

Home › School Reform News › Elementary Teacher Education Is Broken and Needs to Be Reinvented. Here's a...

Elementary Teacher Education Is Broken and Needs to Be Reinvented. Here's a Guide for Reform



Sandra Stotsky August 13, 2021

0



Special long-read weekend essay: a *School Reform News* exclusive

Many of us assume that the guiding principle of education reform is increased student learning. But it logically follows that education reform is unlikely to succeed if elementary and middle school teachers do not have sufficient academic preparation to teach to the standards their states or their students' parents want students to achieve. This means that education reform cannot focus only on K-12 schools, their curricula, and student assessments. It must also provide for the development of appropriate expectations and accountability measures in teacher training. That is what needs to be "reinvented" in teacher

education. This essay focuses on the accountability measures in mathematics we should have for elementary teacher preparation programs.

Among other things, prospective teachers should graduate with a major in the arts and sciences appropriate to the instructional field—rather than in education—to become initially licensed. That was a significant feature of the Massachusetts Education Reform Act (MERA) in 1993/4.^[1]

The state's revised teacher licensing regulations highlighted this change. However, as then happened in the Bay State, the department of education staff found some prospective elementary teachers graduating with two majors, one in the arts and sciences and the other in education. What these colleges required (two majors) was legal (i.e., it wasn't forbidden by MERA). Staff also found that a few teacher education programs had successfully modified their college's psychology department so their college could offer an arts and sciences degree in child development to help aspiring teachers meet the new requirement and at the same time satisfy parents who wanted their child to have an "insurance" major—but only one major.

While this dodge was also legal, elementary students did not necessarily end up with teachers who had had much academic coursework in the subject(s) they taught. In the end, this dodge is easily correctable by legislation requiring prospective teachers to major in a core subject they would teach (e.g., history, geography, English, science). In other words, it is not enough to mandate that all prospective teachers should possess a bachelor's degree or, as the Bay State's regulations now read: "Holds an Initial license in the same field as the Professional license sought." If "field" can mean something other than a core subject taught in K-12, then we are back to the vague wording in MERA. The intent of the legislation was to ensure that prospective teachers took upper-level courses in their college program and in the subject(s) they taught.

Prospective teachers should also pass a test or tests of reading, writing, and arithmetic skills as well as a test of subject matter knowledge for the license they seek—in other words, at least two tests for admission to a teacher preparation program and/or licensure (the number and timing of these tests usually depends on whether the program is at the undergraduate or post-baccalaureate level). In the Bay State, aspiring teachers do not take a preliminary test of arithmetic skills to get into a teacher preparation program. This should be remedied.

Research does not clearly tell us whether aspiring teachers should pass a test of pedagogical knowledge for the subjects and grade levels they are licensed to teach. The “cooperating” teacher in what was once called student teaching, plus visiting staff from the “student teacher’s” preparation program, are the judges of the aspiring teacher’s pedagogical skills, as they have always been.

We also don’t know from research if aspiring teachers should pass a recent subject test taken by the students who were recently in the grade or subject-centered class these teachers hope to teach. The bottom line is that prospective elementary teachers must still take more tests than their students will take, either for admission to or exiting from their preparation programs. How many tests these teachers take is ultimately up to the state legislature.

Bloomsbury Publishing Company is developing a series of books that presents research studies in the field of teacher education. The series is about reinventing teacher education. Yet, we need to know what was invented to begin with.

Most state legislators probably don’t know what they are already funding with their appropriations to state colleges and universities for teacher training. They know that the purpose of public education has changed: schools no longer seek to find and challenge ambitious or capable students but, instead, devote their efforts to improve the academic achievement of their lowest achievers. Puzzlingly, state

legislators have not tried to find out what the departments of education they also already fund are advising their teacher preparation programs in the form of licensure regulations and tests.

It may be the case that required coursework in the arts and sciences is what needs to be reinvented, in Massachusetts and possibly in other states, if aspiring elementary teachers are to be able to teach the content knowledge that low achievers and other minority students need to learn. We learned from the Coleman Report in 1966 that the only education variable that seems to matter for student achievement is a teacher's verbal ability and subject matter knowledge.[2]

So far, according to national tests of student achievement funded by Congress, nothing else, including the pedagogical strategies and interventions that have been developed and implemented in the past half century, has made a difference in reducing the differences in achievement among racial groups in this country.

