



Report to the Legislature: Mathematics and Science Teacher Content-Based Professional Development

Line-item 7061-9804
February 15, 2009



This document was prepared by the
Massachusetts Department of Elementary and Secondary Education
Mitchell D. Chester, Ed.D
Commissioner

Board of Elementary and Secondary Education Members

Ms. Maura Banta, Chair, Melrose
Ms. Harneen Chernow, Jamaica Plain
Mr. Gerald Chertavian, Cambridge
Mr. Andrew "AJ" Fajnzylber, Chair, Student Advisory Council, Brookline
Dr. Thomas E. Fortmann, Lexington
Ms. Beverly Holmes, Springfield
Dr. Jeff Howard, Reading
Ms. Ruth Kaplan, Brookline
Dr. Dana Mohler-Faria, Bridgewater
Mr. Paul Reville, Secretary of Education, Worcester
Dr. Sandra L. Stotsky, Brookline
Mitchell D. Chester, Ed.D., Commissioner
and Secretary to the Board

The Massachusetts Department of Elementary and Secondary Education, an affirmative action employer, is committed to ensuring that all of its programs and facilities are accessible to all members of the public.

We do not discriminate on the basis of age, color, disability, national origin, race, religion, sex or sexual orientation.

Inquiries regarding the Department's compliance with Title IX and other civil rights laws may be directed to the Human Resources Director, 75 Pleasant St., Malden, MA 02148 781-338-6105.

© 2008 Massachusetts Department of Elementary and Secondary Education
Permission is hereby granted to copy any or all parts of this document for non-commercial educational purposes. Please credit the "Massachusetts Department of Elementary and Secondary Education."

This document printed on recycled paper

Massachusetts Department of Elementary and Secondary Education
75 Pleasant Street, Malden, MA 02148-5023
Phone 781-338-3000 TTY: N.E.T. Relay 800-439-2370
www.doe.mass.edu





Mitchell D. Chester, Ed.D.
Commissioner

Massachusetts Department of Elementary and Secondary Education

75 Pleasant Street, Malden, Massachusetts 02148-4906

Telephone: (781) 338-3000
TTY: N.E.T. Relay 1-800-439-2370

January 2009

Dear Members of the General Court:

Pursuant to Chapter 182 of the Acts of 2008, line-item 7061-9804, I am pleased to submit this Report to the Legislature: Mathematics and Science Teacher Content-Based Professional Development, addressing the following:

"provided further, that the department shall report, not later than February 16, 2009, on the number of educators provided content training under this item, the estimated number of mathematics and science teachers currently teaching without certification, and any legislative or regulatory recommendations necessary to make middle school and elementary mathematics and science education more rigorous and data driven; provided further, that said report shall be provided to the secretary of administration and finance, the senate president, the speaker of the house, the chairs of the house and senate ways and means committees and the house and senate chairs of the joint committee on education"

There continues to be a critical need for state funds to support mathematics and science education. Although there has been a slight increase in 2007 and 2008 in student performance on MCAS mathematics tests in all tested grades and on MCAS science tests in grade 8, student scores were effectively flat during the period of 2003-2007. The positive results from the 2007 Trends in International Mathematics and Science Study (TIMSS) suggest that Massachusetts measures up well on the global stage, yet the percentage of Massachusetts students performing at the highest international benchmark category (Advanced) still lags behind leading Asian countries.

There continue to be persistent and disturbing achievement gaps between the performance of white, more affluent students, and the performance demonstrated by low income, racial and language minority students in Massachusetts public schools. In addition, a large number of students entering college need remedial coursework, indicating that they are not prepared for college-level courses. Low mathematics and science performance is a problem that affects districts across the state, and is particularly severe in the urban districts where over 90% of middle schools are now identified in mathematics for improvement, corrective action or restructuring under the No Child Left Behind Act (NCLB). Low K-12 student performance contributes to shortages in the STEM pipeline (as fewer students choose Science, Technology, Engineering and

Mathematics careers) that ultimately produce negative consequences for the knowledge-based economy of Massachusetts.

