to math teachers – it was much easier to teach. The main argument supporting the movement was that students could not succeed in mathematics until they had mastered basic arithmetic, and they could not develop an understanding of more difficult mathematical concepts until they were very familiar with all the formulas and algorithms. In some ways it was even more “traditional” than the so-called “traditional” curriculum of the pre-1950’s. Textbooks were easier to produce as many included mostly pages of computational exercises for “drill-and-practice”. Mathematics teachers could teach using simplified methods, simply showing the class exercises and letting the students practice problem after problem.

The new math movement did not totally disappear. Some teachers continued to teach the modern concepts and develop their own teaching skills. Some concepts, such as geometry, were more prevalent then in the past. Some of Morris Kline’s suggestions were followed while others were ignored. Professor Kline said in his book, “the training of good teachers is far more important than the curriculum.”<sup>7</sup> Along with this suggestion he called for the development of university faculty who would specialize in mathematics education.

The back to basics movement gained many followers but suffered from many of the same problems that were present before new math. As America entered the 1980’s, one group recognized that these problems were not going away. The National Council of Teachers of Mathematics felt that the back-to-basics movement had become a little too basic and an emphasis towards problem solving should be included in mathematics curriculum. In 1980 the NCTM published An Agenda for Action: Recommendations for School Mathematics of the 1980s. The

*Agenda* was a simple, 29-page booklet that contained eight detailed suggestions. The recommendations were as follows:

1. problem solving be the focus of school mathematics in the 1980s;
2. basic skills in mathematics be defined to encompass more than computational facility;
3. mathematics programs take full advantage of the power of calculators and computers at all grade levels;
4. stringent standards of both effectiveness and efficiency be applied to the teaching of mathematics;
5. the success of mathematics programs and student learning be evaluated by a wider range of measures than conventional testing;
6. more mathematics study be required for all students and a flexible curriculum with a greater range of options be designed to accommodate the diverse needs of the student population;
7. mathematics teachers demand of themselves and their colleagues a high level of professionalism;
8. public support for mathematics instruction be raised to a level commensurate with the importance of mathematical understanding to individuals and society.<sup>8</sup>

Most people adopted the *Agenda* and its recommendations rather quickly. The NCTM successfully influenced textbook publishers to include more problem solving exercises, and teachers came to expect problem solving in their lessons and chapters. Although the *Agenda* was considered a success, the NCTM soon saw that drastic changes were needed if America were to make widespread and significant improvements in mathematics education.

### **The Present State of the Math Wars**

In an effort to approve upon its ideas in the *Agenda*, the National Council of Teachers of Mathematics took to the task of developing what they referred to as “curriculum and evaluation standards”. In March of 1989 the Curriculum and Evaluation Standards for School Mathematics reached its final draft with the goal to “establish a broad framework to guide reform in school mathematics in the next decade.”<sup>9</sup>

The *Standards* differed in many ways from the early efforts of Max Beberman and Edward Begle. Perhaps the key difference was that the *Standards* were not a set of textbooks.

Writers of textbooks are under the pressure of producing a product that sells. Textbooks are big business and often the quality of the textbook and the research and evaluation of the methods used in the textbook are sacrificed to the almighty dollar. The NCTM did not have that pressure, giving them the opportunity to be patient and thorough. The *Standards* were developed and written by an organization made primarily of mathematics education professors, and those authors did not have to worry about selling classroom sets of their document to schools across the country. The NCTM had three main audiences for the *Standards*: mathematics education professors, math teachers, and textbook publishers. It would be these people, not a textbook, that would work to reform mathematics in the 1990's.

With the United States performing poorly in international mathematics exams and the memory of the failed new math still fresh in peoples' minds, the NCTM did not release the *Standards* without resistance. In a somewhat bold fashion, the NCTM included lists of those specific topics that should receive either increased or decreased attention. One of the most obvious shifts in attention dealt with an increased use of calculators instead of pencil-and-paper computations. Critics claimed that this decision would create a nation of incompetence where people did even the most basic math on machines. People would become mathematically useless if stranded without a calculator. The back to basics supporters were envisioning their worst nightmares.

