



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

Line-item 7061-9804
February, 2008



This document was prepared by the
Massachusetts Department of Education
Jeffrey Nellhaus
Acting Commissioner of Education

Board of Education Members

Mr. Paul Reville, Chairman, Worcester
Ms. Ann Reale, Vice-Chair, Commissioner, Early Education and Care, Boston
Mr. Christopher Anderson, Westford
Ms. Harneen Chernow, Jamaica Plain
Dr. Thomas E. Fortmann, Lexington
Ms. Ruth Kaplan, Brookline
Dr. Patricia Plummer, Chancellor, Higher Education, Boston
Dr. Sandra L. Stotsky, Brookline
Mr. Zachary Tsetsos, Chair, Student Advisory Council, Oxford
Jeffrey Nellhaus, Acting Commissioner
and Secretary to the Board

The Massachusetts Department of 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, 350 Main St., Malden, MA 02148 781-338-6105.

© 2008 Massachusetts Department of 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 Education."

This document printed on recycled paper

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





Jeffrey Nellhaus
Acting Commissioner of Education

The Commonwealth of Massachusetts Department of Education

350 Main Street, Malden, Massachusetts 02148-5023

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

February 2008

Dear Members of the General Court:

Pursuant to Chapter 61 of the Acts of 2007, line-item 7061-9804, the Department of Education respectfully submits this report *Mathematics and Science Teacher Content-Based Professional Development*, addressing the following;

"... 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...."

Through this line item established in FY07, 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.

While the performance of Massachusetts' students in *mathematics* and science is comparatively strong, our students' average performance is significantly below that of students in many other industrialized nations. Moreover, there are persistent achievement gaps as well as a large number of students that enter college in need of remedial coursework

The Department collects data on the number of mathematics and science teachers who are teaching under a waiver and are not licensed in the field they are teaching. The number of Science, Technology, Engineering and Mathematics (STEM) educators teaching on waiver in the 2006-2007 school year is estimated to be 670. In addition, approximately 5.2% - 12.4% of 2006-2007 mathematics and science teachers are teaching "out-of-field" using the "80% rule," which allows teachers to teach in their licensed field for 80% of their day and teach 20% out of their field without reporting this as "out-of-field".

The Department is working 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 instructional practice expertise.

The four programs detailed in Section II of this report are initial steps in the development of this professional development system:

- *Professional Development Institutes* are offered currently during the summer in locations across the state. The 31 summer 2007 Professional Development Institutes engaged 576 teachers, coaches, paraprofessionals, and administrators in subject-specific courses, including science, technology/engineering, mathematics, literacy, and instructional leadership.
- The *MADOE/Intel Mathematics Initiative* was launched in the fall of 2006 when 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 the summer of 2007, 150 elementary and middle school teachers of mathematics were offered an 80-hour mathematics course focused on K-8 foundational content. Participants in this first cohort, which was drawn from the high-need districts of Boston (75 teachers), Springfield (50 teachers), and New Bedford (25 teachers), completed half of the course during the summer and are finishing their training during the 2007-2008 school year. Course participants are meeting regularly during the school year to reinforce and extend their learning and improve instructional practice.
- The Department is conducting the *ALEKS Mathematics MTEL Preparation Pilot Study* 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. Approximately 100 teachers are currently participating in the study. The Department has contracted with the UMass Donahue Institute to follow up last year's study by examining the effectiveness of ALEKS as an MTEL preparation tool.
- The *HeyMath! Pilot* utilizes an international mathematics teaching and learning software program that is widely used in countries where students consistently achieve high scores on international assessments. HeyMath! provides online resources that have been aligned to the Massachusetts Mathematics Curriculum Framework to support lesson planning and extend teacher content knowledge. The Department has contracted with Hampshire Educational Collaborative to implement the pilot initiative and with the UMass Donahue Institute to conduct the external evaluation.

You will note the work of this line-item is focused on mathematics. With increasing attention being paid to science, this area of professional development is needed as well. Our recommendations offer additional activities to address this need.

If you have comments or questions, please feel free to contact Juliane Dow, Associate Commissioner or Barbara Libby, Director of the Office for Mathematics, Science, and Technology/Engineering.

