UMASS DONAHUE INSTITUTE • APPLIED RESEARCH & PROGRAM EVALUATION

Massachusetts Race to the Top College and Career Readiness Initiatives, 2010–2014

Evaluation Final Report, September 2015

Prepared for the Massachusetts Department of Elementary and Secondary Education

Acknowledgments

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Report Information

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Executive Summary

The Massachusetts Department of Elementary and Secondary Education (ESE) was awarded a federal Race to the Top (RTTT) grant for the years 2010–2014. The college and career readiness components of the grant were designed to help students develop "knowledge and skills necessary for success in postsecondary education and economically viable career pathways." The RTTT initiatives were intended to provide students with opportunities to participate in quality, upper-level high school coursework and new approaches to assist them with high school completion and transition to higher education and the workforce. These programs were part of a broader effort, as specified in the Delivery Plan of ESE's College and Career Readiness group, to increase the Massachusetts 5-year high school graduation rate from 84.7 percent in 2010 to 88.3 percent in 2014, and to increase the number of graduates who complete the MassCore program of study statewide from 68.9 percent in 2010 to 85.0 percent in 2014.

The UMass Donahue Institute conducted an evaluation of three of the college and career readiness components of the Massachusetts RTTT efforts—the Pre-AP Teacher Training program, the STEM-focused Early College High Schools (ECHS), and the MassCore Policy and Implementation initiative. For each of these three programs, this report provides final evaluation findings for the 2010–14 grant period. This report also references the following annual reports from the evaluation, which provide substantial additional detail about evaluation methods and findings:

- Annual Report 2012 – http://www.doe.mass.edu/research/reports/2012/09RTTT-CCR2012.pdf
- Annual Report 2013 – http://www.doe.mass.edu/research/reports/2013/09RTTT-CCR2013.pdf
- Annual Report 2014 – http://www.doe.mass.edu/research/reports/2014/09RTTT-CCR2014.pdf

Two ESE Delivery Plan goals regarding graduation rates and MassCore completion are described above. The goal for the Massachusetts 5-year high school graduation rate was to reach 88.3 percent by 2014. The most recent available 5-year graduate rate is 87.7 percent for 2013, which reflects an increase of 3.0 percentage points since 2010. The 5-year rate for 2014 is not available yet, but if the trend since 2010 continues, the Commonwealth would achieve the goal of 88.3 percent. The MassCore completion goal was 85.0 percent statewide by 2014. As described in greater detail in the MassCore section below, the 2014 rate of 72.4 percent fell short of this goal, and limitations of the relevant indicator call into question the accuracy of MassCore completion rate calculations more generally.

Pre-AP Teacher Training

The aims of the Pre-AP Teacher Training program were to increase the number of low income and minority students prepared to participate and succeed in Advanced Placement courses and credit-bearing college-level coursework in English language arts (ELA), mathematics, and science; to provide teachers in grades 6–12 with high-quality professional development to assist them in developing curricula, instruction, and assessments that prepare students for AP coursework; and to provide an opportunity for teachers to collaborate in horizontal and vertical teams and to network with other teachers in their region for the purpose of improving curriculum and instruction.

Districts selected one or more of the Pre-AP disciplines (i.e., ELA, mathematics, and science) in which to participate in teacher training. The 42 "Project 4D" districts were those that agreed to send the same teachers for four-day trainings in three consecutive summers, to create vertical teams of teachers that would implement the Pre-AP program, to hold quarterly "vertical team meetings" of these teachers, and to have "lead teachers" who would organize and run the vertical team meetings and attend an additional

training day for lead teachers. Other districts used RTTT Goal 4A or non-RTTT funds; these districts were not required to commit to vertical teaming and sending teams for multiple years of training.

In total, 75 districts began their training in the first or second year of the grant—49 in ELA, 59 in mathematics, and 56 in science. Twenty-one additional districts begin their training in summer 2013 or summer 2014, although they were not part of the primary RTTT Pre-AP intervention, and some did not use RTTT funds to procure Pre-AP training services.

The evaluation findings offer a complex picture regarding Pre-AP program implementation and impacts. The state's performance goal was for teachers to complete 1,000 teacher years of training. This goal was substantially exceeded, with 3,170 teacher years of training completed—1,310 in ELA, 1,245 in mathematics, and 615 in science. Annual surveys and interviews indicated that teachers were implementing Pre-AP lessons in their classrooms, which almost all respondents agreed were examples of high-quality pedagogical practices.

The proposed model was for teachers to complete three summers of training, but this was done by only a limited percentage of teachers (25 percent in ELA, 31 percent in mathematics, and 11 percent in science). During the final program year, teachers reported having conducted an average of six Pre-AP lessons by April. (Most administrators reported putting numerous structures in place for promoting program implementation, but did not establish a specific number of Pre-AP activities that teachers were expected to conduct in a given marking period or school year.) With regard to their ability to implement Pre-AP lessons and/or assessments, nearly half of teacher survey respondents did not agree that they had adequate curricular resources, classroom equipment and supplies, or long enough class periods. Only one third agreed that they had adequate planning time and that their students had sufficient academic preparation to participate in the Pre-AP lessons and/or assessments targeted to their grade level.

With regard to program impacts, a mixed picture also emerged. Of more than 500 teachers from 4D districts who responded to the school year 2014 teacher survey, 70 percent or more reported that, as a result of the Pre-AP training, they teach more Pre-AP content, use more Pre-AP pedagogical strategies in the classroom, improved their content knowledge in their primary discipline, and have greater awareness of the importance of using Pre-AP strategies. Just over half agreed that they now use more Pre-AP assessment strategies, that they have changed their teaching philosophy to be more consistent with the Pre-AP program, and that implementing Laying the Foundation (LTF) lessons and assessments represents a substantial change to their teaching practice.

During the grant period, there were substantial increases in the percentage of high needs students taking AP courses—32 percentage points for Project 4D districts compared to 26 percentage points statewide. During the same time period, the percentage of high needs students earning an AP exam score of 3 or higher increased by 23 percentage points for Project 4D students compared to 6 percentage points statewide. Attributing these changes to the Pre-AP program is difficult, however, because almost all high needs students in Project 4D districts were also in districts that were implementing the state's AP program, which targets the same indicators related to AP course and exam participation and success. The impacts of these two programs are deeply intertwined and difficult to identify separately.

No positive, district-level program impacts on 10th-grade MCAS scores were detected. Comparative interrupted time series (CITS) analyses compared Pre-AP districts to similar districts that did not participate in the program, attempting to identify Pre-AP program impacts on MCAS performance in each Pre-AP academic discipline for all grade 6–12 students and several student subgroups, for districts with the highest implementation intensity, and in relation to achievement gaps. No differences were identified

in 69 out of 75 comparisons. The six statistically significant comparisons favored the comparison districts over the Pre-AP districts, although in five of these comparisons the differences may not have been large enough to be educationally meaningful.

While these findings clearly show that the Pre-AP program did not have rapid, positive impacts on 10th-grade MCAS scores, the findings do not demonstrate that the Pre-AP program lacks the potential to have such impacts. Investigating MCAS scores over a longer period might show different outcomes, as the students who were in 6th or 7th grade when their teachers were first trained reach 10th grade, or as the teachers become more experienced with implementing Pre-AP methods. In addition, the program may not have been implemented with sufficient intensity—with regard to percentage of teachers trained district-wide, years of teacher training completed, number of Pre-AP lessons taught, and/or the level of support for districts that was provided during a vendor transition—to achieve larger impacts on MCAS scores.

One factor potentially limiting the Pre-AP program's impact in relation to comparison districts is the Commonwealth's adoption of the Common Core State Standards in 2010, statewide professional development sessions on the new standards during school year 2011, and an expectation that all districts would align their curricula to the standards by the start of school year 2013. This change fully overlapped with the Pre-AP program period, which may have led non-Pre-AP districts to begin working with more rigorous curricula at the same time that Pre-AP districts began using the LTF program materials.

The creation of the Pre-AP program was made possible by the large infusion of resources from the RTTT award. ESE and the program vendors described multiple possible routes for the program and its impacts to continue beyond the RTTT period. First, both vendors plan to continue offering their Pre-AP training and materials to Massachusetts districts that identify internal or external resources to pay for those services, and some districts have already taken this step. Second, some districts have incorporated specific LTF activities into their curricula. Third, some districts have implemented train-the-trainer models that enable trained teachers within the district to disseminate Pre-AP strategies at lower cost than if provided by an external vendor. Fourth, ESE and the vendors believe that exposure to the Pre-AP program has shifted some teachers' pedagogical approaches in ways that will continue beyond RTTT. Nonetheless, all informants have emphasized that sustainability will be challenging in some districts, due to insufficient resources to support additional training as well as the effort required to shift toward Pre-AP pedagogical approaches.

Based on the evaluation findings, strategic considerations are presented for districts that are continuing to pursue the implementation of Pre-AP programs. Proposed strategies include developing materials for differentiation of Pre-AP lessons, aligning district pacing guides with expectations for Pre-AP implementation, reducing training costs, budgeting for additional equipment, providing additional planning time, and assigning the lead teacher role to a district-level curriculum specialist rather than a classroom teacher.

STEM-focused Early College High Schools

In its RTTT proposal, ESE proposed to open six STEM early college high schools (ECHS) to reduce achievement gaps, provide an accelerated pathway to postsecondary education for underrepresented students, and prepare students for productive STEM careers by partnering with colleges and providing opportunities to earn up to two years of college credit while still in high school.

Six districts were chosen in a competitive process and received RTTT Goal 4E funds for this purpose. The six chosen districts each received $120,000 of RTTT funds to be spent over four years for school

planning, start-up expenses, and full implementation. Eight additional STEM ECHS sites received support from discretionary RTTT funds. At ESE's request, UMDI's evaluation efforts focused on the six sites that received Goal 4E funds.

Two schools opened in fall 2011, one opened in summer 2012, two opened in fall 2012, and one opened in fall 2013. The number of student participants was 231 in school year 2012, 557 in school year 2013 (with one site not providing data), and 597 in school year 2014 (with two sites not providing data). Students attempted 462 college courses and earned credit in 420 courses (91 percent). Nineteen different courses were offered, and almost all courses offered three credits.

One goal of the STEM ECHS initiative was to provide an accelerated pathway to postsecondary education for underrepresented students. In service of this goal, three of the STEM ECHSs prioritized the recruitment, selection, and/or enrollment of underrepresented students at some point during the grant period. By school year 2014, each of the STEM ECHS sites had adjusted their selection criteria so that all applicants were accepted, thereby eliminating selection priorities for any student subgroups.

Interviewees reported the following main successes:

- All six STEM ECHS sites were operational.
- Students were engaging with STEM content and were confident in their abilities.
- Students at five sites participated in one or more college courses.
- School and district leaders provided strong support.
- Partnerships between districts and institutions of higher education (IHEs) became increasingly productive over time.
- Some sites strengthened connections with feeder middle schools.
- One site was viewed as a standout success.
- ESE reported increased levels of communication and collaboration among various early college high school stakeholders from across Massachusetts.

Interviewees also reported several challenges. Sites reported logistical challenges that included transportation, staffing, assessment, course scheduling and location, and accommodating different numbers of students across cohorts. During school year 2014, five of six STEM ECHS sites experienced one or more significant transitions in district, school, program, and/or IHE partner leadership. Three districts reported difficulty maintaining the continuity of their planning team, which disrupted work that was in progress.

Surveys of STEM ECHS personnel found that:

- A majority of respondents believed that their district had a plan for and was committed to developing and supporting the STEM ECHS.
- Most respondents believed that their STEM ECHS would contribute to a reduction in achievement gaps between high- and low-performing students in their school/district.
- A majority of respondents believed that their district would not have sufficient funds to support their STEM ECHS after the RTTT funding period was over.
- Most respondents believed that students in their district had a strong interest in participating in STEM ECHS activities.

Three of the six sites indicated that STEM ECHS activities would cease after the STEM ECHS funding period if continued support was not obtained. One site had secured additional funding, and had plans to systematically extend the STEM ECHS initiative for several years. A second site indicated a continued interest in developing their STEM ECHS curriculum and expanding the student population being served, with the continued support of their district. A third site indicated that some STEM ECHS activities would continue, but at pre-STEM ECHS grant levels of intensity.

ESE anticipated that most sites would continue some form of STEM ECHS programming in the short term. ESE had no funds available to continue supporting these sites but expected that their relationships with the sites would continue. The sites would likely become "legacy programs" that receive occasional technical assistance from the state.

Feedback from grantees about collaboration with ESE was consistently positive. All districts reported that ESE had consistently provided effective, professional, and timely assistance. Districts noted that ESE personnel were aware of, and sensitive to, the contexts in which the districts were working.

Technical assistance to STEM ECHS sites decreased during school year 2014. ESE and JFF agreed that the focus of JFF's technical assistance during school year 2014 would shift from providing "on-the-ground support" to supporting districts' efforts to explore, develop, and implement plans for sustainability. To facilitate this shift, the JFF consultant who had served as the primary technical assistance contact for districts was replaced by a new consultant who worked with sites to explore options for sustainability.

ESE said that JFF was a valued partner. ESE did not believe that the technical assistance provided by JFF was sustainable financially over the long term, and that in retrospect it may have been appropriate to combine JFF's policy expertise with a second technical assistance vendor to provide support with program implementation.

Based on the evaluation findings, the following strategic considerations may help ESE and districts continue to advance their goal of developing and supporting successful STEM early college high schools. Each strategic consideration is explained in greater detail in the full report.

- Establishing and sustaining early college models would benefit from improved articulation and funding agreements between high schools and institutions of higher education.
- ESE could build on the successes of the STEM ECHS initiative by continuing their efforts to connect STEM ECHSs with other early college initiatives across Massachusetts.
- Identifying, communicating, and establishing accountability for project milestones could provide ESE with more leverage when making important funding decisions.
- Clarifying benchmarks for recruiting and selecting students from underserved populations could support efforts to develop accelerated pathways to postsecondary education for these students.

MassCore Policy and Implementation

The Massachusetts High School Program of Studies (MassCore) recommends a set of courses and other learning opportunities that Massachusetts students should complete before graduating from high school, in order to arrive at college or the workplace well-prepared and without the need for remedial coursework. The 155 districts that selected the RTTT college and career readiness goal committed to

implementing strategies to increase the percentage of their students who complete the MassCore curriculum.

The state's RTTT goal was to increase the statewide MassCore completion rate from its baseline of 70 percent of school year 2010 graduates to 85 percent of school year 2014 graduates. The state created a goal for each district, using a formula based on the district's reported 2010 MassCore completion rate, the district's number of 2010 graduates, and the total number of graduates statewide needed to reach 85 percent completion. Each district was also expected to determine areas in which courses or supports needed to be expanded in order to meet the 2014 targets, and to create and implement a plan to improve the accuracy of their reporting of MassCore completion levels.