One of the most interesting critics of the *Standards* was a "renegade"<sup>10</sup> math educator and book publisher named John Saxon. Saxon's approach to teaching and learning mathematics is seemingly as far away from the NCTM *Standards* as an approach can get. In fact, Saxon has described the NCTM *Standards* as "capricious at best and approach total irresponsibility at worst."<sup>11</sup> You can open any one of his books and you will see black, white, and practice

exercises. The books contain no color, few pictures, few word or story problems, and enough lessons and problems to keep a student doing thirty or more problems every day of the school year. In fact, a student completing Saxon's three-book algebra sequence will solve about 12,000 problems. Saxon feels the key to being successful in mathematics is similar to the key to success in many other areas – practice makes perfect. In the introduction to his textbooks Saxon claims

Repetition is necessary to permit all students to master all of the concepts, and then the application must be practiced for a long time to ensure retention. This practice has an element of drudgery in it, but it has been demonstrated that people who are not willing to practice fundamentals often find success elusive. Ask your favorite athletic coach for his opinion on the necessity of practicing fundamental skills.<sup>12</sup>

Although this seems to be a sensible approach, Saxon's textbooks are generally disliked among NCTM supporters. One reviewer called the book "sterile".<sup>13</sup> Despite the criticisms, one Saxon method that seems to be universally liked is called "incremental development". It is this method that really sets the Saxon texts apart from the other "traditional" math textbooks. In the "incremental development" method, each practice set of approximately 30 problems will only contain 4-8 new problems and the rest will be problems of types covered in earlier lessons. As students continually review the problems, Saxon claims the students develop confidence and the skills used to solve the problems become automated.<sup>14</sup> This approach has shown particular success with lower-ability students, something John Saxon was usually quick to point out.

Some of the rumors and attitudes surrounding John Saxon and his methods are amusing and almost the stuff of legend. Some people claim that Saxon would strategically place his supporters (or employees) in conferences so that they could provide the audience with convincing testimonials. Some salesmen from rival textbook companies are very willing to put down the Saxon approach in an attempt to glorify their own. Some people claim that Saxon's biggest selling point is the ability to produce his black-and-white books cheaper than the

competition's colored texts. With the death of John Saxon in 1996, the legend will probably continue to grow. His children have succeeded him in the textbook business and have taken some beginning measures to make the Saxon series more *Standards*-compliant.

Other criticisms of the NCTM *Standards* have been plentiful. Edward Effros, a professor at UCLA, comments on the lack of commitment to education. "Although we probably cannot improve mathematics education by changing the curriculum, we can certainly make things worse. One way to do so is to pretend that because students can use calculators, they no longer need to master the basic arithmetical and algebraic manipulations."<sup>15</sup> Some of the criticisms are displayed prominently in popular magazines like Reader's Digest. In her article, Marianne Jennings comments on cooperative learning, another method supported by the NCTM. "Today's math education goes further astray in the jungle of unproven teaching techniques. Under "cooperative learning," for example, students join together in groups with the hope that they will somehow teach each other a concept none has ever seen."<sup>16</sup> In a paragraph adjacent to a pork chop recipe, Jennings also comments, "The engineers who put Neil Armstrong on the moon learned good old-fashioned math. This next generation will have trouble pointing out the moon."<sup>17</sup>

Despite such criticisms, the NCTM pushed on with the *Standards* project. In March of 1991 the NCTM published The Professional Standards for Teaching Mathematics. With this document, the NCTM's goal was "to provide guidance to those involved in changing mathematics teaching."<sup>18</sup> While many criticized the NCTM's vision of future curriculum, the NCTM had been working to develop a set of standards for teachers and teaching methods. This essentially represented the effort called for 25 years prior by Beberman and Begle. Whereas the *Curriculum and Evaluation Standards* were a set of guidelines, the *Professional Standards* could

have been used as a text in a collegiate teaching methods class. Furthermore, the *Professional Standards* solidified the NCTM's commitment to improving all of mathematics education, not just math curriculum.

The final installment in the *Standards* project was published in May of 1995. The Assessment Standards for School Mathematics describes how students should be assessed and evaluated with the values of the *Standards* in mind. One of the major struggles teachers face when changing curricula is how to adjust their methods of assessment. The *Assessment Standards* provide guidelines for teachers that help them make those adjustments.

With the trio of *Standards* books in place, the NCTM had announced a comprehensive vision for changing school mathematics. For the *Standards* to be put to use it was the duty of states and local schools to take the *Standards* and adapt them to their particular situations. The *Standards* were not designed to be a rigid, inflexible set of standards. They are a broad set of guidelines that provide the basic structure that can be shaped by states, school districts, and individual teachers. The apparent vagueness of the *Standards* has come under criticism but the flexibility was necessary for the project's success.