Sincerely,

Jeffrey Nellhaus,
Acting Commissioner of Education

Table of Contents

I. Introduction.....	2
A Critical Need	
A Strategy for Improving STEM Professional Development	
II. Major Initiatives and Programs.....	5
2008 Teacher Professional Development Institutes	
MADOE / Intel Mathematics Initiative	
ALEKS Mathematics MTEL Preparation Pilot Study	
HeyMath! Pilot	
III. Teacher Data.....	9
Teachers on Waivers	
Teachers “Out-of-Field”	
Teacher Data System to Impact Future Reporting	
IV. FY08 Budget.....	12
V. Recommendations for Mathematics and Science Education and the FY09 Budget Line Item.....	13
Strengthening Mathematics and Science Education	
VI. Appendix.....	16
FY08 Budget Line Item Language	

I. Introduction

Pursuant to Chapter 61 of the Acts of 2007, line-item 7061-9804, the Department of Education respectfully submits this report *Mathematics and Science Teacher Content-Based Professional Development*, addressing the following;

"provided further, that the department shall report, not later than February 15, 2008, 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; and 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"

Through this line item established in FY07, 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. The Legislature also extended the spending period for this line item through August, 2008, which is crucial for the successful administration of these funds by allowing the support of professional development activities during the summer when teachers are available.

The FY08 budget language 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.

This report describes the progress achieved in mathematics and science teacher content training that occurred since the February 2007 legislative report, and details FY08 funded program activities from July 1, 2007 through August, 2008.

A Critical Need

As described in detail in the February 2007 report, there is a critical need for state funds to support *mathematics* and science education. While students at grades 3–8 made unprecedented gains on MCAS mathematics tests in 2007, student results in mathematics (except grade 10) and science had been relatively flat between 2003 and 2006.

And while the performance of Massachusetts' students in *mathematics* and science is comparatively strong relative to the nation,¹ our students' average performance is significantly below that of students in many other industrialized nations with whom we

¹ Based on National Assessment of Educational Progress data: <http://www.doe.mass.edu/mcas/naep/>

must compete in today's global economy.² In addition, large achievement gaps persist in Massachusetts public schools between white, more affluent students and racial and language minority students who are less affluent. As well, 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 for improvement, corrective action or restructuring under the No Child Left Behind Act (NCLB).

Contributing to the incidence of low mathematics and science student performance is inadequate content knowledge among many teachers assigned to teach mathematics, and the absence of effective standards-based instructional practices in many mathematics and science classrooms. Successfully teaching all students to reach the 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. 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 with scale up of systemic initiatives to improve the preparation and ongoing professional development of *mathematics* and science teachers.

A Strategy for Improving STEM Professional Development

The Department is working 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 instructional practice expertise.

The programs detailed in Section II of this report and summarized here are initial steps in the development of this professional development system. The Professional Development Institutes currently are offered during the summer in locations across the state. In future years, the Department hopes to offer regionally based teacher professional development institutes, covering key *mathematics* and science content knowledge and related standards-based instructional strategies, throughout the year.

The MADOE/Intel Mathematics Initiative (MIMI), which is described further in Section II is being designed and implemented to provide a high quality, and scalable training approach to enhance the foundational knowledge of elementary and middle school mathematics teachers, and effectiveness. Building upon 150 participant teachers trained to date, MIMI will leverage the 15 trained master teachers to engage 200 participant teachers this summer using a revised and improved curriculum. The MIMI initiative will provide training to teachers in Boston, Springfield, Worcester, and New Bedford this year. With continued state funding for mathematics and science professional development over the next two years, we plan to scale up this initiative to strengthen the teaching capacity of over 1000 elementary and middle school mathematics teachers.

² For example, see the Trends in International Math and Science Study (TIMSS) at <http://nces.ed.gov/timss/> and the Program for International Student Assessment (PISA) at <http://www.pisa.oecd.org>.

Two pilot studies have been designed to explore the use of online technological tools for improving teacher content knowledge. The first study builds off of the teacher content knowledge assessment study funded through this line item last year, and will investigate 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). The second pilot study will explore the international online mathematics program HeyMath! as a tool for increasing teacher content knowledge and supporting improved lesson planning. Both of these studies involve external evaluations to inform the potential future use of these tools by Massachusetts educators.