Teacher quality is a key determinant of student achievement and strong content knowledge is crucial to effective teaching. Successfully teaching all students to reach our state's high standards of mathematics and science learning requires a depth of content knowledge, conceptual understanding, and facility with core skills that exceeds the level of many current elementary and middle school teachers. Professional development is a key strategy for upgrading the skills of the existing workforce, particularly for teachers who are not highly qualified. To date, department-sponsored efforts to improve the content knowledge and instructional practices of mathematics and science teachers have been limited in scope but very well received. This line item provides resources to support the development and scale-up of systemic programs to improve the professional development of mathematics and science teachers.

In 2007-2008 there were 572 STEM teachers on waivers, a relatively high number which is under-representative of the actual demand. Since waivers for a particular position are only granted for one year, schools request more waivers each year than are granted. With so many mathematics and science teachers on waivers and schools needing to fill so many positions, there is great need for the initiatives funded through this line item. These numbers also do not account for the approximately 1,500 waivers in 2007-2008 for special education teachers of students with severe and moderate disabilities, many of whom may be teaching mathematics and science as part of their responsibilities.

This report details the programs funded through this line-item: 2008 Teacher Professional Development Institutes; Massachusetts Intel Mathematics Initiative (MIMI); and ALEKS Mathematics MTEL Preparation Pilot Study. A description and background as well as budget is included.

The Board of Elementary and Secondary Education has identified professional development for mathematics and science teachers as one of the critical budget areas for expansion and has requested an increase of funding in this line item to \$4.9 million for FY10 to scale-up and systematize professional development programs in mathematics and science. This funding level would allow the Department to reach nearly 5000 teachers per year through increased statewide offerings of Professional Development Institutes, an expansion of the MIMI mathematics initiative, the launch of a science initiative to provide subject-specific content and inquiry professional development that targets the needs of urban districts, increased support for ALEKS and other online resources to prepare teachers for the MTEL licensure tests, and maintenance of the earmark for training for AP teachers. I recognize the fiscal pressures facing all of us and appreciate your consideration of this important aspect of public education.

Sincerely,

Mitchell D. Chester, Ed.D.
Commissioner of Elementary and Secondary Education

Table of Contents

I.	Introduction.....	1
	A Critical Need	
	A Strategy for Improving STEM Professional Development	
II.	Major Initiatives and Programs.....	4
	Teacher Professional Development Institutes	
	Massachusetts Intel Mathematics Initiative	
	ALEKS Mathematics MTEL Preparation Pilot Study	
	Earmark - Massachusetts Mathematics and Science Initiative	
III.	Teacher Data.....	7
	Teachers on Waivers	
	Teachers “Not Highly Qualified”	
	Teacher Data System in Place for Analysis	
IV.	FY09 Budget.....	10
V.	Recommendations for Mathematics and Science Education and the FY10 Budget Line Item.....	11
	Strengthening Mathematics and Science Education by Establishing a System of Professional Development	
VI.	Appendix.....	13
	FY09 Budget Line Item Language	
	List of 2008 Professional Development Institutes	

I. Introduction

The Department of Education respectfully submits this Report to the Legislature: Mathematics and Science Teacher Content-Based Professional Development, pursuant to Chapter 182 of the Acts of 2008, line-item 7061-9804, addressing the following:

"provided further, that the department shall report, not later than February 16, 2009, on the number of educators provided content training under this item, the estimated number of mathematics and science teachers currently teaching without certification, and any legislative or regulatory recommendations necessary to make middle school and elementary mathematics and science education more rigorous and data driven; provided further, that said report shall be provided to the secretary of administration and finance, the senate president, the speaker of the house, the chairs of the house and senate ways and means committees and the house and senate chairs of the joint committee on education"

The budget language for this line item states that the funds support professional development to increase the content knowledge of elementary and middle school mathematics and science teachers, particularly those in high-need districts.

