



A Brief History of the Mathematics Curricula in the United States

Senior Project

In partial fulfillment of the requirements for
The Esther G. Maynor Honors College
University of North Carolina at Pembroke

By

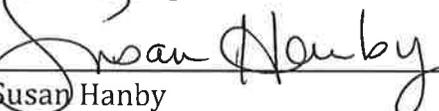
Taylor M. Cooper
School of Mathematics
November 14, 2017



Taylor Cooper
Honors College Scholar

12-4-17

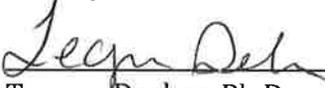
Date



Susan Hanby
Faculty Mentor

12/4/17.

Date



Teagan Decker, Ph.D.
Senior Project Coordinator

12/4/17

Date

Acknowledgements

I would first like to thank my mentor Susan Hanby of the Mathematics Department at The University of NC at Pembroke. She was always willing to help when I had questions about my writing. She also steered me in the right direction when I began choosing a topic, and I am gratefully indebted to her valuable comments and suggestions on this paper.

I would also like to thank my professor Dr. Teagan Decker of the English Department as the second reader of my paper. I am thankful for her input on the formatting and overall quality of this paper.

Abstract

This paper provides a historical overview of how the mathematics curricula has evolved from Colonial times to modern-day America. This paper offers a historical perspective of how math has been taught and how historical events, such as the Great Depression and World War II, affected mathematics education in the United States. It also discusses how the value of math education has changed and how different views of mathematics affected what was taught in the classroom. Government legislation and its effects, both positive and negative, are also addressed. The purpose of this paper is not to critique the way that math has been taught, but rather to provide valuable insight into the development of mathematics education and its dynamic nature.

Keywords: mathematics education, curricula, progressivism, Math Wars, New Math, compulsory education laws, NCTM Standards, No Child Left Behind, Common Core, Race to the Top

A Brief History of the Mathematics Curricula in the United States

Colonial America

In colonial America, formal education depended on the social rank of the family. The English were the main settlers of colonial America, and therefore colonial education was patterned after English schools. Girls were rarely given a chance to be educated and boys from the middle class were educated in dame schools, elementary schools, and grammar schools. Boys from upper class families were usually taught by private tutors and then travelled abroad to English colleges and universities. There they would often take a tour of the great cities of Europe. Eventually, elite colleges such as Harvard, Yale, Princeton, Columbia, etc. were founded in colonial America.

Colonial education primarily consisted of teaching literacy and training the elite in the classics (Waggener, 1996). Reading, writing, and religious instruction were the only topics required in colonial schools. Although there was a greater emphasis on reading and writing, certain mathematical skills such as the “four rules” (addition, subtraction, multiplication, division), fractions, and “the rule of three” (an operation used to solve direct and inverse proportions) were taught in many schools (Swett, 1900). According to Swett (1900), in 1789, neither basic arithmetic nor geography were necessary for admittance into Harvard. It wasn’t until 1814 that the college required knowledge of the rule of three, and in 1816 it “asked for the whole of the arithmetic” (Swett, 1900, p. 142). In 1820, Harvard made algebra a requirement for admission into the college and in 1844 required geometry. Yale also increased its prerequisites around the same time.

19th and early 20th centuries

In the 19th and early 20th centuries most Americans attended one-room school houses where a single teacher would typically have students in grades one through eight. She would teach them all together, and the curriculum usually included reading, writing, history, geography, and arithmetic. Kegley (1947) describes the accounts of men who were school boys in school houses at the end of the 18th century and the beginning of the 19th century. Their experiences tell more of “bare and cold schoolhouses, and the meagre learning and severe discipline of many of their early schoolmasters than they do of methods of instruction and of subject matter taught” (Kegley, 1947, p. 19). Arithmetic, when taught, was learned by drill and memorization. Many schools didn’t have textbooks. During this time arithmetic was considered to be very challenging and students didn’t begin learning math until their early teens (Waggener, 1996). No criteria of arithmetical success existed and to know concepts beyond the rule of three was considered a great accomplishment (Kegley, 1947).

The initial departure from the former way of learning was made by Warren Colburn, a Boston schoolmaster. In the autumn of 1821, Warren Colburn’s *The First Lessons in Intellectual Arithmetic* was published. This book went into use by schools at once and became more popular than any other arithmetic book published. In 1856 it was claimed that 50,000 copies were used every year in Great Britain and 100,000 annually in the United States (Monroe, 1912). It was translated into foreign languages and is still published today. Colburn’s work was based on the ideas of Pestalozzi, a Swiss philosopher and education reformer who felt that lessons should

begin with familiar topics to introduce new information (Silber, 2014). Colburn's book lowered the starting age of arithmetical instruction from the early teens to about 6 or 7 (Baggett & Ehrenfeucht, 2012). It focused on oral instruction rather than memorization and drill. Colburn created problems that were relatable to young children as they were based on their own experiences. His writing style was easy to understand, which contributed to the success of *First Lessons*.