The evaluation raised questions about the validity of the MassCore completion indicator in ESE's Student Identification Management System (SIMS), based on patterns of MassCore completion rates which suggest that some districts have reported inaccurately. Nonetheless, the SIMS indicator is the best available measure of MassCore completion, and rates of MassCore completion are central to the evaluation. In light of this dilemma, findings based on the indicator are presented, while recognizing that they probably contain inaccuracies.

The statewide MassCore completion percentage increased from 69.8 percent for school year 2010 graduates (the year before RTTT began) to 72.4 percent for school year 2014 graduates. The school year 2014 rate of 72.4 percent is an increase of 2.6 percentage points during the grant period; the RTTT goal was for an increase of 15.2 percentage points, to 85.0 percent.

To understand how district reporting practices might influence the observed changes in statewide MassCore completion rates, UMDI examined MassCore completion rates and trends for each district over a six-year period (school years 2009–2014). These data suggest that some districts have adjusted their MassCore reporting practices over time, and that these changes could be obscuring actual increases or decreases in the state's overall MassCore completion rate. Several groupings of districts are identified that could serve as models or that may require technical assistance to increase MassCore completion rates.

ESE's intention was for MassCore to shift from a recommended curriculum to a de facto curriculum for the state during the first year of RTTT. However, the Massachusetts Board of Elementary and Secondary Education voted against this change. As a result, although many districts believe that increasing MassCore completion is a worthy and realistic goal, they have no clear accountability to the state for achieving progress and may therefore be prioritizing other initiatives that have greater accountability or a higher profile.

Districts that received RTTT college and career readiness funding described ongoing and planned strategies for improving MassCore completion rates. The strategies included focusing on aligning the district's graduation requirements with MassCore requirements, adjusting K–12 curriculum scope and sequence, modifying or developing new courses, providing professional development to raise awareness of MassCore requirements, and monitoring and reviewing students' progress toward MassCore completion. Additional strategies included changing schedules, policies, personnel, and facilities, as well as collaborating with external vendors.

Districts also reported many challenges to increasing rates of MassCore completion. The most common curricular challenge was the required fourth year of mathematics, but lab sciences, physical education, world languages, and fine arts were also mentioned. Additional challenges included course scheduling, availability of curricular materials and lab equipment, inadequate funds and staffing in some curricular

areas, student academic readiness and special needs, misalignment of MassCore requirements with district graduation requirements, and the fact that MassCore is not a required curriculum. One district reported that 15 percent of students are exempted from meeting certain MassCore requirements, due to medical, ELL, or special education issues, thereby capping the district's MassCore completion rate at 85 percent. Another district reported that students who transfer into the district as seniors from districts that don't require MassCore are seldom able to graduate in June. Districts also reported challenges in knowing how to calculate completion status for some students.

ESE reported that their greatest challenge in increasing MassCore completion was that it did not become a statewide graduation requirement. ESE reported that in order to promote greater MassCore completion, they have therefore needed to utilize strategies that are more labor-intensive and apparently less effective in achieving higher completion rates. Nonetheless, they reported that many districts have adopted all or part of MassCore as a graduation requirement during the RTTT funding period. ESE anticipates that MassCore completion rates will increase in upcoming years as the students affected by these changes reach graduation.

Based on the evaluation findings, strategic considerations are presented that may help ESE and districts continue to advance their goal of increasing MassCore completion rates. Each strategic consideration is elaborated within the main report.

- Most districts appear to see substantial value in raising MassCore completion rates, but limited accountability for doing so may subordinate MassCore among district priorities.
- Improved accuracy of MassCore reporting should be attainable through low-demand actions and interventions.
- ESE could leverage its limited MassCore advocacy and support resources by providing additional online materials that share lessons learned from successful districts and by establishing an official MassCore contact in each district.
- Accuracy of the MassCore indicator would be increased by enabling districts to report alternative ways that students have fulfilled MassCore requirements.
- Clarifying the relationship between physical education requirements and MassCore completion could improve reporting accuracy.
- Establishing processes for selected MassCore exemptions and for permitting certain extended and out-of-school learning opportunities to meet MassCore requirements may reduce some districts' concerns about conflicting mandates and priorities.
- Adding one or more codes to the SIMS MassCore element could enable tracking of valid exemptions from MassCore completion.
- Current tracking of school and district progress toward MassCore adoption could be improved, while reducing burden on ESE, via a very brief annual survey of Massachusetts high schools.

Introduction

The Massachusetts Department of Elementary and Secondary Education (ESE) was awarded a federal Race to the Top (RTTT) grant for the years 2010–2014. The college and career readiness components of the grant were designed to help students develop "knowledge and skills necessary for success in postsecondary education and economically viable career pathways." The RTTT initiatives were intended to provide students with opportunities to participate in quality, upper-level high school coursework and new approaches to assist them with high school completion and transition to higher education and the workforce. These programs were part of a broader effort, as specified in the Delivery Plan of ESE's College and Career Readiness group, to increase the Massachusetts 5-year high school graduation rate from 84.7 percent in 2010 to 88.3 percent in 2014, and to increase the number of graduates who complete the MassCore program of study statewide from 68.9 percent in 2010 to 85.0 percent in 2014.

The UMass Donahue Institute conducted an evaluation of three of the college and career readiness components of the Massachusetts RTTT efforts—the Pre-AP Teacher Training program, the STEM-focused Early College High Schools (ECHS), and the MassCore Policy and Implementation initiative. For each of these three programs, this report provides final evaluation findings for the 2010–14 grant period. This report also references the following annual reports from the evaluation, which provide substantial additional detail about evaluation methods and findings:

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Two ESE Delivery Plan goals regarding graduation rates and MassCore completion are described above. The goal for the Massachusetts 5-year high school graduation rate was to reach 88.3 percent by 2014. The most recent available 5-year graduate rate is 87.7 percent for 2013, which reflects an increase of 3.0 percentage points since 2010. The 5-year rate for 2014 is not available yet, but if the trend since 2010 continues, the Commonwealth would achieve the goal of 88.3 percent. The MassCore completion goal was 85.0 percent statewide by 2014. As described in greater detail in the MassCore section below, the 2014 rate of 72.4 percent fell short of this goal, and limitations of the relevant indicator call into question the accuracy of MassCore completion rate calculations more generally.

Evaluation Questions

Evaluation of the RTTT college and career readiness programs encompasses data collection and analysis to facilitate both process and outcome evaluations. The programs are being evaluated both individually and collectively, and the project-wide evaluation questions listed below are tailored to both the individual and collective evaluations. As can be seen in the three annual reports, the evaluation questions were refined over time in response to ESE's preferences and emerging information about the three program being evaluated.

Process evaluation

1. In what ways have grantees implemented the program components? What are the major challenges to and facilitators of successful program implementation encountered by grantees? What midcourse corrections and attempts to overcome challenges have been undertaken? What additional steps are planned?

2. In what ways has ESE implemented the program components described in their grant application? What are the major challenges to and facilitators of program support and facilitation encountered by ESE? How have challenges been overcome and midcourse corrections undertaken? What additional steps are planned?
3. How do key project stakeholders rate and explain the quality, relevance, and effectiveness of major program components and services?
4. What infrastructure, systems, and processes were put in place to aid program sustainability during and beyond the grant period? What are the greatest challenges and barriers to creating sustainability?

Outcome evaluation

1. What progress is being made toward the two top-priority goals of ESE's College and Career (CCR) Delivery Plan – increasing the 5-year high school graduation rate to 88.3 percent, and increasing the number of graduates who complete the MassCore program of study to 85.0 percent?
2. To what extent are students in RTTT-funded programs achieving improved outcomes in college and career readiness indicators including graduation, measures of academic achievement (e.g., MCAS, SAT, and AP), participation and success in AP courses and exams, accumulation of high school and college credits, and MassCore completion?
3. At the school and district levels, do observed changes differ across student characteristics such as gender, race/ethnicity, low income status, ELL status, and special education status? Is there evidence that gaps are narrowing? Are program services reaching students who are at the greatest risk?
4. To what extent are observed changes in student outcomes attributable to program activities (including combinations of program activities) versus contextual variables or non-RTTT interventions?
5. What differences in program features, implementation, and contextual variables can be identified across programs whose levels of improvement differ substantially?
6. What is the relationship between level of program implementation and achievement of targeted student outcomes?

Pre-AP Teacher Training

Introduction

The aims of the Pre-AP Teacher Training program were to increase the number of low income and minority students prepared to participate and succeed in Advanced Placement courses and credit-bearing college-level coursework in English language arts, mathematics, and science; to provide teachers in grades 6–12 with high-quality professional development to assist them in developing curricula, instruction, and assessments that prepare students for AP coursework; and to provide an opportunity for teachers to collaborate in horizontal and vertical teams and to network with other teachers in their region for the purpose of improving curriculum and instruction.

"Project 4D" districts were those that paid for their Pre-AP training and support using funds from RTTT Project 4D and who agreed to send the same teachers for four-day trainings in three consecutive summers, to create vertical teams of teachers that would implement the Pre-AP program, to hold quarterly "vertical team meetings" of these teachers, and to have "lead teachers" who would organize and run the vertical team meetings and attend an additional training day for lead teachers. Other districts used RTTT Goal 4A or non-RTTT funds to enroll teachers in the Pre-AP program, but those districts were not required to commit to vertical teaming and sending teams for multiple years of training. Districts selected one or more of the Pre-AP disciplines (i.e., English language arts, mathematics, and science) in which to participate in teacher training.

"Cohort 1" districts are those that completed their first year of Pre-AP training during the summer of 2011, and "Cohort 2" districts are those that completed their first year of training during the 2011–12 school year or the summer of 2012. Districts that began their training later than summer 2012 were not part of the program cohorts utilized for analyses of program impacts, but descriptive statistics are provided regarding their participation in Pre-AP training.

The state's RTTT scope of work indicates that the performance goal for Pre-AP was 1,000 teachers trained at the end of the 2011–12, 2012–13, and 2013–14 school years. ESE clarified that this referred to the total number of "teacher years" of training—for example, the goal of 1,000 teacher years could be met by 200 teachers who each attended for three summers, plus 400 teachers who attended for one summer. ESE also specified that all trained teachers counted toward this total, regardless of Project 4D status.

Methods

Data Collection Activities

The table below summarizes the primary data collection activities for the Pre-AP evaluation. The three annual evaluation reports describe these activities in detail and provide the data collection protocols.

Pre-AP Data Collection Activities by Program Year			
Data Collection Activity	**SY2011–12**	**SY2012–13**	**SY2013–14**
Interviews – Teachers	✓	✓	✓
Interviews – Administrators	✓	✓	✓
Interviews – Vendor(s)	✓	✓	✓
Interviews – ESE	✓	✓	✓
Survey – Teachers	✓	✓	✓
Survey – Administrators	✓	✓	
Observations – Classroom		✓	✓
Observations – Vertical Team Meetings	✓	✓	✓
Observations – Pre-AP Training Sessions	✓		✓
Database – Training Attendance	✓	✓	✓
Database – Vertical Team Meeting Attendance	✓	✓	✓
Review – Vendor Materials & Website	✓	✓	✓
Review – ESE Documents & Databases	✓	✓	✓

Implementation Intensity

ESE's designation of each district's Project 4D status was used for all analyses regarding the 4D districts. This includes 42 districts, 40 using RTTT Project 4D funds and two using district funds to pay for their Pre-AP training and support. At ESE's request, teachers were considered to have "completed" a year of training if they had completed at least three of the four days of a given year's training.

Not all districts that ESE designated as Project 4D followed the program configuration that ESE had prescribed for 4D districts, so Project 4D status has limitations as an indicator of implementation intensity. Consequently, UMDI developed district-level indicators of implementation intensity based on the following three dimensions in each of the three Pre-AP academic disciplines:

- The number of teachers who completed one or more years of training.
- The total number of completed training years across all teachers in the district.[1]
- The number of teachers who were trained during the district's first year of Pre-AP participation.

Six implementation indicators were then created for each of the Pre-AP academic disciplines by dividing these three dimensions by (a) the total number of grade 6–12 students in the district, and (b) the total number of teachers in the district in each Pre-AP academic discipline. For example, one indicator of implementation intensity was the number of science teachers who completed one or more years of training divided by the total number of grade 6–12 students in the district. The three dimensions, two denominators, and three academic disciplines yielded 18 indicators of implementation intensity.

[1] Training completed in summer 2014 was not counted, because it occurred after the data for our outcome indicators were collected, and therefore could not have influenced outcomes.

Impacts on MCAS Performance

Pre-AP is a district-level intervention, so analyses to assess the program's impact on academic outcomes were conducted at the district level, comparing Pre-AP districts to similar districts that did not participate in the program. Performance on the grade 10 MCAS exam was used as the outcome indicator for these analyses because it (a) assesses student performance on content that is substantially represented in the Laying the Foundation (LTF) curriculum materials of the Pre-AP program, and (b) was completed by most 10th graders in all program and comparison districts.

Differences in treatment and comparison districts were assessed using a comparative interrupted time series (CITS) design. In this design, MCAS performance is observed across multiple school years before and after the introduction of the Pre-AP program. The Pre-AP program is intended to "interrupt" the level of MCAS performance and/or the trend (i.e., the change over time) in MCAS performance that would have been observed in the absence of the intervention. Using both Pre-AP districts and comparison districts is what makes the interrupted time series "comparative," and this enables stronger inferences about what MCAS levels and trends would have been observed in the absence of the Pre-AP program.

The Pre-AP program did not utilize random assignment, because each district decided for itself whether or not to participate. Therefore, it is likely that there were pre-intervention differences between Pre-AP and comparison districts. These differences could have represented a significant threat to the validity of the study's findings. To reduce these differences substantially, propensity score weighting procedures were used, thereby improving the validity of the estimates of program impacts.

In essence, propensity score weighting is used to approximate the results of random assignment by reducing multiple covariates (e.g., race, gender, and MCAS performance prior to the Pre-AP program) to a single score called a propensity score. A propensity score was calculated for each Pre-AP and comparison district that described the likelihood of that district participating in the Pre-AP program. Weighting procedures were then applied to balance propensity scores for Pre-AP and comparison districts. Propensity scores were calculated that generated estimates of the average treatment effect for the treated (ATT) population. This approach is typical for quasi-experimental studies that try to assess the impact of a particular program such as the Pre-AP program.

Covariates used in the propensity score weighting procedure included pre-intervention MCAS scores from school years 2008–2011, average class size, gender, race/ethnicity, low income status, English language learner (ELL) status, and special education status. Once weights were assigned, the balance of the covariate distributions between Pre-AP and comparison districts was assessed in terms of standardized bias. For this study, we considered a covariate to be balanced if the standardized bias was less than 0.25. Although there is no universal criterion for assessing precisely when balance has been achieved, 0.25 is commonly used.[2]

For each of the three Pre-AP academic disciplines, assessment of impacts on MCAS scores fell into the four categories below, corresponding to the study's outcome evaluation questions. In total, 75 CITS models were analyzed, 25 for each of the three academic disciplines.