With the responsibility of implementing the *Standards* now falling on the shoulders of local educators, new battles in the math wars have evolved. A World Wide Web site called "Mathematically Correct" has emerged as a leading source for information on the math wars. The site collects articles, editorials, and book reviews designed to provide a strong opposition to the *Standards* movement and the NCTM. On this site you frequently see the terms "fuzzy math", "whole math", and "new-new math". These terms are clearly meant to belittle the new direction in mathematics education encouraged by the NCTM.

Mathematically Correct devotes many of its arguments to California, a state that has traditionally been on the leading edge of new and sometimes questionable educational practices. California approved a set of state standards in 1997. Those standards seem to be highly influenced by the Third International Mathematics and Science Study (TIMSS), an international comparison of math and science achievement in countries around the world. With the United States placing usually at or below average of all the countries represented, California decided to abandon the NCTM *Standards* and write their own set of standards that reflect a more traditional approach. To their credit, Ralph A. Raimi and Lawrence S. Braden of the Thomas B. Fordham Foundation has ranked the new California standards number one among other state standards and have even been placed ahead of the standards from math-power Japan.<sup>19</sup> The standards are also endorsed by Jaime Escalante, the mathematics teacher portrayed in the movie Stand and Deliver. However, NCTM followers have not appreciated California's abandonment of their efforts for an alternative approach. The California standards make no attempt to define proper teaching of the standards. As long as the students meet the benchmarks asked for by the California legislature the teachers can teach in any style they wish.

For many, the passing of the California standards was a major victory against the NCTM *Standards*. Unfortunately, many of the California standards supporters use the TIMSS data to support the failure of the NCTM's reform mathematics. However, the California standards were accepted only two years after the trilogy of *Standards* books were available, indicating little patience for textbook publishers to develop quality texts that reflect NCTM goals and practices. Interestingly, the California approved several books from the Saxon series but did not accept the Saxon Algebra ½ and Algebra I texts.<sup>20</sup> Most all traces of the boldest reform mathematics

textbooks were not accepted, meaning schools will not receive state assistance for the purchase of those texts.

Although the California standards are definitely a blow to the efforts of the NCTM, the efforts to implement and improve the *Standards* continue. The NCTM has been actively working on a project called *Standards 2000*. On April 12, 2000 the NCTM will officially release its final draft of Principles and Standards for School Mathematics. This document, the product of the *Standards 2000* efforts, will bring together all of the ideas from the first trilogy of *Standards* into one comprehensive document. The NCTM has worked to improve their first version of the *Standards*, using their own experiences as well as input from sources across the country at many different levels of mathematics education.

### **The Future of Mathematics Curriculum and the Math Wars**

Will we see an end to the math wars? Probably not anytime soon. Arguments over the way mathematics is taught and presented in textbooks will continue as long as schools and teachers have the ability to choose their own curricula and teaching philosophies. Would a national curriculum end the war? It would certainly change the war, and there would be many more obstacles to overcome until we could consider such an action.

Mathematically Correct has produced a document called "Toward a Cease Fire in the Math Wars" where they claim that the NCTM is pushing their own personal agendas while not keeping the nation's mathematical woes as a top priority. Mathematically offers a set of thirteen guidelines to NCTM to promote "math peace". The guidelines are:

1) Demand greater mathematics knowledge for teachers

The deficiencies of the mathematical background of our teachers is an embarrassment as well as a hindrance. Encouraging the placement of well-prepared teachers in secure classrooms should be the first order of business. Our universities must provide a deeper treatment of mathematics for our future

teachers, and greater mathematics knowledge must be required for teacher placement.