Although Colburn's book was very popular, by the end of the 19th century, mathematics was seen as tool for strengthening the mind through drill and discipline, otherwise called mental discipline. Advocates of this method believed the mind was like a muscle and used drill and memorization without much learning occurring (Waggener, 1996). Transfer of training was another theory in use at this time. Theorists proposed that skills acquired from one activity could be transferred to another activity.

By the late 1800s, there were competing philosophies about the role of American schools. Some thought that schools should prepare students for college, while others felt that schools should prepare students for industrialized or trade jobs. There were also competing philosophies about rote memorization versus critical thinking. There was no set curriculum and students were studying large amount of subjects for short periods of time. There was need for order and standardization.

To address these concerns, the National Education Association appointed the Committee of Ten on Secondary Studies in 1892 in order to standardize the school curriculum. The committee recommended that 12 years of education were

needed, with 8 years of elementary school and 4 years of high school. The committee also proposed that fewer subjects be studied over longer periods of time. Concerning mathematics, the committee suggested that Algebra be studied the first year of high school, geometry the second year, Algebra 2 and Geometry 2 the third year, and Trigonometry and Higher Algebra the fourth year (Mackenzie, 1894). It also called for the better training of teachers, and the committee made clear that the purpose of high schools was to prepare students for college.

In 1900 an additional attempt to organize the educational standards was made when the College Entrance Examination Board (CEEB) was founded. At the close of the 19th century there was little consensus among colleges regarding the knowledge they required of their prospective students. This made it difficult for secondary teachers to prepare their students for college as they were unsure what to teach them (McCandless, 1967). The CEEB standardized college entrance requirements and provided uniformity in secondary schools. This board greatly influenced public secondary school curriculums as it provided an organized set of standards common to all colleges.

In 1908, the International Commission on the Teaching of Mathematics gave a report of the status of mathematics education at the time. The study found that “almost all secondary schools in America provided at least one year of algebra and geometry, 50% of schools had one more semester of algebra, and that less than 20% of schools offered any higher mathematics” (Waggener, 1996).

1920s-1940s

8 Cooper

In the 1920s-1930s during the Great Depression, Americans wanted adults to receive the available jobs instead of children. Before this time, during the Industrial Revolution, child labor increased dramatically as children regularly worked long hours in hazardous factory conditions for little earnings. Immigrants poured in and stimulated industrial growth while also straining the financial resources of the cities. Many of these children worked to support their families and did not receive much education. Reformers in the 19th century worked to improve conditions and outlaw child labor, but it wasn't until the Great Depression that child labor conditions were improved. The Fair Labor Standards Act of 1938 placed limitations on child labor and the employment of children under 16 was prohibited (Yellowitz, 2009). Because of these changes concerning child labor, attendance in schools began to rise.

By 1920, compulsory schooling laws were being more observed, though in many states they were still not strictly enforced. By 1920 the laws included longer amounts of schooling each year, a mandatory school census, attendance officers, and eliminating exemptions for students who had mental or physical conditions (Katz, 1976). In 1900 the average permissible age for leaving school was 14 years and 5 months in states that had truancy laws. By the 1920s it had risen to 16 years and 3 months. Thirty one of the 48 states required school attendance until age 16, one until 17, and five until 18. Eight states required school attendance until age 14 only. From 1890 to 1930 there was a shift from sending kids to work to sending them to school (Katz, 1976).

Based on the ideas of Jean Jacques Rousseau and John Dewey, progressive education has influenced American schools since the early 20th century. William Heard Kilpatrick, an influential education leader and advocate of progressive ideas, wrote a book called *Foundations of Method* in 1925. It became a textbook for teacher education courses in the U.S. As a supporter of progressive education, Kilpatrick rejected the idea that studying math contributes to mental discipline, the belief that learning must be forced and achieved by rigid training such as drill and rote memorization. Instead, he believed that subjects should be taught based on their practical value to the students or if students freely wanted to study the subjects. Kilpatrick proposed that algebra and geometry should no longer be taught in high school “except as an intellectual luxury.” He felt that mathematics is harmful unless it is being used for everyday life (Klein, 2001)

Progressivists based their ideas on the work of Edward L. Thorndike who argued against mental discipline and transfer learning. His findings were useful in challenging the use of drill in the classroom and contributed to the idea that math should be used for practical purposes only (Klein, 2001)

In the 1930s progressivism dominated the textbooks, journals, and courses for educators (Klein, 2001). According to Klein (2001), “It became a cliché in the 1930s, just as in the 1990s, for educators to say, ‘We teach children, not subject matter.’” The Activity Movement of the 1930s called for the integration of subjects in elementary schools and opposed separate instruction in math and other topics. High schools were more hesitant because the teachers were skilled in specific subject areas, and there was public resistance to the education ideas of this time.