1. <u>All students</u> – Impacts on all students in all Pre-AP districts. (Three academic disciplines yielded three CITS models.)

[2] Rubin DB. Using propensity scores to help design observational studies: Application to the tobacco litigation. Health Services & Outcomes Research Methodology. 2001;2:169–188.

2. Subgroups – Impacts on subgroups of students in all Pre-AP districts. Subgroups assessed were female, male, low income, ELL, students with disabilities (SWD), Asian, African American/Black, Hispanic/Latino, White, and a group that combined American Indian/Alaska Native, Native Hawaiian/Pacific Islander, and Multi-Race non-Hispanic students. (Ten subgroups and 3 academic disciplines yielded 30 CITS models.)
3. Achievement Gaps – Impacts on MCAS achievement gaps between subgroups of students in all Pre-AP districts. The gaps are defined as the difference between the average score of a reference group (i.e., a subgroup of students that typically scores higher than students in a comparison group on the MCAS) and the average score of a comparison group. The reference groups, followed by their comparison groups in parentheses, were: female (male), White (Asian, African American/Black, Hispanic/Latino, and combined American Indian/Alaska Native, Native Hawaiian/Pacific Islander, and Multi-Race non-Hispanic), non-SWDs (SWDs), non-ELL (ELL), and non-low income (low income) (Eight comparison groups and 3 academic disciplines yielded 24 CITS models.)
4. Implementation Intensity – Impacts on all students in subgroups of Pre-AP districts selected based on indicators of implementation intensity. The relevant indicators are described in the section entitled "implementation intensity" above. (Six measures of implementation intensity and 3 academic disciplines yielded 18 CITS models.) For each intensity measure, the five districts with the highest level of training density were identified, and the average MCAS achievement of those districts was compared to the average MCAS achievement of districts that that did not participate in Pre-AP training. In cases where partial balance (as explained below) could not be achieved with a sample of 5 districts, the treatment sample was expanded to 10 districts. All samples constructed achieved at least partial balance with a sample size of 10.

The time intervals for assessing impacts were based on the number of years between a given administration of the MCAS exam and when a district began its Pre-AP program (i.e., commenced teacher training). Cohort 1 districts began their Pre-AP training in summer 2011, and the impacts after one, two, and three years correspond to the spring 2012, 2013, and 2014 MCAS administrations respectively. Cohort 2 districts began training in summer 2012, and the impacts after one and two years correspond to the spring 2013 and 2014 MCAS administrations. Because MCAS data were only available through spring 2014, the effects of participating in Pre-AP training three years after initiation are estimated only for Cohort 1 districts.

Two CITS modeling procedures were developed to assess the impact of the Pre-AP program on districts' average MCAS performance. Procedure 1 assesses differences in MCAS scores one year after the program began and also assesses differences in the trend or slope of MCAS scores during the three-year period after the program began. Procedure 2 assesses differences in MCAS scores at three discrete points in time—one, two, and three years after the program began. Procedure 1 was used for all of the CITS analyses. Procedure 2 was tried as well, but the model did not converge in the majority of cases, suggesting that the data were better suited to analysis under Procedure 1. (Lack of convergence is an indication that the model does not fit the data well, because there are too many poorly fitting observations.) These procedures were applied to Cohort 1 and 2 districts, because they have participated for long enough to have multiple years of post-intervention MCAS data. The two modeling procedures are described in more detail in Appendix A.

To assess each CITS panel's potential for producing findings with a high likelihood of validity, the balance of covariates after weighting was considered. When propensity score weighting was completely successful, it yielded a comparison group that met the balance criteria (i.e., standardized bias less than 0.25) for all covariates. Models that achieved this criterion were designated as "fully balanced." Models

that could not be fully balanced were assessed to see if they met the balance criteria for the four baseline MCAS years. Models that achieved this criterion were designated as "partially balanced."[3] For models that did not achieve full balance or partial balance, findings are not reported, due to the lack of an adequately matched comparison group.

Even if individual covariates met the criteria just described for full balance or partial balance, the CITS analysis may determine that the four baseline years of MCAS data, when considered together, differed in terms of their initial level or their four-year baseline trend (corresponding to the β4 and β5 coefficients in Procedure 1; see Appendix A). While such differences raise some concerns about the ability to draw causal inferences about the relationship between the Pre-AP program and MCAS scores, the full or partial balance achieved via the propensity score weighting provides evidence of substantial similarity between the Pre-AP and comparison districts.

Each CITS model's performance in relation to these two criteria is noted in the technical supplement to this report, which is presented as an Excel workbook. Moreover, the table in the findings section below that summarizes significant program impacts indicates which models were only partially balanced and/or had significant differences in their initial MCAS level or four-year MCAS trend.

AP Course and Exam Participation and Success

Two of the evaluation questions for the Pre-AP program are:

1. What percentage of "high needs" students are currently enrolled in AP courses statewide and in each district, by content area?
2. What percentage of "high needs" students currently score a 3 or better on an AP exam statewide and in each district, by content area?

The state datasets used to answer the first question were the Student Course Schedule (SCS) and the Student Information Management System (SIMS). The number of unique ELA, mathematics, and science AP course sections offered in each district was identified based on a combination of the SCS course location, course code, and section number. Sections offered at colleges or online were excluded from section counts, but students who completed an AP course online or through a college were included in participant counts. For the second question, the AP, SCS, and SIMS datasets were used. Only students who had completed an ELA, mathematics, or science AP exam were selected. Using ESE's definition, "high needs" students were defined as those who in the current year receive free or reduced-price lunch, have disabilities, or are ELLs, or who in the two years prior to the current year were ELLs.

[3] In most cases, partially balanced models reflected a difference that was statistically significant but small enough (e.g., 49 percent male vs. 51 percent female) to be arguably not meaningful. The technical supplement shows the exact values for each model.

Findings

Program Implementation

Teachers trained. In total, 3,170 teacher years of training were completed—1,310 in ELA, 1,245 in mathematics, and 615 in science. While a small percentage of these (still to be determined, at ESE's discretion) were supported by non-RTTT funds, the total number supported by RTTT funds far exceeds ESE's goal of at least 1,000 teacher years of training.

Teachers who had the opportunity to complete all three years of Pre-AP training were those who began their training by the end of December 2012. For those teachers, the table below shows the number and percentage in each academic discipline that completed one, two, or three years of training. Depending on the discipline, 42–49 percent of teachers completed one year of training, 27–40 percent completed two years of training, and 11–31 percent completed three years of training. In addition to the 2,200 teacher years of training shown in the table, an additional 970 teacher years were completed by teachers who began their training after December 2012.

Years of Pre-AP Training Completed by Teachers Who Began Training by December 2012

	ELA		Mathematics		Science		Total	
Years Trained	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
1	231	45	191	42	124	49	546	45
2	156	30	124	27	103	40	383	31
3	128	25	140	31	28	11	296	24
Total Number of Teachers Trained	**515**	**100**	**455**	**100**	**255**	**100**	**1,225**	**100**
Total Teacher Years of Training	**927**	**–**	**859**	**–**	**414**	**–**	**2,200**	**–**

These findings represent 75 cohort 1 and cohort 2 districts: 49 for ELA, 59 for mathematics, and 56 for science. Some districts trained teachers in multiple disciplines. Additional districts begin their Pre-AP training in summer 2013 (N=5) and summer 2014 (N=16), although they were not part of the primary RTTT Pre-AP intervention, and some did not use RTTT funds to procure Pre-AP training services.

ESE's RTTT proposal indicated that the state would provide Pre-AP training to teachers in up to 65 schools in low-income communities. ESE defined these schools as those in the lowest income quartile based on the percentage of students receiving free and reduced-price lunch. This goal had been fulfilled by the end of the second summer of Pre-AP training, at which time teachers from 96 schools in the lowest income quartile had completed at least one year of training.

The implementation intensity indicators described in the methods section also provide information about the extent of teacher training. One of the indicators provided the percentage of teachers in a given Pre-AP academic discipline in each district who had completed one or more years of Pre-AP training in that discipline. For Project 4D districts, the average value of this indicator was 44 percent for ELA, 45 percent for mathematics, and 27 percent for science. (As would be expected, average values were much lower in districts that were Pre-AP but not 4D—12 percent for ELA, 16 percent for mathematics, and 14 percent

for science.) These values are slight overestimates for most districts, because the numerator includes all teachers trained in a given academic discipline during the entire four-year grant period, while the denominator is the district's number of teachers in that discipline in just school year 2012. These findings indicate that, on average, Project 4D districts that trained any teachers in a given discipline trained less than half in ELA and mathematics, and about a quarter in science.

Vertical teaming. Each 4D district was expected to create discipline-specific vertical teams of Pre-AP trained and other teachers, led by a Pre-AP trained lead teacher that would meet quarterly to share and deepen their Pre-AP practices. The number of vertical team meetings held is one indicator of a district's level of Pre-AP implementation. During each of the three program years, about three quarters of districts submitted vertical team meeting attendance logs. Depending on the year, about 50–70 percent of these districts reported holding four meetings, 20–40 percent reported holding three meetings, and 10 percent reported holding two meetings. Because a substantial percentage of districts did not submit any vertical team meeting logs, data from the logs were not used as quantitative indicators in state-wide analyses of the level of Pre-AP program implementation.

Implementation of Pre-AP lessons and assessments. Teacher survey respondents reported having conducted an average of 6 LTF lessons by the time the annual surveys were administered in April, and that 2–3 hours of class time were typically required to implement each LTF lesson. Interviewed teachers reported having conducted from 4–20 LTF lessons per year. Multiple interviewees emphasized that their district is utilizing Pre-AP strategies extensively, even in activities that are not LTF lessons. Teachers reported utilizing LTF assessments much less often than LTF lessons, and none of the teachers interviewed had used an LTF assessment in its entirety. Teachers reported that they have changed their teaching practices substantially as a result of the Pre-AP training, particularly by taking a more student-centered approach—such as doing less lecturing, promoting a more hands-on and investigative approach, and having students work together. All teachers interviewed reported that they implement LTF strategies with students at all course levels, not just in honors-level courses, although some teachers reported conducting more LTF lessons with their higher-level classes.

During classroom lessons, UMDI observed that teachers incorporated many elements of LTF's pedagogical approach, although they did so to varying degrees, and some lessons seemed more conducive to LTF's approach than others. For example, more active inquiry and student collaboration was evident in one physics lab, where students were engaged in a hands-on activity, than in an observed mathematics class, where students were focused on a more independent worksheet-based task.

Most administrators indicated that they had not established a specific number or duration of Pre-AP activities that teachers were expected to conduct in a given marking period or school year. Nonetheless, numerous structures were put in place for promoting program implementation. These included asking teachers to identify lessons they plan to implement and share them at vertical team meetings, asking teachers to specify their plans for Pre-AP implementation in their annual teacher evaluation goals, and creating forums (e.g., vertical team meetings, curriculum meetings, or common planning periods) for teachers to discuss LTF activities they had conducted and share student products from those activities.

Additional administrative structures for promoting implementation included:

- Adding specific LTF lessons to district curriculum maps, although not necessarily requiring teachers to implement these activities.
- Developing a spreadsheet and Moodle site that enabled teachers to quickly identify LTF activities that corresponded to specific Common Core State Standards.

- Having a lead teacher conduct LTF science labs in individual classrooms in order to make it easier for classroom teachers to become familiar with and adopt new lab activities.
- Creating lists of LTF activities that, depending on the district, teachers are either required or strongly encouraged to implement.
- Incorporating LTF activities into binders that teachers create for their own evaluations.
- Requiring teachers to maintain a log of LTF activities they have conducted, materials they have obtained from the LTF website, and materials they have shared with colleagues; and requiring teachers to submit this log in advance of each vertical team meeting.
- Conducting classroom walkthroughs that include looking for evidence of teachers using LTF activities or strategies and then discussing observations with teachers.

Several teacher survey items asked teachers about the adequacy of their resources and supports, as well as the preparation of their students. With regard to their ability to implement Pre-AP lessons and/or assessments, 66 percent agreed that they had adequate curricular resources, 53 percent that they had adequate classroom equipment and supplies, and 56 percent that they had long enough class periods. Just 33 percent reported that they had adequate planning time and 45 percent that they had sufficient time to share Pre-AP approaches with same-discipline colleagues. Seventy-three percent agreed that they had full administrative support to integrate Pre-AP lessons into their teaching, and 52 percent agreed that they could implement Pre-AP activities and still adhere to the district's pacing guide. Only 33 percent of teachers agreed that their students had sufficient academic preparation to participate in the Pre-AP lessons and/or assessments that are targeted to their grade level.

With regard to program quality, 84 percent of teachers agreed that the LTF curriculum is well aligned with the Common Core standards, 82 percent of teachers agreed that the connections between the LTF curriculum and the Common Core are well specified, and 86 percent of teachers agreed that the LTF lessons and assessments are examples of high-quality pedagogical practices in their content area. With regard to scaffolding, 78 percent of teachers agreed that they needed to create supplemental activities to introduce or otherwise scaffold aspects of LTF lessons, and 57 percent agreed that the discussion of scaffolding during summer training supported their implementation of LTF lessons and assessments. More than half of the teachers (57 percent) agreed that the LTF lessons and assessments provide appropriate supports for differentiation for students across a wide range of skill levels.

The most common challenges to implementing the Pre-AP lessons and assessments that teachers mentioned were student readiness and available time. Challenges with student readiness were related to language barriers, ability to focus, mastery of foundational skills, and behavioral issues. Planning time and class length were also significant challenges to implementing LTF lessons and activities. Lack of resources, particularly technology resources (e.g., LCD projector, document camera, calculators), poor Internet access, and too few computers were challenges for some teachers. Other challenges reported were: adapting lessons was time-consuming and inconvenient; implementing LTF lessons was difficult with a tight curriculum map or a focus on standardized testing; vendor training was ineffective; and teachers did not buy in to the LTF approach sufficiently.

Training and technical assistance. Several teacher survey items addressed perceptions of the quality and availability of program materials and technical assistance. As noted above, with regard to program quality, 86 percent of teachers believed that the LTF lessons and assessments are examples of high-quality pedagogical practices. Moreover, most interviewed teachers and administrators spoke favorably of the summer trainings.

The Pre-AP program encountered a significant challenge late in the 2013 school year, when circumstances arose that prevented Mass Insight Education (MIE), the program vendor until that time, from utilizing the LTF materials and trainings that had been the basis for their Pre-AP work with RTTT districts. ESE subsequently cancelled MIE's contract, because the vendor was no longer able to provide the LTF program, and issued a new request for proposals from prospective vendors. Both MIE and the National Math and Science Initiative (NMSI) submitted proposals, with NMSI proposing to use the LTF materials (which they own), and MIE proposing to design a new program.

Both MIE and NMSI were approved as Pre-AP vendors in March 2014. Districts were given the choice of which vendor to select, or they could select different vendors for different disciplines. During summer 2014, MIE and NMSI trained teachers from 40 and 39 districts, respectively. ESE reported that the timing of the vendor transition appears to have reduced total program participation, and that the program lost momentum in districts that had low internal capacity to support it, which ESE attributed in part to the lack of vendor support during most of the school year.

