How Did We Get Here? The Path to Our Current K–12 Mathematics Education Curriculum in the United States

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Is curriculum the key to students' success and achievement in mathematics or should the focus be on the "teaching" of mathematics? Some experts in the mathematics education community believe that students' achievements and gains in mathematics are better where there is a common curriculum. Others believe that students achievement and gains are better where the curriculum is more rigorous, focus, and coherent. However, the argument is that teaching should be the next frontier in mathematics education to improve students' achievement in mathematics. This article discusses the evolution of K–12 mathematics education, the efforts by the National Council of Teachers of Mathematics (NCTM) and how standards-based curricula have evolved to the present Common Core State Standards for Mathematics (CCSSM).

Education reform has moved toward standards-based accountability aimed at improving instruction and student learning in mathematics. Consequently, researchers have become increasingly interested in examining the relationship between curriculum and its effect on student learning (Boaler, 2002; Hill, Rowan, & Ball, 2005). Examining the relationship between what is taught, how it is taught, and what should to be taught have led to the development of various curricula and standards. This article discusses historical account of the development of mathematics standards from the 1920s until the 2010s in the United States. The article presents efforts by the National Council of Teachers of Mathematics (NCTM) and how standards-based curricula evolved to the present Common Core State Standards for Mathematics (CCSSM, National Governors Association Center for Best Practices & Council of Chief State School Officers (NGA Center & CCSSO), 2010).

For the past century, mathematics educators in the United States have shifted their focus from traditional curricula to standards-based curricula in school mathematics. During this period, most debates in the mathematics education community have focused on students' performance

and standards-based curricula. “Curriculum materials for grades Kindergarten through grade 12 (K–12) play a central role in what mathematics topics are taught in our schools, how the topics are sequenced and presented to students, what levels of understanding are expected, and what skills students will develop and when” (National Research Council (NRC), 2004, p. vii). However, the teaching and learning practices that teachers employ in the classrooms are central and critical to students’ achievement and gains in mathematics (Boaler, 2002).

From the 1920s to the New Math

The NCTM was founded in 1920 as an outgrowth to give teachers of mathematics a voice (Klein, 2003). Klein explained that the first NCTM president, C. M. Austin, made it clear that the organization would keep the values and interests of mathematics teachers before the educational world and that curriculum studies, reforms, and adjustments must come from the teachers of mathematics rather than from the educational reformers. According to Klein (2003), the NCTM came into being in part to counter the progressivist educational agenda for mathematics, and it played an important role in disseminating the *1923 Report*. The *1923 Report* proposed a curriculum for school mathematics and stressed on the importance of training for mathematics teachers (National Committee on Mathematical Requirements [NCMR], 1923). The *1923 Report* emphasized the importance of algebra to every educated person and justified the study of mathematics in terms of its applications as well as its intrinsic value (NCMR, 1923).

By the 1930s, various movements had promoted the integration of subjects in schools, and argued against separate instruction in mathematics and other subjects (NCTM, 1970). The argument was that school curricula should be determined by professional educators based on children needs and interests and not by academic subjects (NCTM, 1970). However, this did not yield any good result because by the 1940s a scandal revealed that due to sub-standard arithmetic knowledge, the army provided arithmetic training for its recruits on bookkeeping and gunnery (Klein, 2003). By mid 1940s, educational leaders were concerned about the focus on academic curricula in secondary schools and that most students lacked the intellectual capability for college work or skilled occupations (Klein, 2003). As such, students would need rigorous school curricula to prepare them for college, a career, and everyday living.

For this reason, the *New Math* period came into being in the early 1950s and lasted through the decade of the 1960s (NCTM, 1970). The inception of the *New Math* brought about the collision between skills instruction and conceptual understanding. However, the efforts of the *New Math* brought about the establishment of the School Mathematics Study Group (SMSG). The SMSG sought to "emphasize consistency, precision of language, structure of mathematics, and understanding through discovery in school mathematics through curriculum development, instructional improvement, and enhanced teacher preparation" (Garrett & Davis, 2003, p. 514).

Another major contribution of the *New Math* movement was the introduction of calculus courses at the high school level. Before 1960, "no high school graduates had any calculus, today, hundreds of thousands of students entering college have had some calculus" (Bossé, 1995, p. 179). Although, there were important successes in the *New Math* era, some of the *New Math* curricula were excessively formal, with little attention to basic skills or to applications of mathematics (Klein, 2003). The *New Math* movement was clearly a move away from progressivist ideas of mathematics education. Mathematicians and mathematic educators became actively involved in contributing to K–12 school mathematics curricula and created materials that were mathematically rigorous, consistent, and focused on basic skills (NCTM, 1970).