In the 1940s, students were not learning basic skills and much of the public opposed the education doctrines of the progressive movement. World War II marked the start of the U.S. government's interest in math education due to the lack of mathematical skills of incoming officers (Waggener, 1996). By the mid-1940s a new educational program called the Life Adjustment Movement was developed to provide students who were not college bound or headed for skilled occupations with "life skills" to prepare them for everyday living. The math courses focused on practical uses such as buying, insurance, taxes, and budgeting rather than algebra or geometry. Many parents opposed these changes because they wanted their kids educated, and university professors criticized the lack of academics in the life adjustment programs. By the end of the 1940s, the public school system was heavily criticized due to the lack of attention to basic skills, and the life adjustment program died out (Klein, 2001).

1950s-1960s

In the 1950s progressive education died out. The "New Math" period began in the early 1950s and lasted until the end of the 1960s. This period was a move away from the previous half-century of progressivism and proposed curricula that stressed logical justifications for the math procedures taught in schools (Klein, 2001). During the previous fifty years enrollment in advanced math classes had decreased due to progressive education. In the 1952-1953 school year only about 24.6% of high schoolers were enrolled in algebra classes and 11.6% in geometry. In the 1909-1910 school year, forty-three years earlier, 56.9% of high schoolers were taking algebra classes, and 30.9% were enrolled in geometry (Klein, 2001).

In 1957, the Soviet Union launched *Sputnik I*, the first satellite, into space. The United States viewed this as a humiliation and also as a matter of national security (Waggener, 1996). The media highlighted the low quality of the math and sciences in public schools. As a result, congress passed the 1958 National Defense Education Act to increase the amount of science and math majors. It provided funding to support programs to help improve math education. Also in that year, the American Mathematical Society founded the School Mathematics Study Group (SMSG) to develop a new curriculum for high schools.

Due to the New Math movement, calculus courses were introduced to high schools. Another contribution of this period includes the Secondary School Curriculum Committee of the NCTM. There were many other groups that began during this period. Although there were many important influences from this time, math curricula became very formal with little emphasis on elementary mathematics. Courses included set theory and analysis topics that confused students as well as parents. Consequently, criticisms from the public increased, and by the early 1970s New Math had dissolved.

1980s

In the early 1980s, the low-quality of math and science education was addressed. A 1980 report showed low enrollments in advanced math and science classes and lesser school expectations and college admission requirements. The National Council of Teachers of Mathematics released *An Agenda for Action* in 1980 and recommended that problem solving be the focus of school mathematics. The report called for the use of technology to make problem solving available to

students short of basic skills. The report also encouraged the use of manipulatives to illustrate concepts. However, the report got little attention, and in 1983 another report called *A Nation at Risk* caught the public's attention as it described the nation's shortcomings in math education and how the future of the nation was threatened.

A Nation at Risk found that between 1975 and 1980 remedial math courses in public universities had increased by 72 percent and that business and military leaders had spent millions in remedial education programs. The report also described how only 31 percent of recent graduates (1983) had completed intermediate algebra (Klein, 2001).

Additionally, the report addressed the need for student assessment and recommended that standardized tests be administered from grade to grade as well as from high school to college or work. The report addressed the quality of teachers and teacher training programs, as well as teacher shortages. It also drew attention to textbooks and recommended that they include more difficult content. *A Nation at Risk* was talked about all over the country and states created commissions to evaluate their own programs.

In 1986 the NCTM created the Commission on Standards for School Mathematics. During the summer of 1987, the *Curriculum and Evaluation Standards for School Mathematics* was developed and then revised in 1988. The official document was published in 1989 and was referred to as the *NCTM Standards*. The *NCTM Standards* contains sections with standards for the grades K-4, 5-8, and 9-12. The standards reflected the ideas of *An Agenda for Action*, such as the use of

manipulatives and calculators, but with increased detail. The grade level bands included topics that were to receive increased or decreased attention. For example, the K-4 band called for increased attention to meanings of operations, mental computation, and use of calculators for complex computation, among others. It called for decreased attention for long division, paper and pencil computations, and rote practice/memorization, among others. The *NCTM Standards* were characteristic of progressivism, supporting student centered learning. However, it differed from early 20th century progressivism in that the study of mathematics just for the sake of it was not encouraged. By 1997 most states had adopted math standards similar to the NCTM standards.