Established in FY07, through this line item the Legislature appropriated \$2 million to fund content-focused professional development as well as a new Pilot Scholarship Program for mathematics and science teachers. In FY08, a total of \$895,367 was allocated in this line item to support content training for mathematics and science teachers and the scholarship program funds were allocated to a separate line item (see 7070-0065) to be administered directly by the Board of Higher Education. In FY09, the initial allocation of \$991,367 was reduced by 9C cuts of \$505,140 in October and January, leaving \$386,227 for content-based mathematics and science professional development after accounting for a \$100,000 earmark. The Legislature has also extended the spending period for this line item through August, 2009, which is crucial for the successful administration of these funds by allowing the support of intensive professional development activities during the summer when teachers are available.

This report describes the progress achieved in mathematics and science teacher content training that occurred since the February 2008 legislative report, and details FY09 funded program activities from July 1, 2008 through August, 2009.

A Critical Need

There continues to be a critical need for state funds to support mathematics and science education. Although there has been a slight increase in 2007 and 2008 in student performance on MCAS mathematics tests in all tested grades and on MCAS science tests in grade 8, student scores were effectively flat during the period of 2003-2007. The positive results from the 2007 Trends in International Mathematics and Science Study (TIMSS) suggest that Massachusetts measures up well on the global stage, yet the

percentage of Massachusetts students performing at the highest international benchmark category (Advanced) still lags behind leading Asian countries. In science, 22% of Massachusetts 4th graders met the Advanced benchmark, compared to 36% of students in Singapore; in math, 22% were Advanced, behind Singapore (41%), Hong Kong SAR (40%), Chinese Taipei (24%) and Japan (23%).

There continue to be persistent and disturbing achievement gaps between the performance of white, more affluent students, and the performance demonstrated by low income, racial and language minority students in Massachusetts public schools. In addition, a large number of students entering college need remedial coursework, indicating that they are not prepared for college-level courses.¹ Low mathematics and science performance is a problem that affects districts across the state, and is particularly severe in the urban districts where over 90% of middle schools are now identified in mathematics for improvement, corrective action or restructuring under the No Child Left Behind Act (NCLB). Low K-12 student performance contributes to shortages in the STEM pipeline (as fewer students choose STEM careers) that ultimately produces negative consequences for the knowledge-based economy of Massachusetts.²

Teacher quality is a key determinant of student achievement and strong content knowledge is crucial to effective teaching.³ Successfully teaching all students to reach our state's high standards of mathematics and science learning requires a depth of content knowledge, conceptual understanding, and facility with core skills that exceeds the level of many current elementary and middle school teachers. Professional development is a key strategy for upgrading the skills of the existing workforce, particularly for teachers who are not highly qualified. To date, department-sponsored efforts to improve the content knowledge and instructional practices of mathematics and science teachers have been limited in scope but very well received. This line item provides resources to support the development and scale-up of systemic programs to improve the professional development of mathematics and science teachers.

A Strategy for Improving STEM Professional Development

The Department has been working for the past several years to develop a professional development delivery system that provides educators with tools to identify their professional growth needs and offers regionally based opportunities for teachers to enhance their content knowledge and instructional practice. The programs detailed in Section II of this report represent initial steps in the development of this professional development system.

¹ A recent report indicated that among the 2005 cohort of high school graduates in Massachusetts who attended public colleges and universities within the state, 29% required developmental (i.e., remedial) course work in mathematics. See the February 2008 "Massachusetts School-to-College Report Class of 2005" at <http://www.doe.mass.edu/research/reports/0208bhe.doc>.

² See, for example, the 2008 reports: "Gaining Momentum, Losing Ground," by Tapping America's Potential, at http://www.tap2015.org/news/tap_2008_progress.pdf; and "Ready for 21st Century Success: The New Promise of Public Education," by the Patrick Administration at <http://www.mass.gov/Eeoe/docs/ma-edplan-finalrev1.pdf>.

³ See, for example, Chapter 6 of the 2008 National Mathematics Advisory Panel report, "Foundations for Success," at <http://www.ed.gov/MathPanel>.

For the past 15 years, the Professional Development Institutes have been offered during the summer in locations across the state. In future years, the Department hopes to offer a core set of regionally based teacher professional development institutes, covering key mathematics and science content knowledge and related standards-based instructional strategies throughout the year. Due to the 9C cuts in this line item, it is unclear if the Department will be able to continue the Professional Development Institute program in 2009.

