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NOTES FROM THE FIELD

Briefly Recalling Some Antecedents of Standards-Based Reform and Standardized Assessment in American Mathematics Education

Brian Darrow, Jr.
Southern Connecticut State University

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Early Roots of Standardization in Mathematics Education

By the turn of the twentieth century, mathematics education in the United States had been the subject of educational concern for more than a century. Substantial developments in pedagogy and curriculum were sparked by a reevaluation of the teaching and learning of the Colonial Period, which was dominated by the "rules" or "rule method" of teaching which valued core tenets of mental discipline theory (Cohen, 2016; Kliebard, 2004). In the early 1800's, groundbreaking advancements in pedagogy driven by innovative textbook authors challenged the pedagogy of procedural drill and memorization by advocating for a focus on developing conceptual understanding through hands-on, exploratory learning (Bidwell & Clason, 1970; Bjarnadóttir, 2014; Cohen, 2016). This continued well into the Progressive Era of education in the early 1900's, which centered on the holistic development of the individual child to become a fulfilled, productive member of society (Dewey, 1915; Rodgers, 2002). For mathematics education, this translated into a desire to implement a pedagogy that placed value on conceptual understanding and meaningful application by "letting children learn by doing" (Kilpatrick, 2014, p. 329).

Despite significant enthusiasm for such progressive ideals, they were ultimately "rapidly overshadowed by the increasing demand for technological and practical mathematical skills" after the First World War (Permuth & Dalzell, 201, p. 238). As a result, Schoenfeld (2016) notes that by the early 1920's, the focus of mathematics education had once again shifted away from a focus on deep conceptual learning of abstract topics to "the concrete—the arithmetic of home and store" and to "practically oriented applications" (p. 499). According to Schoenfeld, this began a period of "'uniformizing' of curriculum and assessments" which "fed naturally into the measurement regime that typified the first half of the century" (p. 499).

This is recognized as one of the earliest moments in mathematics education where the value of standardization can be clearly seen (Kilpatrick, 2014; Madaus et al., 2003; Schoenfeld, 2016). Schoenfeld (2016) notes that this marked the beginning of "the emergence of scientism" where "'objective' measurement and 'rigorous' methods" began to capture widespread interest (p. 500). Such scientific terms are some of the first historical precursors to modern synonymic terms of assessment and accountability, which are central to the modern standards movement. In modern education, data collection through standardized assessment to evaluate educational outcomes is commonplace. However, during this time period in the 1900's, the stable marriage of scientism and mathematics education was just being formed.

It seems that just as mathematics education was particularly vulnerable to the application of mental discipline theory in the 1800's, so too was it vulnerable to the methods associated with standardized assessment of procedural mathematical knowledge (Cohen, 2016; Kliebard, 2004; Madaus et al., 2003; Schoenfeld, 2014, 2016). Assessments of procedural knowledge that consider only right or wrong answers—not the mathematical processes or cognitive effort required to complete them—are easy to develop, replicate, and standardize. Moreover, many such assessments often do not

assess higher cognitive processes associated with true mathematics learning and doing (NCTM, 2000; NRC, 2001; Madaus et al., 2003; Schoenfeld, 1985, 2013; Stein et al., 2000). Thus, the ease with which procedural assessments of mathematics knowledge can be created, administered, and interpreted, coupled with their perceived association with educational outcomes, has created a lasting place for them in the field. As Kilpatrick (1992) notes, such a movement of assessing student performance through standardized tests in mathematics "had begun around 1910 and was in full bloom by the 1920's and 1930s" (p. 138). The significance of this bloom has been widely recognized and is poignantly characterized by Schoenfeld (2016) as a movement that would "plague education research and practice through the entire 20th century and beyond" (Schoenfeld, 2016, p. 500).

World War II, New Math, and Back to Basics

To fully appreciate the formation of the Standards Era, one must first consider the historical backdrop to its formation. As Schoenfeld (2016) has famously written, "Wars—whether hot, cold, or economic—focus attention on the mathematical and scientific preparedness of American's citizenry" (p. 503). World War I, for example, drastically shifted progressive ideals within mathematics education to those valuing uniformity and practicality (Schoenfeld, 2014, 2016). In citing Garrett and Davis (2003), Kilpatrick (2014) notes that World War II "proved to be a pivotal event that revived interest in school mathematics as an area of curricular concern following decades of decline" (p. 330). Many scholars agree that the previous calls for reform in school mathematics were in fact "legitimized by the war" (NCTM, 1947, as cited in Permuth and Dalzell, 2013, p. 238).

The "New Math" era, as it became to be known, was seen as the answer to these calls. The curriculum of New Math centered on the introduction of new applied and abstract mathematical topics; an attempt to establish a greater cohesion and uniformity within the progression of school mathematics topics; a renewed emphasis on the logical foundations of mathematics and the precision of mathematical argument; a focus on supporting instruction that promoted discovery on the part of the students; and a focus on providing students with a greater foundation for the growing scientific nature of the nation's workforce (Fey & Graeber, 2003; Garrett & Davis, 2003; Kilpatrick, 1992, 2014; Schoenfeld, 2014, 2016). Shortly after this time, the success of the Soviet Union in launching Sputnik I in 1957 left Americans with a feeling that the country had lost the international "Space Race", and federal funding through the National Defense Education Act (NDEA) of 1958 was passed in response to improve higher education and the development of students in the scientific disciplines.