There was public resistance to the standards in the 1990s. The books that parents resisted did not contain basic arithmetic skills and algorithms. Elementary schools urged students to develop their own algorithms. Calculators were used excessively, and student discovery group work was the preferred method of learning. Algebra and arithmetic was less important and some schools did not even provide textbooks as they may have hindered student discovery. Parent organizations worked to apply effective math policies at the state level.

1990s

The 1990s marked the beginning of the math wars, a time of intense controversies over the teaching of mathematics. The debate was triggered by the public criticisms by the NCTM of California's 1997 mathematics standards. Klein (2001) explains that California had the greatest national influence on math education due to the fact that it is the most populated state and textbook companies

try to sell to the California market. This affected what was accessible to the rest of the country. In 1996, national progress reports showed that California's fourth graders scored below their peers in 40 states. There was also an increase in remedial math courses at California State University. To address these problems, in 1997 a standards commission made of non-expert citizens was tasked with developing mathematics standards for California. When submitted to the State Board of Education, the standards were not cohesive and contained mathematical errors. Therefore the State Board asked Stanford University math professors to help with the standards. They rewrote the standards and corrected over 100 errors. The resulting standards allowed teachers to use progressive or traditional teaching methods, and the standards were adopted by California in 1997. The NCTM publicly disapproved of the new California standards, claiming that they "emphasized basic skills and de-emphasized creative problem solving, procedural skills, and critical thinking" (Klein, 2001). Many non-mathematicians thought that the standards were "dumbed down" and focused more on rote memorization.

California mathematicians, however, had different views. More than 100 math professors from colleges in California signed a letter in support of the standards. After a few months, criticisms of the standards lessened. In 1998 the *Framework*, a system that identified textbooks aligning with the new state standards, was adopted by the California State Board of Education. However, public resistance to the state standards remained. In 2000, the NCTM released *Principles and Standards for School Mathematics* (PSSM). It was a revision of the 1989 Standards that gave greater emphasis to algorithms and computational math and

removed some of the more drastic ideas from the 1989 Standards. There continued to be criticisms from the public about the PSSM, and at the end of the 20th century, disagreements continued to exist between parents and mathematicians and educators (Klein, 2001).

2001

In 2001, Congress passed the No Child Left Behind Act (NCLB). President George W. Bush signed it into law in 2002. The act was developed because some felt that the education system could no longer keep up with other countries (Klein, 2015). It also aimed to lessen the achievement gap between groups of students such as English language learners and poor and minority children. States were not required to observe the law but if they didn't, they risked losing federal Title I money. NCLB increased the role of the federal government in the education system. It required that all states annually test every student in reading and math from third to eighth grade. Each school was required to make annually yearly progress (AYP) to meet the proficiency goal by 2013/2014. States were allowed to use their own tests and set their own proficiency standards (Ladd, 2017).

There were both positive and negative results of NCLB. It generated huge amounts of data on student achievement in math and reading. It also made schools accountable for the test scores of subgroups who may have been ignored. Another positive result of NCLB was that it required teachers to be highly qualified and led to more teachers getting Master's degrees (Ladd, 2017). According to Dee and Jacob (2010), "NCLB brought about targeted gains in the mathematics achievement of younger students, particularly those from disadvantaged backgrounds" (p. 149).

A negative aspect of NCLB was the increase of standardized tests, causing many teachers to “teach to the test.” Additionally, many schools could not meet the requirements of AYP and were shamed and ridiculed. Another negative effect of NCLB was the effect it had on teachers. According to Ladd (2017), evidence shows that NCLB has reduced the morale of teachers, especially those in high poverty schools.

2010-present

In 2009, President Obama enacted the Race to the Top (RTTT) program that gives states monetary incentive to reform their education systems. Congress provided \$4.35 billion state grants to encourage reform. Contrary to NCLB, RTTT provided incentive for change rather than punishing states that did not meet the requirements. To date, Obama’s Race to the Top initiative has given over \$4 billion to 19 states. The four key areas of reform included rigorous standards and better assessments, adoption of better data systems to provide schools with information, support for teachers to become more effective, and increased resources for interventions needed to improve schools (*Race to the Top*, 2016). RTTT required that a state that receives a grant to promise to adopt and use common K-12 standards as well as implement common assessments.