The remaining sections of this report describe the *mathematics* and science educator data that are currently available, the FY08 budget, and recommendations for strengthening *mathematics* and science education in future years.

II. Major Initiatives and Programs

Massachusetts 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.

The Institutes focus on content learning and the integration of pedagogical skills necessary to engage students in the content. The new structure developed for the summer 2007 Institutes organized offerings into four “levels” that reflect a continuum of teacher development to meet the diverse professional development needs of teachers across the state.

The 31 summer 2007 Professional Development Institutes engaged 576 teachers, coaches, paraprofessionals, and administrators in subject-specific courses, including science, technology/engineering, mathematics, literacy, and instructional leadership. Approximately 500 participants completed the institute participant survey, providing detailed information about their teaching position and credentials. A summary of the 2007 Institutes data follows:

- Participants represented 177 public school districts and charter schools. 239 of the respondents (48%) taught in 45 high-need districts.
- 209 participants attended the 11 science-focused Institutes, and 304 participants attended the 16 mathematics-focused Institutes.
- Of those respondents teaching science, 53% were certified in the science subject they taught, while 4% were teaching on waiver. In mathematics, 55% were certified in mathematics and 7% were teaching on waiver. Those not certified or on waiver were teaching these subjects out-of-field.
- The participants taught approximately 54,000 students collectively, including approximately 8,800 (16%) Special Education students and 4,750 (9%) English Language Learners.

Funding for the 2008 Summer Professional Development Institutes will allow the Department and Institute providers to refine last year’s course offerings and develop some new courses to meet targeted teacher-training needs. Having a reliable funding stream enables us to make a range of course offerings available from year to year, with predictable scheduling, allowing teachers and administrators to choose experiences specific to each teacher’s professional development needs. Teachers from high-need schools and districts will continue to receive priority for Institute enrollment.

Fund Use

FY08 funds from this line item will partially fund the 2008 Professional Development Institute program, and will need to be combined with other funding sources to offer the Professional Development Institutes planned for the summer of 2008. Line item funds will support professional development providers to refine, add, and implement Institute courses and related follow-up experiences. The Institutes are again expected to offer approximately 25-30 *mathematics* and science courses, enrolling approximately 600 teachers, including a majority from high-need districts.

MADOE/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. The partnership launched the MADOE/Intel Mathematics Initiative (MIMI) in the summer of 2007 by offering 150 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). This first cohort of participant teachers, drawn from the high-need districts of Boston (75 teachers), Springfield (50 teachers), and New Bedford (25 teachers), completed half of the course during the summer and are finishing their training during the 2007-2008 school year. In addition, course participants are meeting 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 hired by MADOE. WestEd will also be evaluating 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.

During the 2008-2009 school year, this line item will fund an additional 200 teachers to take the intensive 80-hour mathematics course, starting in August 2008. The course will be taught by the same group of master teachers, utilizing a carefully revised and improved curriculum based on extensive feedback provided by the evaluators, all participants, and Department staff. Participants from Worcester will be added to the original districts so that the three largest urban districts in the Commonwealth are participating in the initiative.

In the 2009-2010 school year, the Department hopes to significantly expand the MIMI initiative by training a second cadre of master teachers. The expansion will allow the Department to directly support the training of 400 teachers per year, surpassing 1,000 total participant teachers by 2010. This direct training will initially target the nine largest urban districts. In the future years, the MIMI curriculum will be leveraged by providers

across the state to support high-quality mathematics content training for teachers in other urban and high-need districts.

Fund Use

In order to support the second year of MIMI implementation, FY08 funds have been allocated for the following activities: compensation for master teacher training, course planning, and delivery of eight courses; grants to four districts to support participant teacher stipends; and consultant services through UMass Medical School to coordinate and support the mathematical learning communities in participating districts.

The 15 master teachers will attend a two-day training at the end of June 2008 to familiarize themselves with the revised course curriculum. The second cohort of 200 participant teachers, attending eight courses of 25 teachers each, will undergo the first 40 hours of the course in August 2008.

ALEKS Mathematics MTEL Preparation Pilot Study

Background and Program Design

The Department is conducting a pilot study 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 spring or summer 2008). There are approximately 100 teachers currently participating in the study.