In emails and an interview with UMDI, ESE program managers expressed substantial dissatisfaction with one of the two vendor's performance in relation to the summer 2014 trainings and the support materials made available to teachers. UMDI is not able to provide systematic feedback relevant to the summer 2014 performance of either vendor, because the trainings occurred after the end of planned data collection activities for the RTTT C&CR evaluation.

Sustainability. The creation of the Pre-AP program was made possible by the large infusion of resources from the RTTT award. ESE and vendors described multiple possible routes for the program and its impacts to continue beyond the RTTT period. First, both MIE and NMSI plan to continue offering their Pre-AP training and materials to Massachusetts districts that identify internal or external resources to pay for those services. ESE and NMSI reported that some districts have already taken this step. Second, some districts have incorporated specific LTF activities into their curricula. Third, some districts have implemented train-the-trainer models that enable trained teachers within the district to disseminate Pre-AP strategies at lower cost than if provided by an external vendor. Fourth, ESE and the vendors believe that exposure to the Pre-AP program has shifted some teachers' pedagogical approaches in ways that will continue beyond RTTT. Nonetheless, all informants have also emphasized that sustainability will likely be challenging in some districts, due to insufficient resources to support additional training as well as the effort required to shift toward Pre-AP pedagogical approaches.

Program Impacts

Teacher impacts. The school year 2014 Teacher Survey reached 1,684 teachers, with a response rate of 40 percent (N=675; 535 4D and 140 non-4D).[4] In the 4D group, 70 percent or more of teachers agreed that, as a result of the Pre-AP training, they teach more Pre-AP content (73 percent), use more Pre-AP pedagogical strategies in the classroom (74 percent), improved their content knowledge in their primary discipline (70 percent), and have greater awareness of the importance of using Pre-AP strategies (81 percent). A smaller but still substantial number agreed that they now use more Pre-AP assessment strategies (54 percent), that they have changed their teaching philosophy to be more consistent with the Pre-AP program (55 percent), and that implementing LTF lessons and assessments represents a substantial change to their teaching practice (53 percent).

[4] Year 4 survey and interview findings are emphasized in the summary Pre-AP report, because these findings reflect input from stakeholders who have had the longest exposure to and participation in the program.

Teacher perceptions of relevance and effectiveness. Teachers were asked about the relevance and effectiveness of the Pre-AP program, and 57 percent of survey respondents agreed that implementing LTF lessons brings greater relevance to their classrooms. Most teachers agreed that the Pre-AP program will be effective in improving students' preparedness for success in AP-level coursework (78 percent) and college coursework (80 percent).

Impacts on MCAS performance. For each of the three Pre-AP academic disciplines, impacts on MCAS scores were assessed in relation to all students, student subgroups, achievement gaps, and implementation intensity. In total, 75 CITS models were analyzed, 25 for each of the three academic disciplines.

Statistically significant program impacts were identified for 6 of these 75 models, as summarized in the table below. The table indicates significance in relation to two aspects of MCAS performance. The "MCAS Change After One Year" column indicates significant MCAS differences between Pre-AP and comparison districts one year after the Pre-AP districts began their teacher training. The "Annual Change in MCAS" column indicates significant differences between Pre-AP and comparison districts in their MCAS trend during the three years after teacher training began. For three of the model groups (all students, subgroups, and implementation intensity), the changes are in points on the MCAS exam. For the fourth model group (achievement gaps), the changes are in the percentage of students scoring proficient or advanced on MCAS, with a positive number indicating an expansion of the gap.

Pre-AP Program Impacts on MCAS Performance, Summary of Significant Findings

Model Group	Model Description		MCAS Change After One Year	Annual Change in MCAS
	Subject	Subgroup or Measure		
All Students	ELA, Math, Science	n/a	n.s.	n.s.
Subgroups	ELA	White*	-2 points	n.s.
Achievement Gaps	ELA	Non-SWD vs. SWD*	7 percent†	n.s.
Implementation Intensity	Math	First Year – Student Density	-3 points	n.s.
	Math	First Year – Teacher Density	-2 points	n.s.
	Math	One or More Years of Training – Teacher Density	-1 point	n.s.
	Science	All Training – Teacher Density	n.s.	-1 point

Notes: n/a = not applicable, n.s. = no significant differences detected.
*After propensity score weighting, Pre-AP and comparison districts were only partially balanced.
† Change in percentage of students scoring proficient of advanced on MCAS. A positive number indicates an increase in the gap.

For example, the table shows that White students in Pre-AP districts scored 2 points lower on the ELA MCAS exam than White students in comparison districts one year after the Pre-AP program began, but on an annual basis their ELA MCAS scores did not change at a different rate than students in comparison

districts. The asterisk for this group indicates that the Pre-AP and comparison districts were only partially balanced after propensity score weighting. The table also shows that no significant differences were found for ELA, mathematics, or science in the "all students" model group (i.e., when considering all students in a given academic discipline in the Pre-AP and comparison districts.)

In all six cases of statistically significant findings, the impacts were in the opposite of the desired direction (i.e., a decrease in MCAS score or an expansion of the achievement gap for the Pre-AP districts). However, it is important to put this finding in context. First, there were no significant differences in 69 of the 75 models. Second, the five significant findings regarding changes in MCAS scores are statistically significant but may be less educationally meaningful, as they were declines of 1–3 points. The significant finding regarding the achievement gap was that after the first year of the Pre-AP program, the gap between SWDs and other students on the ELA MCAS exam improved by 15 points in the comparison group but only 8 points in the treatment group.

The table above summarizes the six models with significant findings. The tables in Appendix B provide findings for all of the models for which propensity score weighting procedures resulted in partial balance or full balance (N=53), as well as for the "all students" mathematics model, which had a standardized bias of 0.26, just outside the 0.25 threshold for partial balance. Results were not reported for the remaining models (N=21), for which treatment and comparison groups could not be at least partially balanced.

This report's technical supplement, which is presented as an Excel workbook, summarizes the results of the propensity score weighting procedures for all 75 models. Results are separated into different worksheets by model type and academic discipline. Levels of standardized bias are presented both before and after propensity score weighting, and standardized bias values which exceeded the 0.25 threshold for inclusion are highlighted.

AP course participation by high needs students. ESE requested findings on the percentage of "high needs" students statewide who are enrolled in AP courses by academic content area. These findings are presented in the table below and for the following six subgroups of potential interest for assessing Pre-AP program impacts:

1. Students from Project 4D Districts
2. Students from Project 4D, Cohort 1 Districts
3. Students from Project 4D, Cohort 2 Districts
4. Students from Project 4D districts that are also participating in MMSI's AP program
5. Students from Project 4D districts that are not participating in MMSI's AP program
6. Students from districts participating in Pre-AP, but not Project 4D

These six groups are not mutually exclusive; for example, groups 2–5 are all subgroups of group 1, and all students from groups 4 and 5 are also either in group 2 or 3. Totals for ELA, mathematics, and science combined are less than the total of each discipline considered separately, because some students took AP courses in multiple disciplines.

Number and Percentage of High Needs Students Taking AP Courses from SY12 through SY14, by Discipline and District Grouping								
AP Course Subject	District Grouping	SY12		SY13		SY14		% Taking Course Increase SY12 to SY14 (%)
		# Taking Course	% Taking Course	# Taking Course	% Taking Course	# Taking Course	% Taking Course	
ELA	Whole State	2,810	2.3	3,648	2.9	4,065	3.1	36
	Project 4D	1,400	3.5	1848	4.5	2,075	5.0	43
	4D, Cohort 1	953	4.0	1,386	5.7	1,413	5.7	43
	4D, Cohort 2	447	2.8	462	2.9	662	4.2	49
	4D & AP	1,262	4.7	1,673	5.9	1,796	6.2	32
	4D, Not AP	138	1.0	175	1.4	279	2.2	112
	Pre-AP, Not 4D	554	2.2	708	2.8	743	2.8	27
Math	Whole State	2,229	1.8	2,693	2.1	2,786	2.1	19
	Project 4D	917	2.3	1,246	3.0	1,294	3.1	35
	4D, Cohort 1	603	2.6	813	3.4	813	3.3	26
	4D, Cohort 2	314	1.9	433	2.7	481	3.0	59
	4D & AP	772	2.9	1,067	3.7	1,105	3.8	31
	4D, Not AP	145	1.1	179	1.4	189	1.5	37
	Pre-AP, Not 4D	402	1.6	489	1.9	490	1.8	15
Science	Whole State	2,061	1.7	2,465	1.9	2,723	2.1	23
	Project 4D	961	2.4	1,177	2.9	1,292	3.1	29
	4D, Cohort 1	693	2.9	803	3.3	819	3.3	14
	4D, Cohort 2	268	1.7	362	2.2	464	2.9	72
	4D & AP	803	3.0	1,008	3.5	1,111	3.8	28
	4D, Not AP	158	1.2	169	1.4	181	1.4	21
	Pre-AP, Not 4D	363	1.5	412	1.6	464	1.7	16
ELA, Math, and Science Combined	Whole State	5,434	4.4	6,631	5.2	7,235	5.6	26
	Project 4D	2,514	6.3	3,207	7.8	3,454	8.3	32
	4D, Cohort 1	1,710	7.3	2,218	9.2	2,261	9.1	25
	4D, Cohort 2	804	5.0	977	6.1	1,184	7.5	49
	4D & AP	2,175	8.1	2,798	9.8	2,963	10.2	26
	4D, Not AP	339	2.6	409	3.3	491	3.9	50
	Pre-AP, Not 4D	1,015	4.1	1,226	4.8	1,299	4.9	19

Some key findings from this table regarding AP course participation include:

- Statewide and for all district subgroups and academic disciplines, the percentage of high needs students taking AP courses increased from school year 2012 to school year 2014, with the increase ranging from 14 percent to 112 percent, with a median of 30 percent. Also statewide and for all subgroups, the number of high needs students taking AP courses increased from school year 2012 to school year 2014.

- At baseline,[5] high needs students were already taking AP courses at a higher rate in Project 4D districts than in the state as a whole—52 percent higher for ELA, 28 percent higher for mathematics, and 41 percent higher for science. Nonetheless, the increase from school year 2012 to school year 2014 was greater for Project 4D districts than for the whole state—43 percent versus 36 percent for ELA, 35 percent versus 19 percent for mathematics, and 29 percent versus 23 percent for science.

The "4D, not AP" column helps illustrate the substantial challenge of identifying the impacts of the Pre-AP and AP programs separately. Depending on the course subject, only 10 percent (ELA) or 16 percent (mathematics and science) of high needs students are Project 4D but not AP. (For example, for ELA this is 138 out of 1,400 students). In other words, 84–90 percent of high needs students in Project 4D Pre-AP districts were also in districts that were implementing the AP program. The small percentage of 4D students who were not from AP program districts offer some insight into the effects of Pre-AP independent of AP, although their low numbers make it difficult to generalize to the state as a whole. Two notable findings regarding this small group are:

- Their initial rates of AP course participation were 60–79 percent lower than for 4D students whose districts were part of the AP program.
- Compared to students from districts who were both 4D and AP, their rates of course participation increased much faster in ELA (112 percent versus 32 percent) and faster in mathematics (37 percent versus 31 percent). Their rates of course participation increased more slowly in science (21 percent versus 28 percent)

AP exam success by high needs students. ESE requested findings on the percentage of "high needs" students statewide who scored a 3 or better on an AP exam by content area. These findings are presented in the table below for the same subgroups relevant to the Pre-AP program featured in the previous section. The first four columns present school year 2014 values for:

1. The number of high needs students taking an AP exam,
2. The percentage of high needs students taking an AP exam,
3. The percentage of high needs exam takers who earned a score of 3 or higher,
4. The percentage of all high needs students who earned an AP exam score of 3 or higher.

The subsequent four columns reflect the percentage change from school year 2012 to school year 2014 in the same indicators that are presented in the first four columns. Totals for ELA, mathematics, and science combined are less than the total of each discipline considered separately, because some students took AP exams in multiple disciplines.

[5] For the purposes of this bullet, school year 2012 is being used as the baseline year. However, it should be noted that school year 2013 was the baseline year for Cohort 2 students, who comprise about one third of the students.

High Needs Students Taking and Passing AP Exams, by Discipline and District Grouping									
AP Course Subject	District Grouping	SY14				% Change from SY12 to SY14			
		# Taking Exam	% Taking Exam	% of Takers Scoring ≥ 3	% of HN Scoring ≥ 3	# Taking Exam	% Taking Exam	% of Takers Scoring ≥ 3	% of HN Scoring ≥ 3
ELA	Whole State	2,569	2.1	41.7	0.9	46	33	-6	0
	Project 4D	1,249	3.1	36.0	1.1	48	42	-7	27
	4D, Cohort 1	872	3.7	35.6	1.3	45	38	-9	23
	4D, Cohort 2	377	2.3	37.1	0.9	54	57	-4	44
	4D & AP	1,123	4.2	34.4	1.4	42	31	-8	21
	4D, Not AP	126	0.9	50.3	0.5	97	22	-13	100
	Pre-AP Not 4D	609	2.5	37.1	0.9	34	20	-6	11
Math	Whole State	1,881	1.5	48.3	0.7	28	20	-3	0
	Project 4D	800	2.0	38.3	0.8	41	35	-7	13
	4D, Cohort 1	531	2.3	38.6	0.9	31	17	-8	11
	4D, Cohort 2	269	1.7	37.5	0.6	56	53	-4	50
	4D & AP	672	2.5	37.1	0.9	44	32	-8	22
	4D, Not AP	128	1.0	44.6	0.4	21	44	3	25
	Pre-AP Not 4D	361	1.5	43.8	0.6	27	13	13	33
Science	Whole State	1,777	1.4	40.8	0.6	35	29	4	0
	Project 4D	862	2.2	37.8	0.8	29	18	1	25
	4D, Cohort 1	626	2.7	37.7	1.0	12	4	9	10
	4D, Cohort 2	236	1.5	38.1	0.6	71	67	-12	33
	4D & AP	720	2.7	37.5	1.0	36	22	2	20
	4D, Not AP	142	1.1	39.3	0.4	-2	0	1	0
	Pre-AP Not 4D	291	1.2	21.6	0.3	43	25	54	67
ELA, Math, and Science	Whole State	4,717	3.8	45.5	1.7	36	29	-2	6
	Project 4D	2,203	5.5	39.3	2.2	38	33	-6	23
	4D, Cohort 1	1,533	6.5	39.3	2.6	30	23	-6	12
	4D, Cohort 2	670	4.2	39.4	1.6	56	55	-6	50
	4D & AP	1,910	7.1	38.4	2.7	38	28	-7	19
	4D, Not AP	293	2.2	45.2	1.0	38	50	1	50
	Pre-AP Not 4D	959	3.9	38.0	1.5	31	21	9	27

Some key findings from this table regarding AP exam participation and performance include:

- Statewide and for all but one subgroup of Pre-AP participants across all three academic disciplines, the number of high needs students taking AP exams increased from school year 2012 to school year 2014. For the three academic disciplines combined, this increase was 36 percent statewide, 38 percent for Project 4D districts, and 31 percent for districts that were Pre-AP but not Project 4D.