The efforts of SMSG and other early groups received little attention until the U.S.S.R launched *Sputnik*, the first space satellite, in 1957 (Klein, 2003). The appearance of *Sputnik* came at a time when Americans were anxious on several fronts in mathematics education (Dickson, 2004). Since the lunching of *Sputnik*, many curriculum development projects and most researchers have concentrated on designing and implementing innovative mathematics curricula. By the early 1970s, the *New Math* was almost dead and the National Science Foundation (NSF) stopped funding programs of the *New Math* (Klein, 2003). This resulted in a call to the *back to the basics* in mathematics education (NCTM, 1970). The *back to the basics* suggested renewed emphasis on developing skills in arithmetic and algebra. Although most experts in the mathematics education community actively resisted this idea, it really influenced school mathematics in areas such as textbooks development, teaching practices, and student assessment (Fey & Graeber, 2003).

Moreover, the dominant themes in the 1970s were the emphasis on procedural skills of arithmetic and algebra. During this period, educators stressed the use of direct instruction to develop students' mastery and standardized testing (Klein, 2003). By late 1970s, the development of calculators and their application to school mathematics began. The NCTM board of directors in 1978 recommended that mathematics teachers should make technology (computers and calculators) integral component of their instruction (NCTM, 1970). However, it was not until the 1980 publication of NCTM's *Agenda for Action,* a report that called for new directions in mathematics education, that access to calculators (and computers) for all students were supported (NCTM, 1980).

The 1980s: An Introduction to National Standards

The release of NCTM's *Agenda for Action* in 1980 set the stage for a proactive era of professional input in the reform of mathematics education in the United States (Dossey, Halvorsen, & McCrone, 2012). The report called for changes in K–12 mathematics curriculum materials, teaching techniques, and research in effective ways to include problem-solving and basic skills in mathematics at all grade levels. The *Agenda for Action* authors recommended that problem-solving should be the focus of school mathematics along with new ways of teaching (NCTM, 1980). The report writers recommended that team efforts in problem-solving should be the common place in elementary school classrooms, and encouraged the use of manipulatives, where suited, to illustrate or develop a concept or skill (NCTM, 1980).

The *Agenda for Action* authors also called for a wider range of measures than the conventional testing; although it later became issues of contention in the "math wars" of the 1990s (NCTM, 1980). The *Agenda for Action* report stimulated unprecedented activity in problem-solving and helped broaden the scope of discussion of basic skills in mathematics (NCTM, 1980). It also outlined focused and general directions needed to improve mathematics teaching and learning in the 1980s. Most reports on mathematics education in the 1980s referred to the *Agenda for Action*, and it paved way for the *Curriculum and Evaluation Standards for School Mathematics* published by NCTM in 1989 (NCTM, 1980).

The NCTM Standards

Despite NCTM's passion for the objectives of the *Agenda for Action*, the report received little attention. It was largely overshadowed by *A Nation at Risk* report released in 1983 (Gardner, Larsen, & Baker, 1983). According to Klein (2003), *A Nation at Risk* addressed a wide variety of education issues, including specific shortcomings in mathematics education. *A Nation at Risk* described high school course offerings as a "curricular smorgasbord" and envisioned a role for standardized tests that foreshadowed a movement toward accountability in the late 1990s (Klein, 2003). *A Nation at Risk* also addressed the question of textbooks, proposing an upgrade to include more rigorous and challenging content. The report suggested that in considering textbooks for adoption, states and school districts should: (a) evaluate texts and other materials on their ability to present rigorous and challenging material clearly and (b) require publishers to furnish evaluation data on the material's effectiveness (Gardner, Larsen, & Baker, 1983).

With public opinion in support of a strong focus on basic skills and clear high standards, the NCTM took steps to reshape its own agenda under the label of standards (NCTM, 1970). The impact of the *Agenda for Action* brought about the emergence of standards-based reform movement. As a result, standards-based curricula were developed with the support of the National Science Foundation [NSF] (NCTM, 1970). By the late 1980s, the *Curriculum and Evaluation Standards for School Mathematics* (NCTM, 1989) emerged with stronger and focused tasks for school mathematics. The NCTM wanted to ensure quality, emphasize clear goals, and promote change in the standards of school mathematics (NCTM, 1989). The NCTM at that time wanted a standard-based curriculum that created a coherent vision of what it meant to be mathematically literate in a world that relies on technology (NCTM, 1989).

The *Principles and Standards for School Mathematics* (NTCM, 2000) was developed to set forth a comprehensive and coherent set of learning goals for school mathematics. It has been a resource for mathematics educators and has guided the development of curricula frameworks, assessments, and instructional materials. The NCTM published its *Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics: A Quest for Coherence* (NCTM, 2006) as a companion to its comprehensive and influential *Principles and Standards for school Mathematics*. The *Focal Points* emphasized coherence by providing guidance on what students

should learn each year, and the ways in which the strands of mathematical learning should connect with one another across the grades (NCTM, 2006).