The purpose of this essay is to spell out the arts and sciences coursework (not concepts, skills, or standards) that prospective elementary teachers in K-8 should study or address in mathematics, in addition to whatever coursework they are required to take in their teacher preparation programs. The academic coursework I recommend is based in part on what the Bay State required in 2000 after revising its program approval and licensing regulations to address the Massachusetts Education Reform Act (MERA).[3] This revision was done at the request of the commissioner of education and approved by the state's board of education. At the time, James Peyser, now Secretary of Education, was chair of the board.

The recommended coursework in this essay is also based on guidelines in 2008 spelling out what the Bay State's teacher training programs should require of aspiring elementary teachers as preparation for a standalone licensure test in elementary mathematics. I retired from the Department of Education in the fall of 2003 and had no professional involvement with the new mathematics

test.

With the approval of new state boards of education appointed after gubernatorial elections in 2006 and 2014, many of the academic courses required of prospective elementary teachers in the 2000 regulations are no longer in the regulations. They have been completely replaced by ominous language, which I will discuss later. Nevertheless, it should be stressed that students in the Bay State from 2005 to 2017 have had the highest state averages on National Assessment of Educational Progress (NAEP) tests in both Reading and Mathematics and in both Grade 4 and Grade 8.[4]

Perhaps that kind of achievement is no longer desirable. It reflected not only the K-12 standards my staff and I developed or revised, but also the licensing regulations and tests that were approved by the commissioner of education and the State Board of Education at the time.

Mathematics is probably the most difficult subject for elementary teachers to teach successfully if we expect students to be able to take advanced coursework in high school in mathematics/science or major in mathematics-intensive subjects when they attend college. Moreover, teaching and learning mathematics has received much attention only in recent decades, from both researchers and the federal policy makers. On the other hand, reading has received constant attention for over a century from local, state, and federal officials, and the teaching of beginning reading is still controversial.

The United States first became aware of the need to improve mathematics education nationally during World War II, a time when the small number of high school graduates with adequate knowledge of mathematics became woefully evident. In 1950, Congress created the National Science Foundation (NSF). The Russians' launch of Sputnik in 1957 added a sense of urgency to efforts to improve mathematics education. The National Defense Education Act (NDEA) in 1958 provided funds for institutes to develop new curricular

materials for K-12 and for qualified students to pursue advanced education in the sciences and engineering. In fact, more students majored in mathematics in the 1960s and early 1970s than at any other time in the nation's history. Yet, the mathematics education most students experienced in K-12 during the last half of the 20th century did not lead to a strong mathematically literate high school population in the 21st century.

The final report of the National Mathematics Advisory Panel (NMAP), established in 2006 during the presidency of George W. Bush, came out in March 2008, under the direction of Larry Faulkner, former president of UT-Austin.^[5] The charge to the NMAP was to recommend "how students can be best prepared for entry into Algebra." Algebra has long been considered the gateway to advanced science and mathematics coursework in high school and beyond. The Panel noted that success in Algebra I rests on proficiency with whole numbers, fractions, and certain aspects of geometry and measurement. These are the critical foundations for the study of algebra. The Panel's Report further stressed the teaching of fractions on pp. 28/29, suggesting that knowledge of fractions is the most important foundational skill that is not developed effectively in our students.

The Panel's task force on teacher education, headed by Deborah Loewenberg Ball, recommended "direct assessments of teachers' actual mathematical knowledge":

"Research on the relationship between teachers' mathematical knowledge and students' achievement confirms the importance of teachers' content knowledge. It is self-evident that teachers cannot teach what they do not know. However, because most studies have relied on proxies for teachers' mathematical knowledge (such as teacher certification or courses taken), existing research does not reveal the specific mathematical knowledge and instructional skill needed for effective teaching, especially at the elementary and middle school level. Direct assessments of teachers' actual mathematical knowledge provide the strongest indication of a relation between

teachers' content knowledge and their students' achievement..." (p. xxi)

This Task Force also recommended that "teachers must know in detail the mathematical content they are responsible for teaching ... both prior to and beyond the level they are assigned to teach."

To find out what problems young students have in mathematics, the Panel surveyed 743 Algebra I teachers in 2008. These teachers rated their students' background preparation for Algebra I as weak[6]:

"The three areas in which teachers reported their students to have the poorest preparation were rational numbers, word problems, and study habits. For changes in the curriculum leading up to Algebra I, teachers most often cited the need for a greater focus at the elementary school level on proficiency with basic mathematical concepts and skills."

Survey results supported the Panel's recommendations for teacher preparation and professional development. The Panel recommended that a "sharp focus be placed on systematically strengthening teacher preparation, early career mentoring and support, and ongoing professional development for teachers of mathematics at every level, with special emphasis on ways to ensure appropriate content knowledge for teaching." While the Bay State's scores on the grade 4 and grade 8 mathematics tests given by the National Assessment of Educational Progress (NAEP) had placed the Bay State first in the country, the fly in the ointment was the "gap." Despite gains in mathematics by all racial groups, there remained a continuing gap between the scores of low-income and other students, on NAEP tests as well as on tests in the Bay State. What should be done?