- For all but one subgroup of Pre-AP participants across all three academic disciplines, the percentage of high needs students scoring 3 or higher on an AP exam increased. This increase was 23 percent for Project 4D districts and 27 percent for districts that were Pre-AP but not Project 4D. Statewide the improvement was much lower, with no increase for each academic discipline considered separately, and a 6 percent increase across the three disciplines combined.
- Despite the increased participation and performance just reported, the absolute levels of participation and performance may seem low. AP exam participation in one or more academic disciplines by high needs students was 5.5 percent in Project 4D districts and 3.9 percent in districts that were Pre-AP but not 4D. Earning a score of 3 or higher was achieved by 2.2 percent of high needs students in Project 4D districts and 1.5 percent in districts that were Pre-AP but not 4D.

Discussion

The evaluation findings offer a complex picture regarding Pre-AP program implementation and impacts. It's clear that major aspects of the model were implemented, including 3,160 teacher years of training, mostly in 75 cohort 1 and 2 districts, but also including 120 teacher years of training across 21 districts that began in their Pre-AP teacher training in summers 2013 or 2014. During each program year, about three quarters of Project 4D districts submitted evidence of having completed 2–4 vertical team meetings. Annual surveys and interviews indicated that teachers were implementing Pre-AP lessons in their classrooms, which almost all respondents agreed were examples of high-quality pedagogical practices.

The extent of implementation was uneven and lower than originally proposed. The proposed model was for teachers to complete three summers of training, but this was done by only a limited percentage of teachers (25 percent in ELA, 31 percent in mathematics, and 11 percent in science). Most administrators reported that they had not established a specific number or duration of Pre-AP activities that teachers were expected to conduct in a given marking period or school year, and teachers reported having conducted an average of six LTF lessons by April of the 2013–14 school year, when the final teacher surveys were conducted. With regard to their ability to implement Pre-AP lessons and/or assessments, nearly half of teacher survey respondents did not agree that they had adequate curricular resources, classroom equipment and supplies, or long enough class periods, and only one third agreed that they had adequate planning time and that their students had sufficient academic preparation to participate in the Pre-AP lessons and/or assessments targeted to their grade level.

With regard to program impacts, a mixed picture also emerged. Of more than 500 teachers from 4D districts who responded to the school year 2014 teacher survey, 70 percent or more reported that, as a result of the Pre-AP training, they teach more Pre-AP content, use more Pre-AP pedagogical strategies in the classroom, improved their content knowledge in their primary discipline, and have greater awareness of the importance of using Pre-AP strategies. Just over half agreed that they now use more Pre-AP assessment strategies, that they have changed their teaching philosophy to be more consistent with the Pre-AP program, and that implementing LTF lessons and assessments represents a substantial change to their teaching practice.

During the grant period, there were substantial increases in the percentage of high needs students taking AP courses and AP exams. Moreover, the percentage of high needs students earning an AP exam score of 3 or higher increased much faster in Pre-AP districts than statewide. Attributing these changes to the Pre-AP program is difficult, however, because almost all high needs students in Project 4D districts were also in districts that were implementing the state's AP program, which targets the same indicators related to

AP course and exam participation and success. The impacts of these two programs are deeply intertwined and difficult to identify separately.

Finally, the CITS analyses compared Pre-AP to matched comparison districts, attempting to identify Pre-AP program impacts on MCAS performance in each Pre-AP academic discipline for all grade 6–12 students and several student subgroups, for districts with the highest implementation intensity, and in relation to achievement gaps. No differences were identified in 69 out of 75 comparisons, and the 6 statistically significant comparisons favored the comparison districts over the Pre-AP districts, although in 5 of these comparisons the differences may not have been large enough to be educationally meaningful.

While these findings clearly show that the Pre-AP program did not have rapid, positive impacts on 10th-grade MCAS scores, the findings do not demonstrate that the Pre-AP program lacks the potential to have such impacts. Investigating MCAS scores over a longer period might show different outcomes, as the students who were in 6th or 7th grade when their teachers were first trained reach 10th grade, or as the teachers become more experienced with implementing Pre-AP methods. In addition, the program may not have been implemented with sufficient intensity—with regard to percentage of teachers trained district-wide, years of teacher training completed, number of Pre-AP lessons taught, and/or the level of support for districts that was provided during the vendor transition—to achieve larger impacts on MCAS scores.

One factor potentially limiting the Pre-AP program's impact in relation to comparison districts is the Commonwealth's adoption of the Common Core State Standards in 2010, statewide professional development sessions on the new standards during school year 2011, and an expectation that all districts would align their curricula to the standards by the start of school year 2013. This change fully overlapped with the Pre-AP program period, which may have led non-Pre-AP districts to begin working with more rigorous curricula at the same time that Pre-AP districts began using the LTF curriculum.

Clearly, a substantial proportion of teachers believed that their participation in the Pre-AP program significantly benefited their teaching and will be effective in improving students' preparedness for success in AP-level coursework and college coursework. However, many teachers felt that they were already engaged in the types of practices embodied in the LTF lessons and assessments. One implication for future Pre-AP program work would be to identify and focus training and support on those teachers whose practice would be most influenced by program participation.

Strategic Considerations

The strategies below may be effective for districts that are continuing to pursue the implementation of Pre-AP programs. They are a subset of those included in the three annual evaluation reports.

- **Developing materials for differentiation of LTF lessons.** Several teachers noted that the time needed to modify LTF lessons for differentiation was an obstacle to implementation. A program vendor could also be asked to supply such materials.
- **Aligning pacing guides with expectations for Pre-AP implementation.** In the MassGrad study, three out of four teachers agreed that they had full administrative support to integrate Pre-AP lessons into their teaching, but only about half agreed that they could implement Pre-AP activities and still adhere to the district's pacing guide. For the substantial number of teachers who apparently perceive a conflict between their administrator's support and the dictates of their district's pacing guide, maximizing Pre-AP implementation may require (a) changes to the pacing guide, or (b) explicit administrative messages regarding what aspects of the pacing guide teachers should disregard in favor of implementing Pre-AP lessons.

- **Reducing training costs.** Limited professional development funds make it unlikely that districts will pay for the full three summers of training proposed in the RTTT Pre-AP model, and indeed only 24 percent of teachers did complete that level of training. Some districts utilized Pre-AP trained teachers to offer informal sharing and formal professional development of other teachers. Other districts proposed various configurations of securing briefer and less expensive trainings provided by one of the program vendors.
- **Budgeting for additional equipment.** Pre-AP mathematics and science activities require expensive equipment that some schools lack, particularly at the middle school level. Teachers may also require substantial professional development and/or preparation time to be ready to use this equipment with students, and schools may need guidance about which equipment to purchase.
- **Providing additional planning time.** Just one third of Pre-AP teachers reported that they had adequate planning time to prepare Pre-AP lessons and/or assessments.
- **Assigning the lead teacher role to a district-level curriculum specialist rather than a classroom teacher.** Some larger Project 4D districts utilized this model. It permitted the lead teacher to share knowledge and resources more readily across schools, to delve more deeply into program materials, to support teacher implementation by modeling specific lessons and technology tools in classrooms, and by taking on other program implementation tasks for which classroom teachers lacked adequate schedule flexibility and time.

STEM-focused Early College High Schools

Introduction

In its RTTT proposal, ESE proposed to open six STEM early college high schools to reduce achievement gaps, provide an accelerated pathway to postsecondary education for underrepresented students, and prepare students for productive STEM careers by partnering with institutions of higher education (IHEs) and providing opportunities to earn up to two years of college credit while still in high school. Six districts were chosen in a competitive process and received RTTT Goal 4E funds for this purpose. Eight additional STEM ECHS sites received support from discretionary RTTT funds. At ESE's request, UMDI's evaluation efforts focused on the six sites that received Goal 4E funds.

The six chosen districts each received $120,000 of RTTT funds to be spent over four years for school planning, start-up expenses, and full implementation. Two schools opened in fall 2011, one opened in summer 2012, two opened in fall 2012, and one opened in fall 2013. The funded school districts and their higher education partners are shown in the table below.

STEM ECHS Sites and IHE Partners

District and School(s)	Start Date	Institute of Higher Education	Grades Offered
Marlborough Public Schools (Whitcomb MS and Marlborough HS)	Fall 2011	Framingham State University	6–12
Quaboag Public Schools (Quaboag Innovation STEM ECHS)	Fall 2011	Quinsigamond Community College	9–12
Massachusetts Association of Vocational Administrators (MAVA)	Summer 2012	Northeastern University	9–12
Randolph Public Schools (Randolph HS)	Fall 2012	Massasoit Community College	9–12
Worcester Public Schools (North HS)	Fall 2012	Quinsigamond Community College, College of the Holy Cross	7–12
Boston Public Schools (Dearborn MS)	Fall 2013	Northeastern University	6–12

Methods

Data Collection Activities

The table below summarizes the primary data collection activities for the STEM ECHS evaluation. The three annual evaluation reports describe these activities in detail and provide the data collection protocols.

STEM ECHS Data Collection Activities by Program Year			
Data Collection Activity	**SY12**	**SY13**	**SY14**
Interviews – STEM ECHS Administrators	✓	✓	✓
Interviews – IHE Partners	✓	✓	✓
Interviews – ESE	✓	✓	✓
Survey – STEM ECHS Personnel		✓	✓
Observations – Classroom	✓	✓	
Observations – STEM ECHS Technical Assistance Gatherings	✓	✓	
Supplemental Student Data Request	✓	✓	✓
Review – ESE Documents & Databases	✓	✓	✓

Findings

Participation and Outcomes

The 2014 RTTT annual evaluation report included site profiles that summarized participation and outcomes for five of the six STEM ECHS sites. Outcomes including demographic information for STEM ECHS participants and host schools, rates of attendance, college courses offered, college credits accrued, annual dropout rates, graduation rates, and MCAS performance are provided for each site, as appropriate. A profile was not presented for Dearborn because that site did not submit participation data for school years 2013 or 2014. Program design and participation varied widely by site, and the outcome measures presented in the report for each site varied because some outcome measures were not relevant at some sites (e.g., no graduation rate information was presented for Marlborough, because none of their STEM ECHS participants reached 12th grade during the grant period).

STEM ECHS Participation by site. The table below shows the number of students who participated in STEM ECHS activities at each site, and how many students were enrolled in the schools from which STEM ECHS students were selected (hereafter the "host schools"). Summaries of participation by site, gender, race/ethnicity, and grade level are provided in the 2014 annual evaluation report.

Student Population in STEM ECHS and Host Schools						
District	STEM ECHS Participants			Host Schools		
	SY12	SY13	SY14	SY12	SY13	SY14
Boston	0	n.d.	n.d.	0	n.d.	n.d.
Marlborough	177	374	442	2,706	2,780	2,708
MAVA	20	49	46	9,833	9,889	10,276
Quaboag	11	38	49	561	571	639
Randolph	0	26	n.d.	773	834	808
Worcester	23	70	60	1,265	1,378	1,409
Total	231	557	597	15,138	15,452	15,840

Note: UMDI did not receive data from Dearborn in school years 2013 or 2014, or from Randolph in school year 2014. "n.d." stands for "no data."

College course participation by site. The table below shows the college courses offered to STEM ECHS students at each site, the number of students who participated in those courses, the number of students who earned credit, and the number of credits earned. Further detail is available in the 2014 evaluation report. Students attempted 462 college courses and earned credit in 420 courses (91 percent). Nineteen different courses were offered, and almost all courses offered three credits.

College Credits Attempted and Earned at STEM ECHS Sites, School Years 2012 to 2014									
Site and Course Name	Number of Students Attempting College Course			Number of Students Earning College Credit			Number of Credits Earned		
	SY12	SY13	SY14	SY12	SY13	SY14	SY12	SY13	SY14
Marlborough									
College Writing	0	0	18	0	0	18	0	0	72
Expository Writing	0	0	7	0	0	7	0	0	29
MAVA									
Intro to PC Productivity Tools	20	23	0	17	19	n/a	60	57	n/a
Network Foundations I	0	25	23	n/a	25	23	n/a	75	69
Database Software	0	25	0	n/a	24	n.d.	n/a	72	n/a

Network Foundations II	0	24	21	n/a	24	20	n/a	72	60
Website Design	0	0	23	n/a	n/a	19	n/a	n/a	57
Technology and Information Fluency	0	0	23	n/a	n/a	12	n/a	n/a	36
Quaboag									
Electrical Engineering	11	0	0	0	n/a	n/a	0	n/a	n/a
Strategies for College and Career	0	8	6	n/a	8	6	n/a	24	18
Electronics	0	0	7	n/a	n/a	4	n/a	n/a	12
Introduction to Microcomputer Applications	0	0	16	n/a	n/a	16	n/a	n/a	48
Randolph									
College Experience	n.d.	26	n.d.	n.d.	26	n.d.	n.d.	78	n.d.
Truck Components	n.d.	11	n.d.	n.d.	11	n.d.	n.d.	33	n.d.
Worcester North									
Orientation to College	23	24	29	23	24	29	69	72	87
Computer Information Systems	0	22	25	n/a	22	21	n/a	66	63
English Comp	0	0	10	n/a	n/a	10	n/a	n/a	30
Pre-Calculus	0	0	7	n/a	n/a	7	n/a	n/a	21
College Algebra	0	4	1	n/a	4	1	n/a	12	3

Note: Courses that were not offered in a certain year are marked "0" in that year for "Number of Students Attempting College Course," and "n/a" (not applicable) for corresponding table entries. UMDI did not receive data from Randolph STEM ECHS in school years 2012 or 2014. "n.d." stands for "no data."

Successes

A brief summary of successes reported by STEM ECHS sites and their IHE partners is presented below.

All six STEM ECHS sites were operational. During school year 2014 (and only during school year 2014) all six sites reported that STEM ECHS courses and activities were operational and running smoothly. Each year, sites noted that they had made significant changes to their original plans for STEM ECHS programming in order to accommodate challenges such as logistics and personnel matters, as described in the challenges section below.

Students were engaging with STEM content and were confident in their abilities. Interviewees at all sites reported that STEM ECHS students were engaging with STEM content, and that most students were meeting or exceeding expectations for academic development and performance.

Students participated in college courses. During school year 2014, students at five sites enrolled in one or more credit-bearing, college-level courses. During school year 2013, administrators at these sites reported a preference for students taking college courses at college campuses, but during school year 2014 all but one of these sites stated that logistical and budgetary constraints made it preferable to locate college courses at the high school building. The IHE partner of the fifth site was pushing to have STEM ECHS courses moved off campus, preferably to an online format, in order to reduce costs. Even when attending courses on college campuses was not feasible, administrators agreed that participation in college courses was an important part of students' STEM ECHS experiences in terms of creating a rigorous academic experience and increasing students' confidence in their ability to attend college after high school.