However, the companion volume for high school, *Focus in High School Mathematics: Reasoning and Sense Making* (NCTM, 2009), maintains a clear focus on the process standards–particularly, the problem-solving standard and the reasoning and proof standard. The *Focus in High School Mathematics* provided a detailed list of reasoning habits namely, analyzing a problem, seeking and using connections, implementing a strategy, and reflecting on a solution (NCTM, 2009). NCTM through this publication described possibilities for embedding opportunities for reasoning and sense making to ensure that the ultimate goals of the high school mathematics programs are achieved.

Nevertheless, the *No Child Left Behind* (NLCB) Act of 2001 and students' low achievement in mathematics tests such as National Assessment of Educational Progress (NAEP) and Program for International Students Assessment (PISA) necessitated for a national curriculum in the United States (NCTM, 2010). But, does a national curriculum supports and improves students' achievement or gains? Yes, national curriculum ensured that every student irrespective of their social background, culture, or differences in ability, receives the same education entitlement. Additionally, national curriculum ensures continuity between one school and the other and establishes an education system that could be clearly understood by all stakeholders. The assumption in the mathematics education community is to follow nations with national curricula and testing because of its advantages. Arguments made in support of national standards today echo those of the past, and it is assumed that national standards will promote democracy, equity, and economic competitiveness (Goertz, 2010). There is continuous debate about a national curriculum or standards and NCTM's effort led to the CCSSM for K–12 students in mathematics that emphasize college and career readiness.

Common Core State Standards for Mathematics

By 2010, the Council of Chief State School Officers (CCSSO) and the National Governors Association Center for Best Practices (NGACBP) released the *Common Core State Standards for Mathematics* (NGA Center & CCSSO, 2010). The Common Core standards and related expectations for school mathematics are organized by standard of mathematical practices and conceptual categories (NGA Center & CCSSO, 2010). According to the

Common Core, the standards for mathematical practices and conceptual categories are based on the *Principles and Standards for School Mathematics* (NCTM, 2000) and the levels of mathematical proficiency described in *Adding It Up* (Kilpatrick, Swafford, & Findell, 2001).

The Common Core and NCTM's work both emphasized the importance of a coherent curriculum. The Common Core highlights mathematical practices while NCTM focuses on mathematical processes. Although slightly different in details, these practices and processes are both essential mathematics to be learned and ways in which students engage in learning other mathematics content. The Common Core sets grade-specific standards but does not address issues related to how those standards might be implemented (NGA Center & CCSSO, 2010). NCTM has long argued that mathematics curriculum must be considered as one part of a bigger picture of a strong mathematics program that builds on well-aligned and coordinated attention to curriculum, assessment, and instruction (NCTM, 2010).

The Common Core tended to focus on core topics with science and other disciplinary applications, showing the importance of integration and to fix students' learning more firmly in mathematical modeling and the mathematical practices (NGA Center & CCSSO, 2010). Although the common core was modeled on NCTM's past efforts, it serves a different purpose by articulating a vision for school mathematics and providing guidance for the development of state and local standards (NCTM, 2010). Despite some differences, the Common Core and NCTM's work share a common vision. Such common characteristics of the shared vision of the Common Core and NCTM are the need to have a curriculum that is focused, rigorous, and coherent (NGA Center & CCSSO, 2010).

Conclusions

International assessments in mathematics such as PISA and TIMSS have shown that nations performing better than the United States are those with national curricula that are more focused, rigorous, and coherent. With the Common Core, expectations for content and mathematical practices will be common for all K–12 students and it will allow adopting states to collectively create and share tools such as assessments, curricula, instructional materials, and professional development programs. Though standards and assessment are necessary and important, teaching is the next

frontier in the continuing struggle to improve student learning and schools in general (Stigler & Hiebert, 1999).

As curriculum evolve so will the present Common Core change or will be improved. Although the Common Core and NCTM's work place a priority on focus, rigor, and coherence curriculum, to interpret and implement a curriculum that engages students in mathematical practices and processes requires teachers to have an essential understanding of mathematics. Therefore, mathematics educators must pay particular attention to the mathematical practices and processes of teaching and learning mathematics enacted in most classrooms (Boaler, 2002). Thus "standards set the course, and assessments provide the benchmarks, but it is teaching that must be improved to push us along the path to success" (Stigler & Hiebert 1999, p. 2).

Research has shown that teachers' mathematical knowledge for teaching and teaching techniques contributes to gains in students' mathematics achievement (Hill et al., 2005). Efforts to improve teachers' *teaching* through professional development and pre-service programs will improve students' achievement. Consequently, NCTM and other professional organizations in the U.S. have been concerned about and involved in professional development that support in-service and pre-service teachers in their implementation of standards-based curriculum. Therefore, having a focused, rigorous, and coherent curriculum coupled with professional development programs for teachers will set forth learning outcomes that will prepare our students for college and career readiness.

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