Although ALEKS is not specifically designed to prepare teachers for the MTEL tests, teachers who participated in the Department's teacher content assessment study last year identified ALEKS as potentially helpful for mathematics MTEL preparation. The Department has contracted with the UMass Donahue Institute to follow up last year's study by examining the effectiveness of ALEKS as an MTEL preparation tool. 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.

HeyMath! Pilot

Background and Program Design

HeyMath! is an international mathematics teaching and learning software program currently being used widely in countries that consistently achieve high scores on international assessments. HeyMath! provides online resources that have been aligned to the Massachusetts Mathematics Curriculum Framework to support lesson planning and extend teacher content knowledge through dynamic representations of mathematical concepts.

The initiative will leverage teacher subscriptions to HeyMath! in conjunction with introductory training and follow-up support. The initial implementation will be in western Massachusetts in cooperation with Hampshire Educational Collaborative (HEC). HEC will incorporate HeyMath! into the “Teaching Math for Understanding” teacher preparation course that HEC provides as part of their mathematics licensure program. Participants will receive a subscription to HeyMath! and use the software both as a means of increasing their mathematics content and for planning lessons for classroom use.

In the spring of 2008, approximately 30 teachers will receive 10 contact hours of training with the software, as well as follow-up support for classroom implementation. Lesson plans incorporating HeyMath! will be developed and shared. In the summer of 2008, an intensive introduction and training with HeyMath! for approximately 40 additional teachers will be offered to western Massachusetts teachers. The trainings will be revised based on the summer work and will continue during the 2008-09 school year.

Fund Use

Funds from this line item support the Department’s contract with HEC to implement the pilot initiative, including conducting trainings, follow-up, and providing teacher incentives (e.g., stipends), and the Department’s contract with the UMass Donahue Institute to conduct the external evaluation.

III. Teacher Data

The Department collects data on the number of mathematics and science teachers who are teaching under a waiver and are not licensed in the field they are teaching (“out-of-field”). The updated data presented in this section provide an indication of the potential impact of this line item.

Teachers on Waivers

STEM fields have been designated critical teacher shortage areas by the Department. 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 2006-2007 school year.

Number of STEM Educators Teaching on Waiver: 2006-2007

Subject	# of Waivers
General Elementary	169
Middle School Mathematics/Science	28
Mathematics TOTAL	227
Elementary Mathematics (Gr. 1-6)	9
Middle School Mathematics (Gr. 5-8)	86
Mathematics (Gr. 8-12)	132
Science/Technology TOTAL	246
General Science	64
Biology	92
Chemistry	31
Earth Science	19
Physics	33
Technology/engineering	7
TOTAL:	670

While 670 STEM teachers on waivers in 2006-2007 is high, and slightly higher than the previous year (641), 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 2007-2008 school year, the Department has granted 410 of the 619 waivers requested in mathematics and science. With so many mathematics and science teachers on waivers and schools needing to fill so many positions, the need for the initiatives funded through this line item is great. These numbers also do not account for the 984 waivers for special education teachers of students with severe and moderate disabilities, many of who may be teaching mathematics and science as part of their responsibilities.

Teachers “Out-of-Field”

The table below reports the number of mathematics and science teachers not licensed for the field they are teaching (“out-of-field”). The “head count” gives the total number of teachers in each subject. The last columns provide the corresponding percentage of teachers not licensed in the subject they teach. These numbers do not reflect generalist elementary teachers responsible for teaching all subject areas, who are licensed as elementary teachers. The totals in the elementary head count reflect only those elementary teachers that specialize and teach either mathematics or science for the majority of their teaching time.