The Massachusetts Intel Mathematics Initiative (MIMI) has been designed and implemented to provide a high quality and scalable training approach to enhance the foundational knowledge of elementary and middle school mathematics teachers. Due to the 9C cut, only four of 15 master instructors will be deployed to teach two courses in the summer of 2009, down from eight courses in 2008. We will need continued and increased state funding for mathematics and science professional development over the next two years in order to meet the original goal of scaling-up this initiative to strengthen the teaching capacity of over 1,000 elementary and middle school mathematics teachers.

A pilot study exploring the use of online technological tools for improving teacher content knowledge is continuing in the current year. Building on the teacher content knowledge assessment study funded through the line item in its first year, the current pilot study investigates the use of the Assessment and LEarning in Knowledge Spaces (ALEKS) online diagnostic and tutorial program to prepare teachers for the mathematics Massachusetts Tests for Educator Licensure (MTEL). Initial results of the external evaluation are promising and the continuation of this study seeks to inform the potential future use of these tools by Massachusetts educators.

Finally, funds will be provided to the Massachusetts Math and Science Initiative (MMSI), a division of Mass Insight Education and Research Institute, for intensive content-based teacher training to support Advanced Placement courses.

The remaining sections of this report describe these programs in more detail, provide the mathematics and science educator data that are currently available, present the FY09 budget, and articulate recommendations for strengthening mathematics and science education in future years.

II. Major Initiatives and Programs

Teacher Professional Development Institutes

Background and Program Design

The Professional Development Institutes are sponsored by the Department in partnership with non-profit organizations, professional development organizations, educational collaboratives, cultural institutions, school districts, charter schools, colleges, and universities. The purpose of the institutes is to increase the content and pedagogical knowledge of Massachusetts educators necessary to provide effective, standards-based classroom instruction.

Teachers from across the state participated in the summer 2008 Professional Development Institute program, which provided 24 science and mathematics courses and targeted urban districts. These courses engaged 407 teachers, coaches, paraprofessionals, and administrators in subject-specific math and science courses, including foundational courses, courses addressing the needs of special populations in these subject areas, and courses designed to continue to improve teachers' classroom practice through advanced study (see Appendix 2 for course titles). Approximately 380 participants completed the institute participant survey, providing detailed information about their teaching positions and credentials. A summary of the survey data follows:

- *Of the 20 institutes that administered pre- and post-tests of content knowledge, participants from 95% of the institutes showed significant gains.*
- *Participants represented 127 public school districts and charter schools; 177 of the respondents (46%) teach in 30 high-need districts.*
- *The 9 science-focused institutes were attended by 167 participants, and 240 participants attended the 15 mathematics-focused institutes.*
- *Of those respondents teaching science, 71% were certified in the science subject they teach, while 7% were teaching on waiver. In mathematics, 82% were certified in mathematics and 8% were teaching on waiver. Those not certified or on waiver were teaching these subjects out-of-field.*
- *Collectively the participants taught approximately 30,000 students, including approximately 5,200 (18%) students receiving special education services and 3,500 (12%) English Language Learners.*

Fund Use

FY09 funds from this line item funded the fall follow-up components of the summer 2008 Professional Development Institutes. Due to the 9C cut in this line item, it is unclear if the Department will be able to continue the Professional Development Institute program for teachers in summer 2009. The Department will be able to allocate approximately \$35,000 to develop and pilot a science institute for instructional leaders to enhance their capacity to support elementary and middle school teachers of science.

Massachusetts Intel Mathematics Initiative

Background and Program Design

In the fall of 2006, the Department of Education entered into a partnership with the Intel Corporation, the UMass Medical School's Regional Science Resource Center, and University of Vermont mathematician, Dr. Kenneth Gross. In 2007 the partnership launched the Massachusetts Intel Mathematics Initiative (MIMI) and offered 300 elementary and middle school teachers of mathematics an 80-hour mathematics course focused on K-8 foundational content (e.g., arithmetical operations, proportional reasoning, linear equations). Participant teachers from four high-need districts (Boston, Springfield, New Bedford, and Worcester) complete much of the coursework during the summer and also meet regularly during the school year in mathematical learning communities to reinforce and extend their learning and improve instructional practice.