Despite the generation of "a great deal of enthusiastic activity throughout the school mathematics community" of the time (Fey & Graeber, 2003, p. 531), the New Math movement was later criticized nationally and is rarely seen as a successful school reform initiative by both historical and modern critics (Fey & Graeber, 2003; Kilpatrick, 2014; Schoenfeld, 2016). Modest successes in the improvement of curriculum and instruction were not enough to quell public criticism (Fey & Graeber, 2003; Kilpatrick, 1992, 2014). As a result, another short-lived, and largely unsuccessful, reactionary movement in mathematics education known as "Back to Basics" was sparked, which partly focused on skills that were aimed at improving college admissions scores (Fey & Graeber, 2003; Kilpatrick, 2014). As Fey & Graeber (2003) note, this movement was stimulated by the public consensus that the movements following the launch of Sputnik, including New Math, were a failure. The Back to Basics movement also saw a reemergence of more traditional pedagogical practices, replacing the forward-thinking discovery-based approach popular of the New Math era, as well as a renewed emphasis on assessment and accountability to evaluate schools and teachers, leading to a "process-product paradigm" where national standardized tests served as evaluative measures, a theme that would continue well into the Standards Era (Fey & Graeber, 2003, p. 541).

A Nation at Risk and the Birth of the Standards Era

After decades of perceived decline in mathematics schooling; failure and abandonment of several reform initiatives; failure to win the "Space Race"; low scores on international assessments of school subjects; and the evolving social conditions influencing schooling in the United States, stakeholders in education had reached a boiling point of dissatisfaction and angst nearing the 1980's (Permuth & Dalzell, 2013). Such a feeling was epitomized and catalyzed by the famous—and infamous—1983 report of the United States National Commission on Excellence in Education (NCEE), *A Nation at Risk: The Imperative for Educational Reform* (NCEE, 1983). Historians and mathematics educators characterize the document as one of the most influential documents in mathematics curricular change for the nearly forty years

following its publication (Beck et al., 2002; Ferrini-Mundy, 2000; Kilpatrick, 2014; Schoenfeld, 2014, 2016). Permuth and Dalzell (2013) write that "the extremely influential document created barely controlled panic" (p. 242) through its strong and condemning language and blistering critique of public education.

Almost immediately, calls for improvement and accountability in schools were again sparked across the nation. Discussions of widespread standardization and assessment that had been happening in the background for the past forty years were reappearing at the forefront during this time (Kilpatrick, 2014). The most influential group in mathematics education in the country, the National Council of Teachers of Mathematics (NCTM), ultimately satisfied national demand for a standards-based initiative that would fix the seemingly ailing mathematics education system and alleviate public concern. The group's 1980 *Agenda for Action*, which broadened the aims of mathematics education both from a curricular and professional perspective, took on new meaning and application in the wake of *A Nation at Risk* (Fey & Graeber, 2003).

This was later followed by the 1989 NCTM *Curriculum and Evaluation Standards for School Mathematics* (NCTM, 1989), which served as the first nationally recognized and widely implemented official standards-based document of the Standards Era. Kilpatrick (2014) notes that this document was unique and historically significant since it was produced by a professional organization, rather than a governmental agency without outside funding. Further, it was one of the first documents of its kind that "attempted to go beyond local, state and provincial boundaries in laying out recommendations for curriculum and evaluation" (p. 331) in an especially sensitive time. This seminal document was followed by the *Professional Standards for Teaching Mathematics* (NCTM, 1991) and *Assessment Standards for School Mathematics* (NCTM, 1995), which, when taken together, formed a core structure for standards at all levels of mathematics curriculum, instruction, and assessment. These were later refined and formed the widely implemented next installment of the NCTM Standards, the *NCTM Principles and Standards for School Mathematics* (NCTM, 2000).

The standards set forth by NCTM were historically significant for several reasons. First, they were presumably the first of their kind in mathematics education. Since this time, standards-based initiatives have permeated and become a central component to mathematics education policy, research, and practice (Schoenfeld, 2016). Second, the standards deviated, in a significant way, from previous "top-down" reform initiatives of the 1900's and instead focused on "those very close to decisions about mathematics curriculum—teachers, supervisors, and developers of instructional material" (Ferrini-Mundy, 2000, p. 38). Third, as mentioned previously, the standards transcended local boundaries and became the first nationally recognized curriculum reform document. As a result, this work "took on a life of its own" (Ferrini-Mundy, 2000, p. 38) and began to influence national science standards; the local and state development of additional curricular standards; and were reflected in independent instructional materials and textbooks. This was partly due to the attractive nature of standards in providing a common language for professionals to communicate desired outcomes and adjust their practice.