2006-2007 Mathematics and Science Teachers Who Are “Out-of-Field”

Subject	# Head Count			# Not Licensed			% Not Licensed		
	Elem	Middle	HS	Elem	Middle	HS	Elem	Middle	HS
Mathematics	449	2,279	3,468	33	160	179	7.3	7.0	5.2
Sciences (Total)	354	2,097	4,121	39	104	327	12.4	5.2	8.6
General Science	303	1,714	644	37	79	62	12.2	4.6	9.6
Biology	0	61	1,351	0	4	83	0	6.6	6.1
Chemistry	0	6	794	0	1	59	0	16.7	7.4
Earth Science	5	86	347	0	5	36	0	5.8	10.4
Physics	1	12	629	0	4	69	0	33.3	11.0
Tech/Eng	45	218	356	2	11	18	44	5.0	5.1

Prepared by Data Analysis & Reporting, December, 2007

As with waiver data, the number of teachers “out-of-field” is under-represented in this chart. Many schools are able to make use of the “80% rule,” which allows teachers to teach in their licensed field for 80% of their day and teach 20% out of their field without reporting this as “out-of-field” teaching. This is particularly true in the sciences, where the variety of disciplines make it more difficult for schools and districts to justify hiring particular teachers for every course offering. In addition, the majority of elementary and middle school teachers hold standard generalist licenses which do not ensure that they have the requisite content expertise in mathematics and/or science. Mathematics and science is taught under various other licenses without mathematics or science subject matter knowledge requirements, such as special education teachers, English language learner teachers, and Title I teachers.

Teacher Data System to Impact Future Reporting

To date, the Department has had limited capacity to collect, manage and report data linking educators’ licensure status with their current teaching assignments. To address this critical need for such data in 2006, the Department designed and piloted an Education Personnel Information Management System (EPIMS). Funding to fully implement this system was appropriated in FY07. The first phase of implementation began in May 2007 with districts assigning a unique identifier to all education staff. EPIMS will also collect demographic and professional data along with work assignment

information on all individual public school educators, paraprofessionals and administrative staff (approximately 150,000 individuals). The EPIMS data will be used to perform greatly needed analysis on our educator workforce. 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. FY08 Budget

Program or Initiative	Estimated Amount
Teacher Professional Development Institutes.....	\$231,367
2007 institute follow-up	\$114,300
2008 contracts for five institutes	\$117,067
MADDOE / Intel Mathematics Initiative.....	\$629,000
Cohort I contracts for seven courses, evaluation, and mathematical learning community development	\$267,000
Cohort I district grants and teacher stipends	\$110,000
Cohort II contracts for eight courses, evaluation, and mathematical learning community support	\$152,000
Cohort II district grants and teacher stipends	\$110,000
ALEKS Mathematics MTEL Preparation Pilot Study.....	\$10,000
External evaluation contract	\$10,000
HeyMath! Pilot.....	\$25,000
Implementation contract	\$15,000
External evaluation contract	\$10,000
TOTAL.....	\$895,367

V. Recommendations for Mathematics and Science Education and the FY08 Budget Line Item

Strengthening Mathematics and Science Education

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, there are a number of areas in which increased focus is needed to strengthen mathematics and science education in the Commonwealth. Outlined below are crucial areas that require future support.

Expanded Professional Development System

While this line item has provided a platform for developing systematic statewide professional development, the current level of offerings are inadequate to meet the need. 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.³

The level of FY08 funding (\$895,367) is not sufficient to fully fund the Professional Development Institutes program. In the summer of 2007, the 31 Professional Development Institutes engaged 576 participants. At an average cost of \$24,321 per Institute (\$1,310 per participant) for 40 hours of instruction and 20 hours of follow-up, the total cost was approximately \$750,000. The 2007-2008 MIMI initiative costs approximately \$45,000 per course (\$1800 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 develop and initiate these two programs is \$1.11 million, representing a shortfall of over \$200,000 to maintain the current levels of implementation. This shortfall was made up with funding from the United States Education Department last year, but the availability of federal funding for this program varies year to year.

We respectfully request an increase of funding in this line item to \$2 million for FY09 to allow the scale up of both of these programs. A first step would be to increase the number of Professional Development Institutes to 50 courses (\$1.25m) and double the capacity of the MIMI initiative to 16 courses (\$750k) so that it can reach 1650 teachers total. This would represent a significant scale up of these systemic initiatives and position the Department well to continue to grow these programs to meet the challenges ahead.

³ 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/>.

Mathematics and Science Coaching

School-based content coaching is needed to address the inconsistent implementation of standards-based instructional practice in mathematics and science classrooms across the state. Many teachers teach mathematics and science “by the book,” without steady reference to the state’s learning standards, and without using effective instructional practices that engage and challenge students to learn and perform to rigorous academic standards. Content coaching is a proven method of effecting change in practice at the classroom level to strengthen instructional rigor.