School and district leaders provided strong support. Most STEM ECHS administrators said that they received strong support from district-level administrators throughout the STEM ECHS funding period, and that the program was well received by district leadership and staff. Interviewees stated that continued support and commitment from district leadership was critical to the success of the STEM ECHS. Several sites also reported that they have received ongoing support from their district to promote the STEM ECHS to students, parents, community members, and the business community.

Partnerships between districts and IHEs became increasingly productive over time. All sites built trust with their IHE partner over time by continually clarifying their respective expectations and responsibilities for engaging STEM ECHS students in college courses. Sites also indicated that their IHE partner had been positive and supportive. Regular meetings between STEM ECHS personnel and IHE partners were instituted at four of six sites. One interviewee said, "Our partnership is going well—no problems …. There is a monthly meeting with [our IHE partner], the program director, the head guidance counselor, the head of the school internship program, and two of the instructors who taught college." Similarly, most IHE partners indicated that their partnership with the STEM ECHS continued to move in a positive direction. As previously noted, service and course delivery shifted at several sites (e.g., on-campus classes were shifted to high schools, course offerings were revised).

All sites with students enrolled in college courses worked with their IHE partner(s) to increase the program's chances of being sustained over time. For example, one IHE partner continued the work of institutionalizing the administrative and personnel structures needed to support the STEM ECHS (e.g., identifying and organizing resources to support program operation). This site viewed their STEM ECHS partnership as an opportunity to have a lasting impact on the local school system and community. During

school year 2013–14, two IHE partners hired community engagement liaisons that were responsible for managing relationships with local high schools, including STEM ECHS partnerships.

Some sites strengthened connections with feeder middle schools. The school year 2013 evaluation reported that three sites were attempting to integrate middle and high school learning experiences into a comprehensive STEM ECHS experience, and that none of the sites had clearly articulated a plan for bridging the two school levels. During school year 2014 two of these sites reported that they had made significant progress in connecting their middle school and high school STEM ECHS activities. One site reported that their district had created a new district-level administrative position, in part to ensure that a cohesive vision for STEM activities was being implemented across the middle and high school programs.

Marlborough was viewed as a standout success. Several sites, ESE, and Jobs for the Future (JFF—the technical assistance vendor for STEM ECHS) identified Marlborough as a standout success. One interviewee said, "Marlborough, by anyone's definition, is successful." During the RTTT funding period, Marlborough was able to realize several key elements of its vision for a grades 6–12 STEM ECHS program. Elements of Marlborough's success include: (1) adding STEM programming at one grade level at each of the middle school and high school buildings during each year of the grant, (2) developing and implementing key components of a STEM-centric curriculum (e.g., project-based learning, cross-curricular activities, one-to-one laptops for all participants), (3) developing a system of supports for students and teachers engaged with STEM ECHS activities (e.g., reduced class size, STEM team meeting period), and (4) successfully enrolling a cohort of STEM ECHS students in one college-level course. Marlborough partnered with JFF to submit a grant application to the Department of Labor, and in 2014 they were awarded $1.8 million to continue and expand their STEM ECHS activities.

Communication and collaboration increased among early college high school stakeholders statewide. ESE and JFF reported that efforts to coordinate early college activities that are taking place across Massachusetts were gaining momentum. When asked to describe the successes of the STEM ECHS initiative, ESE said,

> The victories we have had with this $720,000 investment over four years are not only the individual successes we saw at these "laboratories," but also that we are starting to get a little bit of traction around early college design pathways. We are trying to figure out how to incorporate [various dual-enrollment programs and efforts] from across the Commonwealth. The victory statewide is that we are starting to get some traction on what this might look like. I think [ESE] is starting to provide some leadership, along with some of our [Department of Higher Education] friends.

Challenges

Interviewees also reported several challenges. All site administrators and IHE partners said that securing the financial resources to sustain the STEM ECHS programs was their primary concern. Several interviewees said that without outside financial support it would be extremely difficult for their STEM ECHS to offer college experiences for students, and that college course offerings would be eliminated or significantly reduced after the RTTT grant expired. ESE said that the burden for sustaining the STEM ECHS programs falls largely on the districts. ESE also noted that, at the state level, it is difficult to form a broad coalition of support to sustain STEM ECHS programs.

Sites also reported logistical challenges that included transportation, staffing, assessment, course scheduling and location, and accommodating different numbers of students across cohorts. Administrators

at each implementing site said that their leadership teams were working closely to address these logistical concerns, many of which had been difficult to anticipate. During school year 2014, five of six STEM ECHS sites experienced one or more significant transitions in district, school, program, and/or IHE partner leadership. Three districts reported difficulty maintaining the continuity of their planning team, which disrupted work that was in progress.

One goal of the STEM ECHS initiative was to provide an accelerated pathway to postsecondary education for underrepresented students. In service of this goal, three of the STEM ECHS sites prioritized the recruitment, selection, and/or enrollment of underrepresented students at some point during the grant period. By school year 2014, each of the STEM ECHS sites had adjusted their selection criteria so that all applicants were accepted, thereby eliminating selection priorities for any student subgroups. One site adjusted their selection criteria in part because a small group of parents and community members objected to such selection priorities. Ultimately, each site chose to admit all applicants because the programs had the capacity to do so. At most sites, the composition of STEM ECHS participants and their host schools was similar in terms of race/ethnicity and low income, special education, and ELL status.

Several sites reported that they had received less support from JFF during school year 2014 than in previous years of the program, and that JFF had assigned a new consultant to the project. Both of these changes were perceived as challenges. One interviewee said, "This year less support was offered. The transition [to a new consultant] was not well communicated. Sites did not understand that there was going to be a reduced level of service and support."

Survey Findings

The STEM ECHS personnel surveys found that:

- A majority of respondents believed that their district had a plan for and was committed to developing and supporting the STEM ECHS.
- Most respondents believed that their STEM ECHS would contribute to a reduction in achievement gaps between high- and low-performing students in their school/district.
- A majority of respondents believed that their district would not have sufficient funds to support their STEM ECHS after the RTTT funding period ended.
- Most respondents believed that students in their district had a strong interest in participating in STEM ECHS activities.

A majority of STEM ECHS personnel believed that their district had a clear commitment to developing and supporting their STEM ECHS, that STEM ECHS teachers had the expertise and access to resources needed to implement the STEM ECHS curriculum effectively. Additionally, half of all survey respondents disagreed or strongly disagreed that their district would have adequate funds to pay for planned STEM ECHS program activities after the RTTT funding period was over.

Advice for other districts. During school year 2014, survey respondents (N=17) were asked to provide advice for other districts that are attempting to establish a STEM ECHS. The two pieces of advice offered most frequently were to schedule enough planning time (N=4) and to develop a clear plan before implementation (N=4). One respondent said, "Spend a serious amount of time in the planning stage of the ECHS instead of diving right in and trying to figure it out later." Another said, "Try to start by establishing a clear vision of what you'd like to achieve. Develop this vision by observing what others are doing and developing an understanding of your district's strengths and weaknesses with a group of stakeholders."

The advice offered second most frequently was to develop strong partnerships (N=3), create a sustainability plan (N=3), and establish staff buy-in (N=3). One respondent said, "Partnerships need to be developed with business and industry as well as with post-secondary institutions." Another added that partnerships are important for sustainability. Three respondents emphasized having a sustainability plan before implementation. Regarding staff buy-in, one respondent said, "Do not force teachers to become part of the program. Be sure that teachers have supports and common planning time. If the teachers are interested and willing to do the work, the program will be successful." Other suggestions were to engage in external training (N=2), obtain support from the central office (N=2), observe successful districts (N=1), ensure solid leadership (N=1), and have access to necessary technology (N=1).

Lessons Learned

STEM ECHS administrators and IHE partners were asked to summarize lessons learned from program implementation. Their feedback is summarized below.

- **Focus on sustainability from day one.** Have discussions with multiple people who have been through the process of developing a STEM ECHS before launching into the planning process. Use these conversations to identify the supports and the resources that are in place to support the STEM ECHS.
- **Identify a point person or leadership team.** Have a group of people involved with and informed about the process, and hold a single individual responsible for getting things done, while offering appropriate levels of support and oversight.
- **Build a program that matches the available capacity and need.** Do not build a program that requires staffing capacity that is greater than the capacity available in your building or district.
- **Make a strong effort to engage and garner support from multiple stakeholders** (e.g., students, teachers, school and district leaders, parents, IHE partners, local and regional businesses). Use this engagement to establish a uniform vision for STEM curriculum, and then build a coalition of support around that vision.
- **Identify an IHE partner who is well aligned with and willing and able to support the programmatic and philosophical approach of the STEM ECHS leadership team.**

ESE also reflected on lessons learned. They said that it would have been beneficial to complete more of the state-level "early college design work" before the initiative was launched. They also learned that cities and towns did not provide as much financial support as ESE had anticipated. ESE explained, "It was like we were giving them 20 percent of the funding it would take to do what they were going to do, but none of the sites came close to getting 80 percent matches [from their districts or other funding sources]." Last, ESE said that having alternate sites and/or the ability to end funding to under-performing sites would have been helpful. The way that the STEM ECHS funding was structured left ESE with little control over the sites once the funds were released.

When asked to comment on lessons learned during school year 2014, JFF said,

> One of the solid takeaways from the grant is that there is a clear role for ESE and DHE in organizing some of these connecting activities so that they make sense to both sides of the equation, for the colleges and for the high schools …. If the Commonwealth sees a benefit from sustainable ECHS programs across the board, obviously with district choice, then the Commonwealth has a role in helping them figure out how to do that in a way that makes sense. This is also a district problem, and a college problem, and those people

> need to be in the room having a conversation about this, and it's not rocket science. I think it would be really exciting.

Technical assistance to STEM ECHS sites decreased during school year 2014. JFF and ESE did not host technical assistance meetings for just the STEM ECHS sites as in previous years, but did invite the six sites to participate in two relevant technical assistance gatherings that included a larger group of program participants. ESE and JFF agreed that the focus of JFF's technical assistance during school year 2014 would shift from providing "on-the-ground support" to supporting districts' efforts to explore, develop, and implement plans for sustainability. To facilitate this shift, the JFF consultant who had served as the primary technical assistance contact for districts was replaced by a new consultant who worked with sites to explore options for sustainability. Administrators from several sites said that they had not been aware that the level of technical assistance would be reduced during school year 2014, and that the purpose and timing of the consultant transition could have been communicated more clearly.

ESE said that JFF was a valued partner. ESE did not believe that the technical assistance provided by JFF was sustainable financially over the long term, and that in retrospect it may have been appropriate to supplement JFF's policy expertise with a second technical assistance vendor to provide support with program implementation.

Next Steps

During school year 2014, STEM ECHS program administrators, ESE, and JFF provided a brief overview of their intended next steps, which are briefly described below.

Next steps for sites. Three of the six sites indicated that STEM ECHS activities would cease unless they secured continuation funding. One site (Marlborough) had secured additional funding, and had plans to systematically extend the STEM ECHS initiative for several years. One site (Dearborn) indicated a continued interest in developing their STEM ECHS curriculum, and expanding the student population being served, with the continued support of their district. Finally, one site (Worcester North) indicated that some STEM ECHS activities would continue, but at pre-STEM ECHS grant levels of intensity.

Next steps for ESE. ESE anticipated that most sites would continue some form of STEM ECHS programming in the short term. ESE had no funds available to continue supporting these sites but expected that their relationships with the sites would continue. The sites would likely become "legacy programs" that receive occasional technical assistance from the state.

ESE noted that the STEM ECHS initiative is one of many CCR initiatives of which they were asking, "How are we moving forward with this?" One way is by continuing the work of "bringing in all of [the] early college design partners" to discuss best practices. ESE said, "Kids taking rigorous coursework while they are still in high school, whether it be AP, IB, dual enrollment, or early college is going to continue to be a priority of ours, and of schools. It is just figuring out how it works."

ESE said that as part of this work, JFF prepared a document which describes strategies for sustaining STEM ECHSs and acknowledged that "there is no system across the Commonwealth for [structuring financial agreements relevant to dual enrollment]." ESE reported that some efforts were being made to better understand the landscape of early college programming in Massachusetts and said, "There is still a huge gap between K–12 and higher education, not to mention individual campuses, around what these articulation agreements look like." ESE also said that there was no standard or generic academic content

articulation agreement from which K–12 and IHE partners could begin their work, and that ESE was exploring the development of such agreements to support ongoing and future early college design efforts.

Next Steps for JFF. JFF said that they did not foresee working with the STEM ECHS sites (with the exception of Marlborough) beyond the end of their RTTT contract.

Feedback on ESE

Feedback from grantees about collaboration with ESE was consistently positive. All sites reported that ESE had consistently provided effective, professional, and timely assistance. Sites noted that ESE personnel were aware of, and sensitive to, the contexts in which the districts were working. Recent comments from interviewees included the following:

- ESE has an effective relationship with the sites. Communication is easy. I know where they are coming from. I think they know where I am coming from. We support each other. I know what they need to do. I think they know what I am trying to do. So that working relationship is a success from my view.
- We went to an ESE conference earlier in the year, did some networking. These meetings are good for brainstorming ideas.
- We've had few contacts with ESE this year, but networking opportunities have been helpful.

Strategic Considerations

ESE remains invested in providing accelerated pathways to postsecondary education for underrepresented students through initiatives such as STEM ECHS. The strategic considerations below were selected to provide support in achieving and assessing progress toward that goal. The first three strategic considerations were presented in prior annual evaluation reports.

- **Establishing and sustaining early college models would benefit from improved articulation and funding agreements between high schools and institutions of higher education.** ESE, JFF, representatives from the sites, and their partnering institutions of higher education all acknowledged that ESE has an important role to play in directing this conversation and collaborating with IHEs and other partners to systematize these agreements.
- **ESE could build on the successes of the STEM ECHS initiative by continuing their efforts to connect the STEM ECHSs with other early college initiatives across Massachusetts.** ESE said that they were already making some efforts to support and connect various initiatives that aim to help high school students engage with rigorous and often college-level curriculum.
- **Identifying, communicating, and establishing accountability for project milestones could provide ESE with more leverage when making funding decisions for future early college high school sites.** ESE reported that it may have been advantageous to have more leverage in making annual STEM ECHS funding decisions and flexibility in moving funds from low-performing to high-performing sites. Such milestones could be established based on STEM ECHS evaluation findings as well as literature on early college models.
- **Clarifying benchmarks for recruiting and selecting students from underserved populations could support efforts to develop accelerated pathways to postsecondary education for students from those groups.** At most sites, the composition of STEM ECHS participants and

their host schools was similar in terms of race/ethnicity and low-income, special education, and ELL status. It is not clear if this met ESE's goal that STEM ECHSs would provide an accelerated pathway to postsecondary education for underrepresented students. Establishing benchmarks for serving students from underserved populations would help all stakeholders realize this goal.