An external evaluation, conducted by WestEd and funded primarily by Intel, has provided early indications of success, with preliminary results pointing to effective implementation of the summer portion of the course taught by the 15 master teachers that were selected and contracted by the Department, as well as positive outcomes from the mathematical learning communities component of the initiative (developed and supported by UMass Medical School and delivered by trained district personnel). The evaluation is designed to provide evidence of overall effectiveness as well as formative information to guide future scale-up efforts.

This line item will fund an additional 50 teachers to take the intensive 80-hour mathematics course, starting in the summer of 2009. Four of the 15 trained master instructors will be deployed for this purpose.

Fund Use

FY09 funds have primarily been used to complete the second cohort of MIMI during the fall of 2008. Due to the 9C cut, the MIMI initiative has been scaled down by 75% for the summer 2009 cohort of teachers.

FY09 funds will be allocated for the following activities to support two courses in summer 2009: compensation for master teacher training, course planning, and delivery of two courses; grants to districts to support participant teacher stipends; and consultant services through UMass Medical School to coordinate and support the mathematical learning communities in participating districts.

ALEKS Mathematics MTEL Preparation Pilot Study

Background and Program Design

The Department is continuing a pilot study that began last year to examine the potential benefits to teachers and teacher candidates of using a web-based tutorial program to prepare for the MTEL Elementary Mathematics (#53) and Middle School Mathematics (#47) tests.

Study participants receive a free three-month subscription to Assessment and Learning in Knowledge Spaces (ALEKS) software, a web-based assessment and learning system. After an initial adaptive diagnostic assessment, ALEKS provides each participant with a summary report that can guide the participant's use of the learning mode tutorial where the program provides detailed explanations, opportunities for practice, and tracks the mastery of concepts and skills. Participants in the study agree to use ALEKS for a minimum of 10 hours, document their experience by completing three surveys, and register and take an MTEL mathematics test in November, March, May or July. Last year, 198 people participated in the study and there are approximately 100 new teachers currently participating.

Although ALEKS is not specifically designed to prepare teachers for the MTEL tests, teachers who participated in the Department's teacher content assessment study two years ago identified ALEKS as potentially helpful for mathematics MTEL preparation. The Department has contracted with the UMass Donahue Institute to examine the effectiveness of ALEKS as an MTEL preparation tool. From the small sample of study participants taking the Elementary Math MTEL last year, 89% of the people who learned most of the material (86% or more) for an ALEKS course for middle school students were able to pass the MTEL. This year, the Department is investigating these results more fully and is trying to determine if mastery of Algebra I topics serves as a similar predictor for people taking the Middle School Mathematics MTEL. The Department is also exploring the effectiveness of providing MTEL preparation course participants with ALEKS. If the results of this study are promising then the Department may consider supporting the use of ALEKS or similar tools for prospective mathematics teachers as a means of addressing the workforce shortage in this area.

Fund Use

Funds from this line item support the Department's contract with the UMass Donahue Institute to conduct the ALEKS mathematics teacher training pilot study.

Earmark - Massachusetts Mathematics and Science Initiative

Background and Program Design

The Massachusetts Mathematics and Science Initiative (MMSI), a division of Mass Insight Education and Research Institute, is designed to promote academic excellence and transform school culture by increasing the number of students enrolled in math, science and English Advanced Placement (AP) courses and passing those AP exams. Created by a grant from the National Math & Science Initiative, MMSI selects schools to participate in its AP Training and Award program through a competitive process, which includes an RFP, initial assessment visits, and letters of agreement with grantee schools. In the summer of 2008, MMSI provided intensive, content-based teacher training to 55 AP and Pre-AP mathematics and science teachers from nine school districts.

Fund Use

Funds will be granted to 10 schools for teacher professional development to take place in the summer of 2009.