States began working to create consistent standards before the RTTT initiative, and in 2010, the Common Core State Standards were developed to prepare students for college and careers. The Common Core was a state led effort that is not a part of any federal initiative (*Myths vs. Facts*, 2017). State adoption of the standards is not mandatory, but many states that received the RTTT grant did implement Common Core as well as states that were not chosen for Race to the Top

grants. Common Core standards aimed to provide standards that were consistent throughout all states and grades and address only math and ELA.

There has been public resistance to the Common Core standards. Some have complained that there are no science, social studies, or art/music Common Core Standards. Some feel that the standards are too vague and not specific enough. Also, some have the opinion that the standards have led to a greater importance on standardized test performance (Meador, 2017).

In 2015, Congress replaced NCLB with Every Student Succeeds Act (ESSA) (Ladd, 2017). Under this new law, states are still required to test all students in math and reading. The main change is that state governments will have responsibility for designing and enforcing their own accountability systems, but with some federal regulations.

Conclusion

It is clear from the research that the mathematics curricula has drastically changed over the years. Historical events, such as the Great Depression, World War II, and the Cold War triggered curriculum reform, although not all efforts were effective. Due to the de-emphasis on math during the progressive era, for example, enrollment numbers in higher math courses decreased. To combat this, a more extreme approach to math curricula in the 1950s-1960s emerged. However, the math was too difficult and the “New Math” period ended. The 1980s brought standardized testing, and the 1990s was a time of heated debates over the correct way to teach mathematics. Today, there are continued efforts being made with legislation such as NCLB and Race to the Top. More recently, the Every Students

Succeeds Act (ESSA) was passed, giving state governments the ability to design and enforce their own accountability systems. From the research it is evident that there have and continue to be disagreements over the way mathematics should be taught. Curriculum reform has become frequent and normal and will most likely continue to change in the future. We can only hope that the role the federal government will play in the future will be more positive and constructive than it has been in the past.

References

- Baggett, P., & Ehrenfeucht, A. (2012). *History and theories of mathematics education: A graduate mathematics course* (Syllabus). Las Cruces, NM: Math Department, New Mexico State University.
- Dee, T., & Jacob, B.A. (2010). The impact of No Child Left Behind on students, teachers, and schools. *Brookings Papers on Economic Activity*, 149-194.
- Katz, M.S. (1976). *A history of compulsory education laws*. Bloomington, IN: Phi Delta Kappa Educational Foundation.
- Kegley, T.M. (1947). Warren Colburn. *Peabody Journal of Education*, 25(1), 19-26.
- Klein, A. (2015). Issues A-Z: No Child Left Behind: An overview. *Education Week*, 34(27).
- Klein, D. (2001). *A brief history of American K-12 mathematics education in the 20th century*. Retrieved from <http://www.csun.edu/~vcmth00m/AHistory.html>
- Ladd, H.F. (2017). No Child Left Behind: A deeply flawed federal policy. *Journal of Policy Analysis and Management*, 36(2), 461-469.
- Mackenzie, J.C. (1894). The report of the Committee of Ten. *The School Review*, 2(3), 146-155.
- McCandless, S.A. (1967). *A brief description of the historical background and current status of the testing program of the college entrance examination board*. New York, N.Y.: College Entrance Examination Board.
- Meador, D. (2017). *What are some pros and cons of the Common Core State Standards?* Retrieved from <https://www.thoughtco.com/common-core-state-standards-3194603>

Monroe, W.S. (1912). Warren Colburn on the teaching of arithmetic together with an analysis of his arithmetic texts: I. The life of Warren Colburn. *The Elementary School Teacher*, 12(9), 421-426.

Myths vs. facts. (2017). Retrieved from <http://www.corestandards.org/about-the-standards/myths-vs-facts/>

Race to the top. (2016). Retrieved from <https://obamawhitehouse.archives.gov/issues/education/k-12/race-to-the-top>

Silber, K. (2014). Johann Heinrich Pestalozzi: Swiss educator. In *The Encyclopedia Britannica online*. Retrieved from <https://www.britannica.com/biography/Johann-Heinrich-Pestalozzi>

Swett, J. (1900). *American public schools: History and pedagogics*. New York, NY: American Book Company.

Waggener, J.F. (1996). A brief history of mathematics education in America (Unpublished manuscript). University of Georgia, Athens, Georgia.

Yellowitz, I. (2009). *Child labor*. Retrieved from <http://www.history.com/topics/child-labor>