The Standards and Standardization: Connections to Today

The push for greater accountability coupled with the perceived success of standards-based reform initiatives has fueled a reemergence of scientism and standardized assessment in the United States at all levels of education (Schoenfeld, 2014). Arguably the most influential—and detrimental, according to many scholars—reform initiative in modern education was the 2001 No Child Left Behind Act (NCLB) (Beck et al., 2002; Ferrini-Mundy, 2000; Schoenfeld, 2014, 2016). According to Schoenfeld (2014), NCLB "epitomized" (p. 53) the standards movement and completed the connection between standards-based reform and accountability. The focus on assessment for accountability, Schoenfeld (2014) writes, created the pervasive idea that "students, schools, districts, and states must meet certain standards or suffer the consequences" (p. 53). In addition to the goal of generally improving education, NCLB also targeted the achievement gap, which scholars have notably criticized as an educational focus due its potential to perpetuate negative and inequitable narratives with respect to race and achievement (Gutiérrez, 2008).

Originally aimed at improving American education, NCLB instead became a gatekeeper of federal funding for education and proliferated standardized assessment for accountability. Therefore, the modern era of high-stakes, standardized assessment on which many evaluations of teacher, school, and district performance and the distribution of national funds relies was in many ways cemented with NCLB (Reys, 2014). Moreover, the central yet lofty goal of having 100% of all students be proficient in mathematics by 2014 was not obtained and created substantial anxiety for schools, dishonesty in

reporting, and an antithetical lack of consistency and accountability at all levels of education (Resnick et al., 1992; Reys, 2014). NCLB was ultimately deemed a failure and was later replaced by the Every Student Succeeds Act of 2015. However, the lasting effect of NCLB on standards-based assessment for accountability remains.

More recent standards-based initiatives such as the Common Core State Standards for Mathematical Content (CCSSM) have been implemented to improve the quality of mathematics curricula and teaching in an attempt to provide a unified, national set of standards (NGA, 2010). Sponsored by the National Governors Association (NGA) and Council of Chief State School Officers, the CCSSM was aided by a substantial federal investment in its implementation, resulting in the majority of all states adopting the original, or a modified form of the standards (Hill et al., 2019; Porter et al., 2011). The NGA note that the standards were developed to make the mathematics curriculum in the United States "substantially more focused and coherent in order to improve mathematics achievement" as well as "answer the challenge" of "a curriculum that is 'a mile wide and an inch deep'" (NGA, 2010, p. 3).

For some, the CCSSM were notable for building on the successes of the NCTM standards and establishing a state and federally supported push for a national curriculum. However, critics have noted that the CCSSM seems to share the same characteristics of NCLB (Hess & McShane, 2013) and that the CCSSM merely "provides the basis for a new generation of standardized tests" (Tampio, 2018, p. 8). In addition to these tests, in accordance with the Every Students Succeeds Act of 2015, several states require perhaps the most traditionally debated standardized assessment in the United States, the SAT, as a federally required assessment, which has in turn has become an assessment utilized to assess learning with CCSSM. Currently, the growing sentiment is that the initiative has resulted in yet another standards-based installment that, like its predecessors, is difficult to implement, monitor, and consistently modify. More recently, it has been noted that the development of state and local school mathematics standards is effectively "signaling the end of Common Core" (Lee, 2021).

Regardless of the latest reform trend, it currently seems as if standards-based curriculum and standardized assessment are as common in modern schooling as brick and mortar. This is a consequence of their mutual historical development as intimately linked components of educational reform. Since this piece provides only a brief and general discussion of some of the intricate and interrelated factors of this complex history, more comprehensive and informative works on these topics cited here should certainly be consulted for further reading. This paper merely serves to recall several important moments in the history of mathematics education history to provide another lens through which to view modern mathematics education in the United States.

It should also be noted in closing that the efforts of reformers and other stakeholders in education for more than a century have resulted in a great many improvements to the quality of curriculum and instruction in mathematics and have benefitted both the educational enterprise and the children learning within it. However, it is also clear that the waves of educational reform discussed here have, despite best intentions, created a lasting place for standards-based curriculum and standardized assessment in the field of mathematics education. There is growing evidence that the assessment and accountability movement has had detrimental effects on the growth and success of education in the United States, which has even led to a growing countermovement of standardized test refusal (Braun & Marion, 2022; Pérez, 2018; Resnick et al., 1992; Tampio, 2018). Additionally, despite the high value placed on these tests for academic decision making, from evaluations of school districts to college admissions, recent longitudinal studies have shown that characteristics inherently unmeasurable through standardized assessments of crystallized learning are more influential and meaningful predictors of collegiate academic success, retention, and graduation and success in the mathematics classroom (Ben-Avie & Darrow, 2019).

Nevertheless, it is a dubious proposition at best that the current educational enterprise will shed the trappings of assessment and accountability that have become solidified over the course of the past century. From standardized college admissions tests such as the SAT to Advanced Placement Examinations in high school to yearly standardized grade-level examinations across the country, standards-based, standardized assessment continue to be bound within the educational experience in America. Although more work is certainly needed to evaluate both the successes and failures of the past initiatives discussed here, it is perhaps more important to inform future change through the recognition and consultation of the historical development of the current era of educational reform. For if the aim is to meaningfully reform education for future progress, the past to which it is inextricably linked cannot be overlooked.

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