III. Teacher Data

The data available provide the basis for an estimate of the number of mathematics and science teachers who are teaching without proper certification. However, the data are not without limitations and the figures provided are a conservative reflection of the challenges facing the state. Explanations for why this is so are included below.

Teachers on Waivers

The Department has designated STEM fields as critical teacher shortage areas. Schools can take advantage of a Critical Shortage Waiver to hire retired teachers into these fields. Schools can also fill positions under the general waiver program, in which school districts can hire unlicensed teachers on a short-term basis (typically limited to one year).

The table below shows the number of Massachusetts teachers who were teaching in STEM fields under waivers for the 2007-2008 school year.

Table 1: Number of STEM Educators Teaching on Waiver, 2007-2008

Subject	# of Waivers
General Elementary	106
Middle School Mathematics/Science	31
Elementary Mathematics (Gr. 1-6)	11
Middle School Mathematics (Gr. 5-8)	83
Mathematics (Gr. 8-12)	115
Mathematics TOTAL	209
General Science	53
Biology	75
Chemistry	32
Earth Science	18
Physics	33
Technology/Engineering	15
Science/Technology TOTAL	226
TOTAL:	572

Source: ESE Data Analysis and Reporting

While 572 STEM teachers on waivers in 2007-2008 is high, this number is under-representative of the actual demand. Since waivers for a particular position are only granted for one year, schools request more waivers each year than are granted. For example, at this point in the 2008-2009 school year, the Department has granted 342 of the 484 waivers requested in mathematics and science. With so many mathematics and science teachers on waivers and schools needing to fill so many positions, there is great need for the initiatives funded through this line item. These numbers also do not account for the approximately 1,500 waivers in 2007-2008 for special education teachers of students with severe and moderate disabilities, many of whom may be teaching mathematics and science as part of their responsibilities.

Teachers “Not Highly Qualified”

The table below reports the number of mathematics and science teachers not highly qualified for the field they are teaching by virtue of not having an acceptable subject area license or by lacking subject matter competency. The figures displayed show full-time equivalents (FTEs) to avoid inflating head count figures for teachers that teach multiple subjects. The last columns provide the corresponding percentage of teachers not highly qualified in the subject they teach.

Limitations to the data presented here should be noted:

(1) These numbers do not reflect generalist elementary teachers responsible for teaching all subject areas (including math and science) who are licensed as elementary teachers. The General Curriculum elementary license currently does not ensure that teachers have the requisite content expertise in mathematics and/or science.⁴

(2) The highly qualified status of teachers is based on district reporting. Currently the ESE does not have the ability to verify this information, but future plans for the integration of teacher data systems will allow verification.

(3) Technology and Engineering is not currently considered a core academic subject area, therefore highly qualified information on teacher work assignments are not required. The figures below only represent Technology and Engineering teachers without a license.

(4) The data do not capture those teachers teaching math courses in work assignments that school districts have designated as non-core.

*Table 2: Mathematics, Science & Technology/Engineering Teachers by School Levels and Percent Not Highly Qualified-FTE**

Subject	# FTE			# FTE Not Highly Qualified			% Not Highly Qualified		
	Elem	Middle	HS	Elem	Middle	HS	Elem	Middle	HS
General Science	407	1,426	239	20	92	27	4.9	6.5	11.3
Biology	3	65	1,164	0	1	89	0.0	1.5	7.6
Chemistry	0	19	615	NA	1	46	NA	5.3	7.5
Earth Science	17	294	363	1	17	30	5.9	5.8	8.3
Physics	1	49	617	0.2	1	74	20.0	2.0	12.0
Tech/Engineering	26	194	138	1	10	11	3.8	5.2	8.0
Sciences (Total)	454	2,047	3,136	22	122	277	4.8	6.0	8.8
Mathematics	680	2,453	3,486	42	157	239	6.2	6.4	6.9

Source: ESE Data Analysis & Reporting, December 2008

* FTEs rounded to whole numbers unless it is less than 1 but greater than 0

* NA= Not applicable

⁴ For details on the efforts to strengthen the preparation and licensure requirements for elementary and special education teachers who teach mathematics, see <http://www.doe.mass.edu/news/news.asp?id=3801>.