MassCore Policy and Implementation

Introduction

The Massachusetts High School Program of Studies (MassCore) recommends a set of courses and other learning opportunities that Massachusetts students should complete before graduating from high school, in order to arrive at college or the workplace well-prepared and without the need for remedial coursework. The 155 districts that selected the RTTT college and career readiness goal committed to implementing strategies to increase the percentage of their students who complete the MassCore curriculum.

The state's RTTT goal was to increase the statewide MassCore completion rate from its baseline of 70 percent of school year 2010 graduates to 85 percent of school year 2014 graduates. The state created a goal for each district, using a formula based on the district's reported school year 2010 MassCore completion rate (calculated from the MassCore element of the state's SIMS database), the district's number of 2010 graduates, and the total number of graduates statewide needed to bridge the gap between the 70 percent baseline and the 85 percent goal. Districts were also expected to determine areas in which courses or supports needed to be expanded in order to meet the 2014 targets, and to create and implement a plan to improve the accuracy of their reporting of MassCore completion levels.

In addition to assessing progress toward increased MassCore completion for the state overall and key subgroups, the evaluation investigated steps that districts have taken toward this goal, looking at facilitators, challenges, solutions, and sustainability.

Methods

Data Collection Activities

The table below summarizes the primary data collection activities for the MassCore evaluation. The three annual evaluation reports describe these activities in detail and provide the district administrator interview and survey protocols.

MassCore Data Collection Activities by Program Year			
Data Collection Activity	**SY2011–12**	**SY2012–13**	**SY2013–14**
Interviews – District MassCore Administrators	✓		✓
Interviews – District Data Administrators		✓	
Interviews – ESE	✓	✓	✓
Survey – District Administrators	✓		
Review – ESE Documents & Databases	✓	✓	✓

Findings

MassCore Completion Rates

The evaluation raised questions about the validity of the MassCore completion indicator in SIMS, based on patterns of MassCore completion rates which suggest that some districts have reported inaccurately. (There was no evidence to suggest that inaccuracies were due to intentional misrepresentation.) Moreover, some interviewees described changes in their district's reporting procedures that caused large changes in reported MassCore completion rates without any underlying change in actual rates. These changes were not all increases or all decreases, so it cannot readily be determined whether the resulting findings produce systematic underestimates or overestimates.

Nonetheless, the SIMS indicator is the best available measure of MassCore completion, and rates of MassCore completion are central to the evaluation. In light of this dilemma, findings based on the indicator are presented below, while recognizing that they probably contain inaccuracies.

Statewide completion rates. The statewide MassCore completion percentage increased from 69.8 percent for school year 2010 graduates (the year before RTTT began) to 72.4 percent for school year 2014 graduates, as shown in the table below. The school year 2014 rate of 72.4 percent is an increase of 2.6 percentage points; the RTTT goal was for an increase of 15.2 percentage points, to 85.0 percent. This finding should be interpreted in light of the earlier comments about the validity of the MassCore indicator.

Statewide MassCore Completion Rates, School Years 2010 to 2014			
Year	**# of Graduates Completing MassCore**	**Total Number of Graduates[6]**	**% of Graduates Completing MassCore**
2010	45,386	65,058	69.8
2011	44,752	64,725	69.1
2012	44,571	65,159	68.4
2013	46,601	66,359	70.2
2014	47,461	65,540	72.4

Completion rates by subgroup. The following table shows MassCore completion rates of student subgroups as well as gaps in completion between subgroups for the 2010 and 2014 school years. The gaps are defined as between a reference group and a comparison group or groups, where the reference group typically scores higher than the comparison group(s) on the MCAS. For example, the table shows 2010 gaps ranging from 2.5 percentage points (males lower than females) to 27.4 percentage points (ELL students lower than non-ELL students).[7]

The final two columns of the table address the change in MassCore completion gaps during the RTTT grant period. For example, these columns show that the gap between Black/African American and White

[6] For each year included in this analysis, the number of graduates included in MassCore calculations (by ESE and by UMDI) is greater than the number of graduates reported by ESE (4-year cohort graduation rate).

[7] Following ESE's decision rules for calculating MassCore completion rates, students are counted as ELL if they were ELL at any time during high school.

students decreased by 1.7 percentage points from school year 2010 to school year 2014, and that this was a 6.2 percent decrease in the size of the gap. The MassCore completion gap declined for three subgroups, by 0.1 to 4.8 percentage points, corresponding to a decrease of from 0.5 percent (Hispanic/Latino) to 35.6 percent (Native Hawaiian/Pacific Islander) in the size of the gap. The MassCore completion gap increased for seven subgroups, by 0.1 to 4.4 percentage points, corresponding to an increase of from 0.4 percent (Low Income) to 16.1 percent (ELL) in the size of the gap.

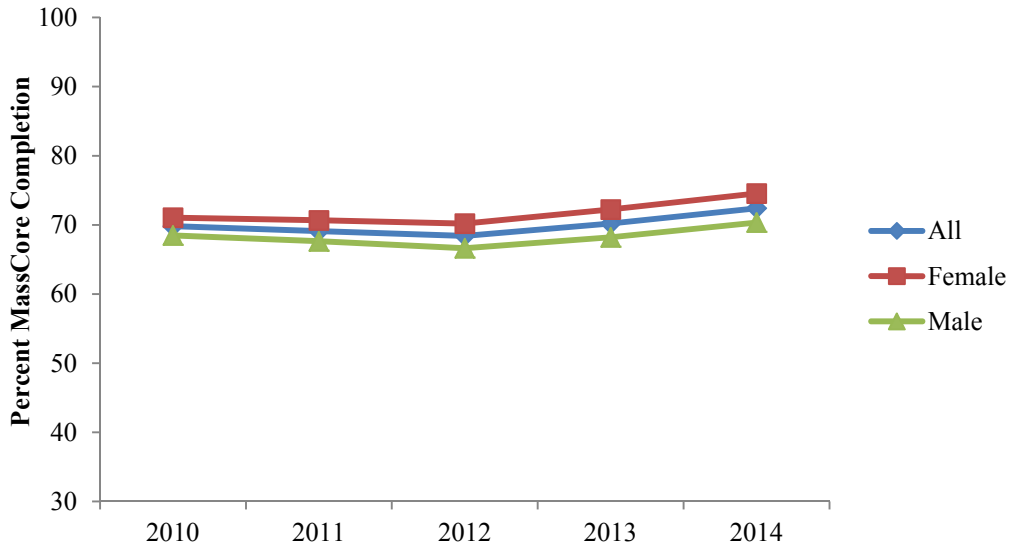
MassCore Subgroup Completion and Gaps, School Years 2010 and 2014

Subgroup	SY10 Completion %	SY14 Completion %	SY10 Gap % Points	SY14 Gap % Points	Gap Change SY10 to SY14	% Gap Change SY10 to SY14
All	69.8	72.4	—	—	—	—
Female	71.0	74.5	—	—	—	—
Male	68.5	70.3	2.5	4.2	1.7	68.0
White	74.5	77.6	—	—	—	—
Asian	70.3	72.5	4.2	5.1	0.9	21.4
Black/African American	46.9	51.7	27.6	25.9	-1.7	-6.2
Hispanic/Latino	54.3	57.5	20.2	20.1	-0.1	-0.5
Multi-Race, Non-Hispanic/Latino	71.2	71.5	3.3	6.1	2.8	84.8
American Indian/Alaskan Native	57.5	58.8	17.0	18.8	1.8	10.6
Native Hawaiian/Pacific Islander	61.0	68.9	13.5	8.7	-4.8	-35.6
Students without Disabilities	71.4	74.4	—	—	—	—
Students with Disabilities	60.4	62.6	11.4	11.8	0.4	3.5
Not ELL	70.9	74.3	—	—	—	—
ELL	43.5	42.5	27.4	31.8	4.4	16.1
Not Low Income	77.1	81.3	—	—	—	—
Low Income	54.8	58.9	22.3	22.4	0.1	0.4

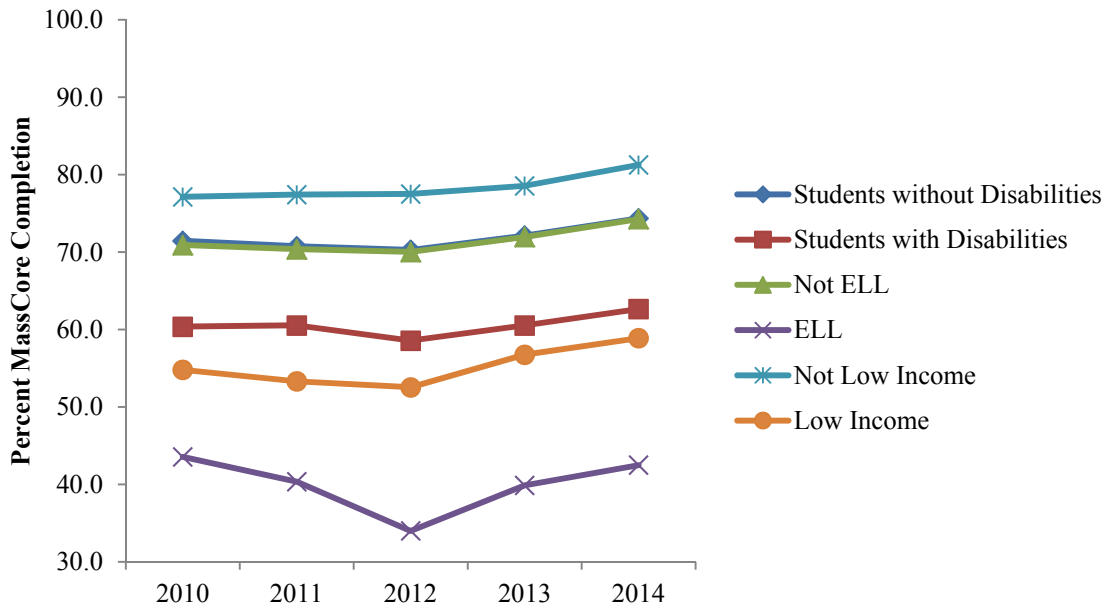
The tables and figures on the following pages provide annual MassCore completion rates for student subgroups for school year 2010 through school year 2014.

MassCore Completion by Student Subgroups, School Years 2010 to 2014					
Subgroup	**2010**	**2011**	**2012**	**2013**	**2014**
All	69.8	69.1	68.4	70.2	72.4
Female	71.0	70.7	70.2	72.2	74.5
Male	68.5	67.6	66.6	68.2	70.3
White	74.5	74.4	74.5	75.3	77.6
Asian	70.3	67.8	66.7	68.5	72.5
Black/African American	46.9	47.3	44.4	50.5	51.7
Hispanic/Latino	54.3	51.6	49.8	55.5	57.5
Multi-Racial, Non-Hispanic/Latino	71.2	66.8	60.4	71.1	71.5
American Indian/Alaskan Native	57.5	63.6	52.7	56.9	58.8
Native Hawaiian/Pacific Islander	61.0	61.4	68.3	63.5	68.9
Students Without Disabilities	71.4	70.7	70.3	72.1	74.4
Students With Disabilities	60.4	60.5	58.6	60.5	62.6
Not ELL	70.9	70.4	70.0	71.9	74.3
ELL	43.5	40.3	34.0	39.9	42.5
Not Low Income	77.1	77.4	77.5	78.6	81.3
Low Income	54.8	53.3	52.5	56.8	58.9

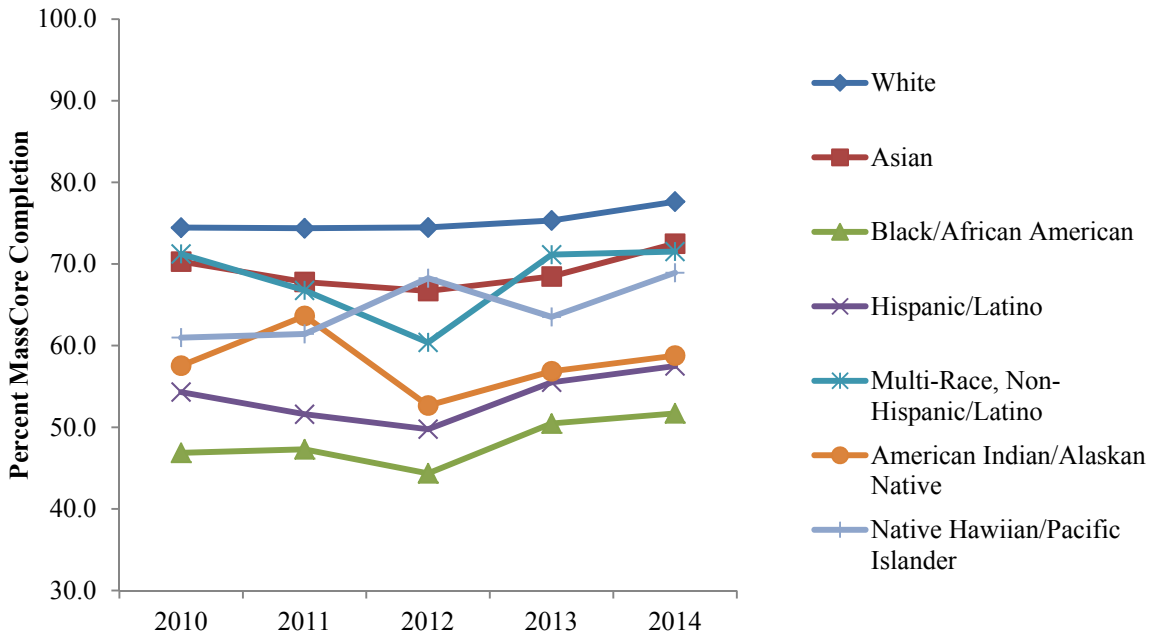
MassCore Completion, All Students and by Gender, School Years 2010 to 2014



Percent MassCore Completion by Student Subgroups, School Years 2010 to 2014



Percent MassCore Completion by Student Subgroups, School Years 2010 to 2014



District-level completion trends. To understand how district reporting practices—rather than actual change in MassCore completion rates—might influence the observed changes in statewide MassCore completion rates, UMDI examined MassCore completion rates and trends for each district over a six-year period (from 2008–09 to 2013–14). This resulted in creating categories of MassCore completion trends that reflected common, uncommon, likely, and unlikely patterns. The intention was to identify groups of districts that may either serve as models for other districts or benefit from technical assistance and/or clarification of MassCore completion and reporting requirements. To support that process, a list of districts and their MassCore trend categories is provided in Appendix C.