In 2008/9, governors, commissioners of education, and members of state boards of education were asked to agree to the adoption of Common Core's College and Career-Ready Standards, sets of K-12 standards for mathematics and English language arts (ELA) that would, it was claimed, ensure all students' readiness for college-level

coursework. Top elected and appointed officials in most states voted in 2010/11 to adopt Common Core's standards, although their legislatures were not asked to discuss or approve the decision. They also voted to join a testing consortium that would help to ensure via statewide tests that each state would meet Common Core's goal of college readiness for all students. Ten years later, the goal has not been met. In fact, on the latest NAEP tests, the gap between high-achieving and low-achieving students increased. Worried NAEP officials have had no explanation for this phenomenon. [7] Nor do they know how to address the growing gaps between blacks and Asian Americans in school achievement. Were teachers or teaching pedagogy part of the problem? Not so far as we can tell.

Massachusetts is not at the top of the rank-ordered list of states needing to close gaps for good reason. When the mathematics scores of its low-income students were compared with the scores of low-income students in the other states (when relevant data were available in 2007), it turns out that the low-income students in the Bay State were tied for first place in Grades 4 and 8. Their gains also showed up on the state's tests, i.e., Massachusetts Comprehensive Assessment System (MCAS) tests. For example, in 2001, only about 15% of black and Latino tenth graders scored at the proficient and advanced levels on the MCAS mathematics test. The percentages rose to about 45% in 2007, a three-fold increase in the percent of those who are proficient or advanced. Interestingly, the 2007 percentage of black/Latino 10th graders who are proficient or advanced (45%) was only slightly below the percentage of white students who were proficient or advanced in 2001 (50%).

Thus, the figures tell students and teachers a very different story from the usual analysis. As others' scores have risen, so have the Bay State's low-income students' scores. The gap is large not because the performance of the state's low-income students is worse than similar students in other states or because they haven't shown much improvement but because the performance of the state's other students is high or much better than those in other states. While we

don't have explanations of why this is the case, the performance of the state's higher-income students may help to explain the stress on pedagogy in the new arts and sciences requirements in the Bay State, to be discussed later.

The Panel's report noted that current integrated approaches at the high school level (a national phenomenon) may make it more difficult for students to take advanced mathematics course work in their senior year than a single-subject approach, beginning with Algebra I in Grade 8, that enables students to take an Algebra II course by their sophomore year. This possibility, which was based on an analysis of one state's standards, was supported by a report to the Massachusetts Board of Education in 2000 on the sequence of mathematics courses needed for taking calculus in grade 12. This report was based on responses from mathematics department chairs in 17 school districts in Massachusetts; almost all said, in 2000, that in order to take calculus in grade 12, most students would need to take what they called an honors level Algebra I course in Grade 8.[8]

In Massachusetts, the slowly increasing percentage from 2001 to 2007 of Grade 8 students who reported on MCAS (state test) surveys that they were enrolled in an Algebra I course or in Geometry (suggesting that they probably took Algebra I in Grade 7) may have been a major factor accounting for the state's lead on the mathematics test given by NAEP in Grade 8. In the meantime, it seemed to state-based educators that in order to strengthen the performance of its low-income elementary or middle grade students in mathematics, the state would need to strengthen the capacity of its elementary teachers to teach mathematics—and to require a standalone licensure test in elementary mathematics, in addition to the standalone reading test it already required as of 2000.

The new standalone reading test for all prospective elementary teachers in the 2000 revision of the state's regulations for teacher training had not entailed new coursework in the arts and sciences. It had meant changes in the reading methods courses required in

teacher preparation programs. But this was not the case with the new subject test in elementary mathematics. Changes in pedagogy in teaching mathematics were not the central issue driving the new mathematics test as they had been in reading.