Funding to support content-based coaching to improve teachers' instructional practice would enable the Department, districts, and schools to:

- (1) provide training to existing coaches and disseminate resources that provide guidance on the implementation of high-quality coaching practices.
- (2) establish networks of instructional coaching specialists and support district-level coaching positions and programs. The Department has established an urban districts’ mathematics support specialist network and has been leveraging the work of the network for the past three years to contribute to standards-based reform efforts. Similar supports are needed in large and small districts statewide.
- (3) fund content coaching positions in under-performing schools and districts and train new coaches. The Department would set criteria for high-quality coaches and assist in the recruitment and selection process of coaches for under-performing schools.
- (4) provide incentives for structural changes in the ways schools are organized to free up time for teachers to meet regularly to collaboratively improve practice.

Formative Assessment for Student Mathematics and Science Learning

Formative assessment systems are needed to generate data on student learning and gaps in student achievement to inform teacher lesson planning and flag students in need of instructional intervention. The MCAS system tests students once a year to provide summative assessment data. MCAS data is of great assistance in determining school and district level performance trends but cannot provide the “real time” specific information on student learning that is needed to guide instruction. Over the past several years, the Department has worked with several urban districts to pilot interim assessments in mathematics to track the progress of student learning and support data-driven instructional practices. This is a promising development to advance standards-based approaches to teaching and learning.

Support for effective formative assessment practices in schools and districts would allow the Department, districts, and schools to:

- (1) establish technology infrastructure or a statewide license for widespread implementation of a formative assessment system that enables district-wide student assessments as well as on-demand classroom assessments of students by teachers. The Department is currently piloting an educational management system in eight districts that could serve this purpose.
- (2) provide professional development to administrators and teachers to build capacity in assessment literacy.
- (3) assist districts with the development of detailed curriculum pacing guides based on the learning standards.

Science and Technology/Engineering Laboratory Facilities

A reinvigoration of science and technology/engineering (STE) laboratory facilities is needed to increase student learning and achievement in the sciences. With a strong focus on mathematics and English language arts over the past several years—due to both NCLB and state policies—many elementary and middle schools have reduced the amount of time available for science instruction. Additionally, with tight budgets in the past years, many schools have not updated or maintained their laboratory facilities and have cut back on basic science materials, kits, and supplies.

Promoting Technology/Engineering

Recognition and support for technology/engineering as an important academic subject, equivalent to and offered in partnership with other science courses, is a vital need if we are to graduate a technologically literate workforce. Our state technology/engineering learning standards are recognized nationally. Massachusetts recognizes a full year high school course in technology/engineering as equivalent to other science courses, including chemistry, biology, physics, or earth and space science. Technology/engineering courses are not, however, recognized for purposes of admission to our state colleges and universities. Given recent reports about the need for a stronger scientific and technologic workforce in order for Massachusetts to remain competitive, support to promote and provide quality technology/engineering courses is needed.

Instructional Interventions

Instructional interventions in mathematics and science are needed to remediate student learning gaps when they are first evidenced and provide academic support services to at-risk students. Many high schools have in place some “safety net” programs in mathematics to address the academic needs of student who fail grade 10 MCAS tests and may not qualify for graduation. Few districts, however, are poised to intervene to address student learning gaps evidenced by students in grades K–9. Students who evidence a lack of understanding of the mathematics or science concepts and skills they are being taught need individualized instructional supports before they fall dramatically behind his or her grade-level peers. Readily available student intervention services are critically important to supporting the mathematics and science achievement of all students.

VI. Appendix

FY08 Budget Line Item Language

7061-9804

For teacher content training in mathematics and science; provided, that said training shall include mathematics specialist and Massachusetts test for educator licensure preparation; provided further, that funds from this item shall be expended on content based professional development in mathematics and science, with a focus on increasing the content knowledge of elementary and middle school mathematics and science teachers in districts with a high percentage of students scoring in level one or two on the mathematics or science MCAS 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, 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 the department shall report, not later than February 15, 2008, 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; and 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, 2008. \$895,367