- 2) Stress that standards of learning must have yearly benchmarks  
Effective standards detail content-based learning objectives at least for each year/course of the curriculum. While the NCTM documents belie this approach by their use of the name "Standards" there is no excuse for not clearly directing the development and use of real standards by states and districts.
- 3) Admit that weak programs have resulted from following NCTM guidelines  
Whether intended by the NCTM or not, seriously deficient curriculum materials have been written in the name and spirit of alignment with NCTM and now are found in many schools. This fact must be admitted and condemned, otherwise there remains defacto support of these programs.
- 4) Refrain from promoting any theory of learning or method of teaching  
Diversity in the student population is no excuse to promote methods such as constructivism or cooperative learning over methods such as direct instruction. The well-prepared teacher is skillful in a variety of approaches and in deciding which approach to use in specific classroom situations. Any guiding document on mathematics education should avoid promoting one approach over others.
- 5) Encourage frequent objective tests to monitor student progress  
The use of objective tests of student knowledge and skills has been much maligned. Regardless of whatever other measures are used, students should also be able to do well on these more traditional, objective indices of achievement. The importance of frequent measures of student progress necessitates the use of these valuable tools.
- 6) Keep the focus on mathematics  
The key to success is not just making mathematics fun and interesting -- mathematics achievement will continue to require hard work. Diverting time and attention away from the mathematical focus with projects and activities that contain little mathematics is self-defeating. Similarly, skipping among unrelated topics in a misguided effort to increase interest destroys the mathematical focus.
- 7) Refrain from promoting heterogeneous grouping or repudiating homogeneous grouping  
The use of heterogeneous grouping and disdain for homogeneous grouping is without empirical basis and may detract from the learning potential for all students. Any guiding document on mathematics education should avoid these issues.
- 8) Admit that arithmetic and algebra are the key elements of the early curriculum  
Arithmetic and algebra have continually been stumbling blocks for many students. Rather than a reason for mathematics education to shy away from these areas, this is a reason for increasing the emphasis on and attention to these subjects. The putative changes in mathematics have been used to justify broadening the scope of math education to the point of detracting from these important areas, and their rightful emphasis must be restored.
- 9) Include symbolic skill-building, abstract mathematics, and repeated practice  
Not all learning in mathematics must or should be based in applications. Even when the ultimate objective is real-world application, the acquisition of skills and

knowledge may often require more abstract and fundamentally pure mathematical material along the way.

- 10) Reinstate an emphasis on proof and mathematical justification  
The de-emphasis on proof and the casual approach to mathematical reasoning have been harmful to this important feature of mathematics. The gradual development of formal logic and proof must begin earlier in the curriculum and be given greater emphasis.
- 11) Emphasize that algorithms should be taught, understood, and used  
Algorithms and operations are not evil, but in fact are techniques to be taught, understood and then used to make processes more efficient and thus make room for further advancement.
- 12) Delete the list of topics for de-emphasis  
The NCTM "Standards" contain a list of topics for de-emphasis that has been taken to an extreme, including NSF-funded programs that eliminate these contents. Whether intended or not, the list has resulted in great harm and must be eliminated.
- 13) Indicate that calculators and computers should be used sparingly  
The advances of technology proceed at an alarming rate, making it all but impossible to evaluate their impact on education. Introduction of these has to be assumed to place learning at risk unless it is done conservatively, including a large portion of class/curriculum/tests that do not allow technology.<sup>21</sup>

This "peace treaty" by Mathematically Correct has some strong points as well as some weak and unfounded arguments. Ideas like demanding greater knowledge for teachers and keeping the focus on mathematics are not likely to be disputed by the NCTM. Many of the requests made by Mathematically Correct are the result of misinterpretations of the original *Standards* documents. The NCTM has used these and other criticisms to improve its vision in *Standards 2000*.

The NCTM's *Standards 2000* promises to shape the way we view, teach, and learn mathematics as we begin the 21<sup>st</sup> century. Thirteen different *Standards*-based curriculum projects have been endorsed and funded by the National Science Foundation<sup>22</sup>, and as these curricula work their way into schools the NCTM will finally begin to see its visions implemented at a widespread level. *Standards 2000* will also help clarify some of the misconceptions of the

previous *Standards*. The NCTM comments this way in the Preface of the Discussion Draft of *Standards 2000*:

Issues about the fidelity of interpretations to the original *Standards* documents are complex. The original *Standards* intended to provide guidance and vision without being overly prescriptive and left specific curricular decisions to the local level. As a result, an enormous range of policies and practices claim to fit beneath the *Standards* umbrella. Another result is that the *Standards* may be implemented in curricula or instructional practice in ways unintended by the original *Standards* writers. Examination of such implementations may therefore lead to inappropriate claims about the effects – both positive and negative – of the *Standards* in situations that are far removed from the original documents. ...With the hindsight of ten years of experience, it is clear that certain messages of the original *Standards* documents were not understood as they were intended. For instance, the charts in the *Curriculum and Evaluation Standards* that listed “Topics to Receive Decreased Attention” were sometimes interpreted as advocating the complete removal of certain topics from the curriculum. As teachers and policymakers have worked with the *Standards* documents in the past decade, it also has become clear that certain ideas in the *Standards* – such as the role of basic skills and conceptual learning – needed refinement and elaboration. In producing this draft of *Principles and Standards*, we have benefited from recognizing the difficulties surrounding issues of interpretation.<sup>23</sup>

Clearly this is an attempt to resolve problems and issues such as those outlined in the "Cease-Fire" called for by Mathematically Correct. In particular it is in agreement with Mathematically Correct's third guideline, the request that the NCTM admit that weak programs have resulted from following (or misinterpreting) NCTM guidelines. Judging from the organizations' previous battles in the math wars, it is not likely that *Standards 2000* will win the favor of those at Mathematically Correct.