So, how many mathematics courses in the arts and sciences should aspiring elementary teachers now take? According to the commissioner of education in the Bay State, three or four. As the authors of these guidelines to approved program providers wrote,

"Most approved programs for teaching licenses at the elementary level will need to expand the number and depth of mathematics courses that are available to their candidates. As in every subject area, candidates will have developed different levels of competence in mathematics prior to enrolling in the program. However, the research is clear that competence across the population in general, including candidates for licenses at the elementary level, is lower in mathematics than in reading, writing, and language arts. For those candidates enrolling with typical knowledge and fluency in mathematics, attaining the necessary level of content knowledge will normally require at least three to four college-level, subject-matter courses, i.e., 9–12 semester-hours, taught by mathematics faculty, potentially in partnership with education faculty. These should be taken after any necessary remedial courses and either integrated with or taken prior to math methods courses." [9]

As happened in the Bay State, this recommended guideline, written chiefly by in-state mathematics educators, mathematicians (Richard Bisk and Solomon Friedberg), and a scientist (Andrew Chen) to accompany the Board of Education's approval of a standalone mathematics licensure test for prospective elementary teachers, caused a flap at the college level. Whose credits would these courses reflect—arts and sciences credits for a college diploma or education credits for a teacher preparation program? We don't know. The Board of Higher Education in the Bay State might have available statistics on what the state's preparation programs across the state now offer or

require.

Because colleges and universities in and outside the state have different course structures, schedules, general education requirements, and other constraints, and because high school graduates enrolling in these colleges may have varying degrees of mathematical preparation despite the common adoption across states of Common Core's mathematics standards, the Massachusetts Department of Elementary and Secondary Education decided to recommend relative weightings for the four strands in its K-12 mathematics curriculum framework rather than attempt to define the specific courses that would prepare prospective teachers for the new standalone elementary mathematics test. These weightings are as follows:

- i. Numbers & Operations 45%
- ii. Functions & Algebra 25%
- iii. Geometry & Measurement 20%
- iv. Statistics & Probability 10%

By 2009, the Bay State required prospective elementary teachers to pass both a standalone reading test and a standalone elementary mathematics test, in addition to a General Curriculum test for the other major subjects taught in the elementary grades. The pass rate for the standalone mathematics test in recent years has been about 60%, usually a little less than the pass rate for those taking the reading test.^[10]

Whether or not aspiring elementary teachers take three or four mathematics courses in the arts and sciences or in education schools, the major change that may have occurred in their academic requirements is in the coursework they take. Aspiring elementary teachers may take mathematics methods courses in their preparation

programs addressing the standards their future students must address. But it is not as clear as it used to be what specific courses, if any, they will take in the arts and sciences to support their students.

The first edition of the revised program approval regulations (in 2000) required thirty-six hours of arts and sciences coursework in the major subjects they teach in the elementary school (composition; American, British, and other literature; mathematics; science; U.S., European, and world history; geography; economics; and U.S. government).[11]

After a complaint by Margaret McKenna, then-President of Lesley University, that 36 hours of arts and sciences coursework for prospective elementary teachers would damage the enrollment of prospective middle school teachers in Lesley's preparation program for middle school teachers and her recommendation that the requirement be abolished, the commissioner and I agreed to reduce the number of arts and sciences credit hours to 18. But even that 18-credit compromise requirement, intended to ensure that prospective elementary teachers would have some academic background for teaching literature, U.S. history, mathematics, and science in K-8, is not in the current regulations.

Instead, the current regulations require only that prospective teacher candidates for grades 1-6 "must demonstrate the necessary depth and breadth of content knowledge needed to support all students in mastering expectations outlined in the following Massachusetts Curriculum Frameworks":

1. 2017 English Language Arts (ELA)/Literacy Framework: Grades Pre-K—8
2. 2017 Mathematics Curriculum Framework: Grades Pre-K—8
3. 2016 Science and Technology/Engineering (STE) Curriculum Framework: Grades Pre-K—8
4. 2018 History and Social Science Framework: Grades Pre-K-8"[12]

It is quite clear that pedagogy takes priority over academic content. See the entire section under Context.

“As you can see from the continuum of content knowledge for educators above, after the provisional licensure stage of an educator’s career, all assessments associated with SMKs begin to assess content knowledge through pedagogy. Whether this is through the content-specific performance assessment of the pre-practicum gateways or during employment through the Educator Evaluation system, eventually it is inappropriate to separate out content knowledge from pedagogical skill.” (p. 3)

We do not know if this philosophy of teaching, learning, and assessment was developed by teachers using classroom teaching experience to support prioritizing pedagogical skill. We do not know what the “necessary depth and breadth of content knowledge” is for a potential grade 5/6 classroom teacher teaching a Common Core-aligned curriculum. We do not know who would decide what content knowledge is necessary for that college student, nor how it would be decided. The suggestion in this document that teachers should have content knowledge two grade spans above and below the level of their license is meaningless since we are not given a way to determine the level of content knowledge needed for the license itself. This philosophy should point to empirical support before it is implemented in practice. But no references are provided to research, experience, philosophy, or curriculum assessment.