Teacher Data System in Place for Analysis

The Department completed the first statewide implementation of the Education Personnel Information Management System (EPIMS) in 2008. EPIMS collects demographic and professional data along with work assignment information on all individual public school educators, paraprofessionals and administrative staff (approximately 150,000 individuals). Educator information is collected to the classroom level. The EPIMS data has been linked to the Department's licensure database (ELAR) and the Department is moving forward to integrate the data for more sophisticated analysis. For our purposes, data on mathematics and science teacher licensure will, over time, help us to note trends, identify high need areas, and assist districts with their recruiting efforts.

IV. FY09 Budget

Original Appropriation		\$991,367
	9C Cuts	<u>-\$505,140</u>
	Total Available	\$486,227

Program or Initiative		Estimated Amount
Teacher Professional Development Institutes		\$137,030
Follow-up activities to summer 2008 institutes	\$103,623	
Science institute pilot	\$33,407	
Massachusetts Intel Mathematics Initiative		\$244,197
Cohort II contracts to finish eight courses, evaluation, and mathematical learning community support	\$152,300	
Cohort II district grants and teacher stipends	\$21,897	
Cohort III district grants to start two courses, teacher stipends, and mathematical learning community support	\$70,000	
ALEKS Mathematics MTEL Preparation Pilot Study		\$5,000
External evaluation contract	\$5,000	
Earmark – Massachusetts Math and Science Initiative		\$100,000
	TOTAL	\$486,227

V. Recommendations for Mathematics and Science Education and the FY10 Budget Line Item

Strengthening Mathematics and Science Education by Establishing a Professional Development System

With the recent attention placed on mathematics and science education through the expectations of the No Child Left Behind Act (NCLB) and our state's competency determination policy, it is crucial that we continue making the investments needed to strengthen mathematics and science education in the Commonwealth. While this line item has provided an initial platform for developing a statewide system of professional development, the amount of professional development offered by the Department has been inadequate to meet the need in the past. Scaling up and sustaining a state-wide professional development system will require additional state funds, and a potential adjustment in how school districts direct professional development spending. It has been suggested that an investment of \$50 million per year in content training for teachers would be required to sufficiently retool the mathematics and science teaching force.⁵ Recent survey responses from urban district Superintendents and mathematics curriculum coordinators identified content-based professional development in mathematics as a top priority for district support, highlighting the importance of these programs to education improvement efforts.

Even before the substantial 9C cut of \$500,000 from this line item, the level of FY09 funding (\$991,367) was not sufficient to fully fund the Professional Development Institutes program. In the summer of 2008, the 24 Professional Development Institutes engaged 407 participants. At an average cost of \$28,168 per institute (\$1,661 per participant) for 40 hours of instruction and 20 hours of follow-up, the total cost was approximately \$676,000. The MIMI initiative costs approximately \$45,000 per course (less than \$2000 per participant) for 80 hours of instruction, mathematical learning, community support, and teacher stipends, totaling approximately \$360,000 at current levels. The total spending to implement these two programs at the level of 2008 is over \$1 million, representing a shortfall of more than \$600,000 in FY09.

We recommend that the state continue to develop a systemic approach to professional development. The Board of Elementary and Secondary Education has identified professional development for mathematics and science teachers as one of the critical budget areas for expansion and has requested an increase of funding in this line item to \$4.9 million for FY10 to scale-up and systematize professional development programs in mathematics and science. This funding level would allow the Department to reach nearly

⁵ See the 2005 report by Mass Insight Education and Research Institute, "World Class: The Massachusetts Agenda to Meet the International Challenge for Math- and Science-Educated Students," at <http://www.massinsight.org/>.