The key to the success of *Standards 2000* will not come from battles with organizations like Mathematically Correct. *Standards 2000* will only succeed when its ideas are adopted at the classroom level, and not adopted solely at the request of the school administration or state department of education. Teachers will have to implement reform mathematics in their own classrooms independent of a political agenda. This is essentially no different from the feelings of Beberman and Begle nearly forty years ago.

To ask an established, experienced teacher who has been using what they claim to be "successful" teaching methods to drastically change the way they teach is a battle that the NCTM is losing more than they are winning. The battle best fought by the NCTM is with young teachers, particularly those still in college methods courses. It is at this level where the NCTM's message can be best implemented, away from the distractions of the normal classroom environment where some teachers feel they must rely on traditional methods for their own survival.

If this is to be the case, if the leaders of the reform movement are the young teachers and the future teachers, then the NCTM is releasing *Standards 2000* at an important time in our nation's educational history. The baby-boomer generation is reaching retirement age and the demand for new teachers, particularly in science and mathematics, is extremely high. The large influx of new teachers will be responsible for carrying the message that the NCTM intends to deliver with *Standards 2000*.

The next ten years of mathematical education in America will be greatly affected by technology. Technology is a rather broad category, and technology in mathematics usually refers to graphing calculators. The technologies that may possibly revolutionize the math classes of the future are curriculum management systems such as Accelerated Math by Advantage Learning Systems.

It is a near-universal opinion that students could be better served by teachers with more individual attention and curricula that moves at the pace of the student. This may be fine for tutoring a small number of students, but the mastery learning concept is extremely difficult to manage for large numbers of students with varied abilities. Accelerated Math is a first-

generation software tool available to teachers that helps them manage a mastery learning approach with a large number of students.

Accelerated Math allows teachers to enroll students into virtual classes where the students are assigned objectives appropriate to their own ability level. The program generates unique, multiple-choice assignments to each student, ensuring that the student does not have the same problems as the other students and is therefore unable to cheat or copy from their classmates. Upon completion of the worksheet, the results are scanned into the computer and within seconds a report is printed indicating correct and incorrect answers as well as what objectives the student has passed. When the student has passed enough objectives the teacher can print a test for the student. If the student does well enough on the test, the objectives are marked as "mastered" and the student continues with future objectives. If anywhere along the process the student encounters repeated difficulty, troublesome objectives are marked "intervene", a signal to the teacher to give some remedial instruction to that student.

Accelerated Math has some clear advantages. First, all the students are allowed to work at their own pace. They receive assignments that are unique to them, therefore curbing their ability and desire to cheat. With Accelerated Math, the teacher does not have to invest as much time into correcting assignments. Instead, the teacher can examine the reports generated by Accelerated Math to decide which students are in need of help.

Accelerated Math also has obvious shortcomings. With the exception of a few special objective libraries, all work is multiple choice. Students can develop skills for multiple choice tests that do not necessarily coincide with the skills needed to perform quality mathematics. Because of the current limitations of the software, the multiple choice questions are very traditional in nature. The goals of the NCTM and the *Standards* are not evident throughout the

software, although Advantage Learning Systems does make an effort to indicate which objectives relate to particular NCTM standards. Accelerated Math also falls under the "not approved" list of curricula in the state of California.<sup>24</sup> As a curriculum, Accelerated Math does not stand on its own merits. Until the quality of the mathematics improves, Accelerated Math is not suitable as the core curriculum of a classroom.

Accelerated Math has shown itself as a unique supplement to a developing reform curriculum. Several seventh grade teachers at Phillips Middle School in Fort Dodge, Iowa began using Creative Publications' MathScape curriculum in the fall of 1998. MathScape is a NSF-funded standards-based curriculum that was far different from what the teachers or students were accustomed to. As often happens when making the leap to reform-based curricula, the teachers at Fort Dodge felt the need to supplement the reform curriculum with more traditional, computational worksheets. Reform curriculum takes a great deal of patience and it may take some time before the transition feels comfortable for both the teachers and the students.