On the other hand, we find this as first under “Recommendations for Teacher Preparation Programs”: “Look to coursework, not just test prep strategies, to best prepare candidates in the content they need to teach elementary grades.”^[13] While strong in its intentions, the authors are not clear where “content” coursework would be taught—in the arts and sciences or in education schools. Who the teaching faculty would be is the issue. The authors of the guidelines to prepare aspiring elementary teachers in Massachusetts for a new standalone mathematics tests make it clear that mathematics faculty alone or

with education faculty should be in charge of required mathematics (not mathematics education) coursework.

A literature professor or instructor, for example, would be unlikely to teach a course in literature in classes designed only for prospective elementary teachers (as may be the case for a college physics, science, or mathematics course, credit for which is disallowed for those majoring in or planning to major in a mathematics-intensive subject or area). If such a course is designed for a group of college students intending when licensed to teach literature to K-8 students, a college instructor of literature will likely assign middle school-level literary and non-literary texts that are suitable for them to use themselves as teachers in their own upper elementary grades. It is also not clear who will show such college students how to address the reading standards for students in those grades. On the other hand, college literature professors are more likely to assign college students not intending to become teachers literary or nonliterary works written for adults. With such advice built into a document for pedagogical faculty, there is no incentive for an arts and sciences instructor to try to educate licensure-intending college students beyond a grade 8 reading level.

Any content-limiting perspective on academic coursework for college students working for a teaching license will no doubt take care of the problem perceived by many education reformers today of well-educated teachers gravitating to jobs in high schools with large numbers of motivated or ambitious secondary students. If Pre-K to 8 teachers are taught in their arts and sciences coursework just enough subject matter to enable them to address the Pre-K to 8 standards in their state, it's true that these teachers' academic backgrounds will be equalized, because most if not all states use Common Core-aligned standards. (All states have used Common Core-aligned tests.) That is one way to reinvent teacher education (i.e., change the requirements for their academic background and emphasize pedagogy). But it is unlikely to address the learning needs of most minority students in our schools in light of the failure of the Common Core standards to live

up to their proponents' promises.^[14]

[1] <https://eric.ed.gov/?id=ED37755>

[2] According to the Coleman Report, teacher quality is "one of the few school characteristics that significantly affects student performance." James S. Coleman, Ernest Q. Campbell, Carol J. Hobson, James McPartland, Alexander M. Mood, Frederic D. Weinfeld, and Robert L. York, *Equality of Educational Opportunity* (Washington, DC: US Government Printing Office, 1966), p. 335.

[3] <https://eric.ed.gov/?id=ED377559>

[4] <https://www.mass.gov/news/massachusetts-naep-results-lead-nation-for-12th-year>

[5] <https://files.eric.ed.gov/fulltext/ED500486.pdf>

[6] https://www.researchgate.net/publication/228513219_Final_report_on_the_national_survey_of_algebra_teachers_for_the_National_Math_Panel

[7] See <https://pioneerinstitute.org/academic-standards/study-finds-historic-drop-in-national-reading-and-math-scores-since-adoption-of-common-core-curriculum-standards/> and also https://www.nationsreportcard.gov/mathematics/supportive_files/2019NAEPgrade12MRpressrelease.pdf

[8] Massachusetts Department of Education, internal report, *Course Progression and Placement Leading to Enrollment in Advanced Placement Calculus in the Twelfth Grade*, March 2000.

[9] <https://www.doe.mass.edu/mtel/MathGuidance.pdf>

[10] <https://www.doe.mass.edu/mtel/results/default.html>

[11] Sandra Stotsky, with Lisa Haverty. (2005). *Can a State Department of Education Increase Teacher Quality? Lessons Learned in Massachusetts*. In D. Ravitch (Ed.), *Brookings Papers on Education Policy*, 2004, (pp. 131-180). Washington, DC: Brookings Institution. <https://eric.ed.gov/?id=EJ897596>

[12] *Subject Matter Knowledge (SMK) Guidelines, Updated September 2019*. Massachusetts Department of Elementary and Secondary Education, p. 13.

[13] Hannah Putman and Kate Walsh, *Driven by data: Using licensure tests to build a strong, diverse teacher workforce*, National Council on Teacher Quality (NCTQ), July 2021. p. 36.

[14] <https://www.independent.org/publications/tir/article.asp?id=1622>

Sandra Stotsky was Senior Associate Commissioner at the Massachusetts Department of Elementary and Secondary Education from 1999 to 2003. She was in charge of revising or developing all K-12 standards in major subjects as well as all teacher and administrator licensing requirements and teacher subject tests.