5000 teachers per year through the following: increased statewide offerings of Professional Development Institutes to 100 courses (\$2.5m); an expansion of the MIMI initiative to 32 courses (\$1.5m); the development and launch of a science initiative to provide subject-specific content and inquiry professional development that targets the needs of urban districts (\$0.75m); increased support for ALEKS and other online resources to prepare teachers for the MTEL licensure tests (\$0.15m); and maintenance of the earmark for training for AP teachers (\$0.1m). These investments would enable a significant scale up of these systemic initiatives and provide a basis for transitioning these programs from direct coordination by the Department to a regionalized mode of delivery that leverages a state system of support.

In past legislative reports we have also highlighted other areas of need, such as mathematics and science coaching, formative assessment, science and technology/engineering laboratory facilities, the promotion of technology/engineering, and support for student interventions. Although these areas continue to require attention, the need for high quality systematic professional development in mathematics and science is at a critical level that demands the highest priority and a renewed commitment.

VI. Appendix

Appendix 1: FY09 Budget Line Item Language

7061-9804

For teacher content training in math and science; provided, that said training shall include math specialist and Massachusetts test for educator licensure preparation; provided further, that funds from this item shall be expended on content based professional development in math and science, with a focus on increasing the content knowledge of elementary and middle school math and science teachers in districts with a high percentage of students scoring in level 1 or 2 on the math or science Massachusetts Comprehensive Assessment System exams, or in districts which are at risk of or determined to be underperforming in accordance with sections 1J and 1K of chapter 69 of the General Laws; provided further, that such professional development courses shall demonstrate proven, replicable results in improving teacher and student performance, and shall demonstrate the use of best practices, as determined by the department, including data comparing pre-training and post-training content knowledge; provided further, that not less than \$100,000 shall be expended for the Massachusetts Math and Science Initiative for the purpose of providing grants to no less than 10 school districts for teacher training for advanced placement instruction; provided further, that the department shall report, not later than February 16, 2009, on the number of educators provided content training under this item, the estimated number of math and science teachers currently teaching without certification, and any legislative or regulatory recommendations necessary to make middle school and elementary math and science education more rigorous and data driven; provided further, that said report shall be provided to the secretary of administration and finance, the senate president, the speaker of the house, the chairs of the house and senate ways and means committees and the house and senate chairs of the joint committee on education; provided further, that no funds shall be expended for personnel costs; and provided further, that for the purpose of this item, appropriated funds may be expended through August 31, 2009

Appendix 2: List of 2008 Professional Development Institutes

	Region	Host District	Course Title
Science			
1	Gr. Boston	Boston	On The Waterfront
2		Boston	Engineering, A New Approach to Science
3		Chelsea	Laboratory-Based Chemistry Content
4	Northeast	Lawrence	How to Effectively Engage Students in Standards-Based Biology Learning K-12
5		Lowell	Laboratory-Based Physics Content
6	Southeast	Fall River	On The Waterfront
7		Fall River	How to Effectively Engage Students in Standards-Based Biology Learning K-12
8	Central	Fitchburg	Teaching Laboratory-Based Engineering
9	West	Chicopee	Assessing and Addressing Misconceptions in Physical Science
Math			
10	Gr Boston	Boston	Counting and Number Sense
11		Boston	Developing Algebraic Thinking
12		Revere	Increasing Accessibility to Algebra and Geometry for Special Education Students
13		Chelsea	Unlocking Linear Equations and Exploring Their Foundations
14	Northeast	Lawrence	Sheltering Instruction in MS Mathematics
15		Lowell	Geometry & Measurement-Area, Perimeter and Transformations
16		Lowell	Assessing with Rich Tasks and Problems
17	Southeast	Brockton	Understanding Rational Numbers: Fractions, Decimals, Percents and Proportionality
18		Fall River	Reasoning and Problem Solving: Number Sense, Algebra and Measurement
19	Central	Fitchburg Leominster	First Steps in Mathematics: Number
20		Worcester	Increasing Accessibility to Algebra and Geometry for Special Education Students
21	West	West Springfield	Understanding Rational Numbers: Fractions, Decimals, Percents and Proportionality
22		West Springfield	Math Coaching and Beyond for Teacher Leaders and Coaches
23		Chicopee	Patterns, Polygons, Proportionality.. for Special Populations
24		Springfield	Developing Algebraic Thinking