One teacher, Lynda Peterson, liked the MathScapes curriculum and the positive attitude it seemed to breed within her students. Students still struggled with mathematical concepts, but now with fewer complaints. In the spring of 1999, Mrs. Peterson heard about Accelerated Math and its capabilities. After piloting the software alongside the MathScapes curriculum Phillips Middle School became the first school in the state of Iowa to purchase the software.

Full use of Accelerated Math began in the fall of 1999. Many teachers were initially reluctant – some did not like the idea of yet another new curricula while others resisted the idea of depending on a computer in their class. Many of the teachers still had not begun use of the MathScapes curriculum. Eventually other teachers became familiar with the software and wanted to benefit from its advantages over traditional worksheets. The administration, which

had worked to make the expensive purchase of the software, also wanted to see it used building-wide.

The math teachers of Phillips Middle School are now trying to find the best balance between MathScapes and Accelerated Math. Mrs. Peterson has designed her classroom to focus primarily on the MathScapes curriculum and let the responsibility of progressing through Accelerated Math to the students. With Accelerated Math, Mrs. Peterson knows that every student has something to work on when the MathScapes lessons and assignments finish early. She also knows that all the students are working at their own pace and at their own ability level. Without the extra homework to correct, Mrs. Peterson can devote more of her time to helping students and developing future lessons with the MathScapes curriculum. In the future Mrs. Peterson would also like to see Accelerated Math available to students during the summer months. It would be an excellent opportunity for students to progress farther than they would in an average school year.

It is easily foreseeable that, in the very near future, textbook companies are going to develop computerized curricula similar to Accelerated Math. As these tools emerge and find their way into classrooms, teachers are going to have to use their own best judgement to combine different curricula. Just as in the “Peterson Model”, an honest effort to use reform curricula with appropriate teaching methods will need to be balanced with new technologies designed to make the classroom environment more manageable. It will take time for the strengths of reform curriculum and the strengths of technology to develop into one product.

### **Conclusion**

Will the combination of technology and proper curriculum end the math wars? No. The math wars are not fought by textbooks. They’re fought by people. The math wars are not really

a war, rather they are the result of differing yet strong opinions by people who want what's best for the children of this country. So which curriculum is better? Traditional or reform? The past has shown that traditional curriculum has its faults. The present has shown us that reform has its share of problems as well. While the reformists battle the traditionalists, the rest of us should worry about our own kids, our own classrooms, and ourselves. People need to closely examine the arguments and make the best decisions for their own situations. Surely some reform will prevail and some traditional approaches will never go away. It is imperative that we remain flexible in our thoughts and remain willing to try new things and fairly assess the results. Only then will the politics end and the uninhibited focus on mathematics education will begin

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### **Notes**

<sup>1</sup> Kline, p. 110.

<sup>2</sup> Kline, p. 110.

<sup>3</sup> Kline, p. 110.

<sup>4</sup> Miller, p. 76.

<sup>5</sup> Kline, p. 128.

<sup>6</sup> Kline, p. 132.

<sup>7</sup> Kline, p. 170.

<sup>8</sup> NCTM, An Agenda for Action: Recommendations for School Mathematics of the 1980s, p. 1.

<sup>9</sup> NCTM, Curriculum and Evaluation Standards for School Mathematics, p. v.

<sup>10</sup> Finn, p. 31.

<sup>11</sup> Sykes, p. 125.

<sup>12</sup> Finn, p. 31.

<sup>13</sup> Finn, p. 31.

<sup>14</sup> Saxon, p. 0.

<sup>15</sup> Effros, p. 19.

<sup>16</sup> Jennings, p. 182.

<sup>17</sup> Jennings, p. 182.

<sup>18</sup> NCTM, Professional Standards for School Mathematics, p. 2.

<sup>19</sup> Raimi, <http://www.edexcellence.net/standards/math.html>.

<sup>20</sup> "New California Mathematics Adoptions", <http://www.mathematicallycorrect.com/calbooks.htm>.

<sup>21</sup> "Toward a Cease-Fire in the Math Wars", <http://mathematicallycorrect.com/cease.htm>.

<sup>22</sup> Reys, et. al., p. 455.

<sup>23</sup> NCTM, Principles and Standards for School Mathematics: Discussion Draft, p. 13.

<sup>24</sup> <http://www.mathematicallycorrect.com/calbooks.htm>

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