Districts were excluded that had missing or non-existent MassCore completion rates for one or more years, or that had fewer than 20 graduates in one or more years. Each remaining district was coded according to the following trends observed in their MassCore completion rates:

- *Primary trend codes.*
    - *All 100 percent*. District reported 100 percent MassCore completion all six years.
    - *Consistently high.* Greater than or equal to 80 percent each year, but not all 100 percent.
    - *Consistently moderate.* Between 50 percent and 80 percent each year.
    - *Consistently low.* Less than or equal to 50 percent each year, but not all 0 percent.
    - *All 0 percent.* District reported 0 percent MassCore completion all six years.
- *Secondary trend codes.* Districts that did not meet the criteria for a primary trend code or an exclusion code received one of the following codes:
    - *Steady increase.* Rate increased at least twice, and never decreased.
    - *Steady decrease.* Rate decreased at least twice, and never increased.
    - *Major jump up.* Rate increased 30 percent or more in a single year.
    - *Major jump down.* Rate decreased 30 percent or more in a single year.
    - *Spike up.* Rate increased 30 percent or more in a single year and then decreased 30 percent or more in a subsequent year.
    - *Spike down.* Rate decreased 30 percent or more in a single year and then increased 30 percent or more in a subsequent year.
    - *Multiple spikes.* In three consecutive years, rates increased, then decreased, then increased again; or decreased, then increased, then decreased again. Each change was at least 30 percent.
    - *Missing data.* District did not report data for one or more of the six years.
    - *Not enough graduates.* District did not have at least 20 graduates each year.
    - *Uncoded.* No other primary or secondary trend codes were applicable.

The table below summarizes trends in rates of MassCore completion for each district in the state from 2008–09 to 2013–14.

MassCore Completion Rate Trends by District, 2008–09 to 2013–14		
Trend Description	**Number of Districts**	**Percent of Districts**
All 100%	51	16.1
Consistently high (≥80%)	67	21.1
Consistently moderate (≥ 50% and ≤ 80%)	8	2.5
Consistently low (≤50%)	19	6.0
All 0%	1	0.3
Steady increase	6	1.9
Steady decrease	1	0.3
Major jump up	16	5.0
Major jump down	28	8.8
Spike up	5	1.6
Spike down	17	5.4
Multiple spikes	11	3.5
Uncoded (no defined trend)	39	12.3
Missing data	37	11.7
Not enough graduates	11	3.5
Total	**317**	**100.0%**

These data suggest that some districts have adjusted their MassCore reporting practices over time. These changes could obscure actual increases or decreases in the state's overall MassCore completion rate. Variations in patterns of MassCore completion are explored in further detail below.

While the state's rate of MassCore completion has changed by about three percentage points during the five-year period examined, completion rates of many districts have varied by much larger margins during the same time period. Almost half of all districts (46.0 percent) reported relatively stable levels of MassCore completion (i.e., those coded as Consistently High, Consistently Moderate, Consistently Low, All 100%, or All 0%). However, about one in four districts (24.0 percent) reported highly variable rates (i.e., those coded as Major Jump Up, Major Jump Down, Spike Up, Spike Down, or Multiple Spikes).

Highly variable rates may signal substantial changes in MassCore-related policies and/or reporting practices in these districts, or possibly in a subset of schools within these districts. Learning more about MassCore policies, reporting practices, and relevant contextual factors in these districts would be important for developing a better understanding of changes in the statewide MassCore completion rate. Districts that have reported highly variable rates may benefit from technical assistance regarding MassCore reporting. The six districts that had a steady increase represent a core of potentially model districts that are taking actions that result in gradual improvement.

Fifty-one districts reported that 100 percent of their graduates completed MassCore for each of the six years included in this analysis. An additional 67 districts reported consistently high rates of MassCore completion. In ESE's efforts to promote improved MassCore reporting practices and higher rates of MassCore completion, this group of districts may serve as one source of models. For example, districts that consistently report 100 percent completion may share common policies, such as graduation requirements that meet or exceed MassCore requirements. A clear understanding of the policy environment that exists in these districts could inform the broader conversation about MassCore. Before utilizing these districts as models, it would be important to check the accuracy of their approaches to assessing MassCore completion, in case their high rates reflect a calculation or reporting error.

Finally, 19 districts reported consistently low rates of MassCore completion, and 1 district reported 0 percent MassCore completion for all years included in this analysis. These districts apparently have not adopted MassCore as a graduation requirement. If ESE wanted to know more about policy, reporting, and logistical challenges related to incorporating MassCore as a standard graduation requirement, these districts may offer valuable insights. As with the high-scoring districts, it would be important to check the accuracy of these districts' approaches to assessing MassCore completion, in case their low rates reflect a calculation or reporting error.

Progress and Challenges in Increasing MassCore Implementation

ESE's intention was for MassCore to shift from a recommended curriculum to a de facto curriculum for the state during the first year of RTTT. However, the Massachusetts Board of Elementary and Secondary Education voted against this change. As a result, although many districts believe that increasing MassCore completion is a worthy goal, committed RTTT and other resources in service of that goal, and believe it is a realistic goal for the majority of their students, districts have no clear accountability to the state for achieving progress and may therefore be prioritizing other initiatives that have greater accountability or a higher profile.

The following two quotations from district administrators interviewed by UMDI who were leading any efforts related to MassCore in their respective districts illustrate a wide range of district stances with regard to increasing MassCore completion:

> *We see major benefits. We are making a significant commitment of our Race to the Top dollars in moving ourselves towards a state of readiness for MassCore and promoting that. We see it as essential for college readiness, issues of rigor and readiness amongst students who begin college, and we also see it as a standard that will increase our graduation rate.*
>
> *MassCore is kind of on the side burner right now because of the other things that are going on in the system…I can't even get [my school] to take MassCore seriously at this point.*

The three annual RTTT evaluation reports provide in-depth findings about implementation successes, challenges, and solutions, which are briefly reviewed next. In the MassCore needs assessment and action plans provided to ESE by 99 districts that were receiving RTTT college and career readiness funding, the districts described ongoing and planned strategies for improving MassCore completion rates. The strategies included focusing on aligning the district's graduation requirements with MassCore requirements, adjusting K–12 curriculum scope and sequence, modifying or developing new courses,

providing professional development to raise awareness of MassCore requirements, and monitoring and reviewing students' progress toward MassCore completion.

UMDI also interviewed district MassCore administrators, who repeated some of the strategies just mentioned and also described additional strategies for moving toward greater implementation of the MassCore program of studies. These included structural changes (e.g., shifting to block scheduling), changing policies (e.g., permitting after-school sports to fulfill physical education requirements), personnel changes (e.g., hiring additional teachers to be able to offer a fourth year of mathematics to all students), and collaborating with external vendors (e.g., to introduce online credit recovery courses). In some cases changes to facilities were also required to accommodate additional lab science and art courses.

Districts also reported many challenges to increasing rates of MassCore completion. The most common curricular challenge was the required fourth year of mathematics, but lab sciences, physical education, world languages, and fine arts were also mentioned. Additional challenges included course scheduling, availability of curricular materials and lab equipment, inadequate funds and staffing in some curricular areas, student academic readiness and special needs, misalignment of MassCore requirements with district graduation requirements, and the fact that MassCore is not a required curriculum. A scheduling challenge reported by multiple schools was ensuring that all students could participate in wellness activities during all four years of high school.

A challenge in raising MassCore completion rates reported by one district was that some students are exempted from meeting certain MassCore requirements, such as exemptions from physical education courses for medical reasons, or exemptions from foreign language courses for some ELLs and special education students (as a provision of their individualized education plans). This district reported that such exemptions applied to about 15 percent of their students, accounting for the district's 85 percent MassCore completion rate despite having MassCore completion as a graduation requirement. Another challenge is presented by students who transfer from a district that does not require MassCore completion to a district that does require it. One district reported that students who transfer into the district as seniors from districts that don't require MassCore are seldom able to graduate in June.

Interviews with five district data administrators focused on district processes for determining MassCore completion status, including any challenges encountered and technical assistance needed. It was clear that processes vary widely across districts and in some cases represent a substantial work burden. Two districts said that guidance staff review students' individual transcripts by hand, and one district said that software calculated completion status based on course codes and grades entered into a student information system. One district said that they don't calculate students' completion status because they know that no students have completed MassCore requirements. In the final district whose data administrator was interviewed, MassCore completion status had not been calculated prior to UMDI's initial interview. However, follow-up revealed that the district had subsequently calculated completion status for all students via transcript review. This district noted that UMDI's interview was a catalyst for completing this process.

Four out of five districts reported challenges or questions related to determining a students' MassCore completion status; only one district reported that the process was entirely straightforward. Challenges included issues related to applying physical education (PE) requirements uniformly, lack of alignment between MassCore requirements and typical course scheduling at career and technical education schools, and a perceived conflict between MassCore and existing graduation requirements. Specifically, one district does not want to introduce MassCore requirements, because they anticipate that doing so would

further reduce their already low graduation rates. They are currently more accountable for increasing their graduation rate than their MassCore completion rate, so they prioritize the graduation rate.

This is consistent with the greatest challenge reported by ESE—that MassCore completion did not become a statewide graduation requirement as ESE had hoped, leading many districts to prioritize initiatives other than MassCore. ESE reported that in order to promote greater MassCore completion, they have therefore needed to utilize strategies that are more labor-intensive and apparently less effective in achieving higher completion rates, such as making presentations about MassCore at gatherings of educators who have convened for other reasons. Nonetheless, they reported that many districts have adopted all or part of MassCore as a graduation requirement during the RTTT funding period. ESE anticipates that MassCore completion rates will increase in upcoming years as the students affected by these changes reach graduation.

Strategic Considerations

ESE remains invested in raising rates of MassCore completion statewide. The strategic considerations below—a subset of those included in the three annual evaluation reports—were selected to provide support in achieving and assessing progress toward that goal.

- **Most districts appear to see substantial value in raising MassCore completion rates**, but limited accountability for doing so may subordinate MassCore among district priorities. Nonetheless, a recent ESE study indicated that about twice as many schools have MassCore as a graduation requirement in 2015 than in 2010[8], suggesting that an increase in completion rates may be evident in upcoming graduation classes.
- **Improved accuracy of MassCore reporting should be attainable through low-demand actions and interventions.** Districts are eager both to report accurately and to increase actual completion rates. Continued education and outreach efforts might therefore achieve important successes. Such outreach might include working with districts that have low, decreasing, and/or unlikely patterns of MassCore completion, and enlisting districts that have high and/or increasing patterns of MassCore completion to serve as models that could help other districts improve. In addition, if ESE lacks the resources to conduct conversations and/or audits with each district, a district self-audit tool may be successful in clarifying basic misconceptions, such as those described in the interview findings above. Such a tool could include a series of questions and checkboxes to help districts ascertain whether they understand the components of MassCore completion and reporting them accurately.
- **ESE could leverage its limited MassCore advocacy and support resources by:** (1) Providing additional online materials that share strategies utilized and lessons learned by districts that have adopted MassCore as a graduation requirement. (2) Establishing an official contact in each district that is most knowledgeable about the district's status, history, and plans related to MassCore implementation. Having this information would facilitate dissemination of advocacy and support resources, as well as research and evaluation.
- **Accuracy of the MassCore indicator would be increased by enabling districts to report alternative ways that students have fulfilled MassCore requirements.** Regardless of whether ESE continues to determine MassCore completion from the SIMS database or transitions to SCS,

[8] Fuentes, Nyal. "Graduation requirements for the class of 2015 and MassCore: A survey of Massachusetts high schools." PowerPoint presentation. Malden, MA: Department of Elementary and Secondary Education. 16 October 2015.

schools would benefit from support in creating policies to recognize alternatives (e.g., athletic team participation for meeting physical education requirements) and record those alternatives in information management systems. If ESE transitions to calculating MassCore completion from SCS, that database might require new data elements and/or codes to recognize alternatives to traditional courses.

- **Clarifying the relationship between physical education requirements and MassCore completion could improve reporting accuracy.** The vagueness of Massachusetts law regarding PE requirements makes achieving that clarity challenging. Moreover, the available MassCore guidance documents suggest a reluctance to acknowledge that meeting the requirements could be accomplished by five minutes of almost any physical activity, or that students are apparently required to take PE but not to pass it. Nonetheless, while it is clear that some districts are providing adequate PE to meet the letter of the law, only some of these districts are counting those activities toward MassCore completion. These districts also seem to be making minimal use of their ability to count extracurricular athletic activities toward MassCore completion, as at least one district that reported 0 percent MassCore completion based on perceived PE shortcomings surely had students who were participating in substantial extracurricular athletic activities.
- **A MassCore exemption process may reduce some districts' concerns about conflicting mandates and priorities.** Districts said that some high-performing students, who excel on typical measures of academic achievement, may fall short of MassCore requirements due to taking Advanced Placement courses, or developing advanced art portfolios that prevent them from taking some required MassCore coursework. In addition, some students with severe learning disabilities may be unable to complete MassCore requirements, and being required to do so may be inconsistent with their IEPs. Some districts also lack costly infrastructure, such as adequate physical education facilities, that is needed for students to complete MassCore. The state may wish to consider whether there are cases in which conflicting priorities warrant exemption from specific MassCore requirements. Permitting certain extended and out-of-school learning opportunities to meet MassCore requirements may also address some of these concerns.
- **Adding one or more codes to the SIMS MassCore element could enable tracking of valid exemptions from MassCore completion.** In the MassCore administrator survey, one district reported that a substantial percentage of students were considered exempt from completing MassCore requirements due to IEPs and medical conditions. To the extent that ESE considers certain types of exemptions valid, enabling districts to report on those exemptions could yield a more accurate calculation of MassCore completion by non-exempt students. Using the current approach to MassCore reporting, this could include adding one or more "exemption codes" to the MassCore data element in SIMS. If calculation of MassCore completion transitions to SCS, one way to track exemptions would be to repurpose the SIMS code so that it was used solely for reporting whether a student was exempt from MassCore completion. Tracking exemptions would also require ESE to educate districts about what exemptions the state considers valid.
- **ESE may wish to work toward having the SCS database replace the MassCore indicator in SIMS.** (ESE has already discussed with UMDI that this change is being considered.) Once SCS gains sufficient years of data, it may be possible to use SCS to determine MassCore completion status for most students, although not for those who transfer into the state having already earned some high school credits. While this would circumvent some of the potential inaccuracies and misunderstandings in district reporting, it would of course be subject to inaccuracies in district reporting of student course completion, and would require the ability to draw clear conclusions regarding whether courses reported in SCS meet the requirements of specific Massachusetts Curriculum Frameworks.

- **Current tracking of school and district progress toward MassCore adoption could be improved, while reducing burden on ESE, via a very brief annual survey of Massachusetts high schools.** ESE has conducted a survey of high school graduation requirements five times in the past ten years, most recently by reviewing requirements that schools posted on their websites. Particularly if a statewide survey of any school-level information is already conducted, several questions could be added asking whether schools require each of the MassCore elements (e.g., four years of English, four years of mathematics). Such a survey would be a small burden on districts, substantially decrease the burden on ESE, enable this information to be collected annually, and increase the likelihood that some of the schools not included in the most recent survey would participate in future surveys. ESE would still have the option of reviewing online materials of schools that did not respond. Such a survey might also incorporate brief questions about other school-level issues of high priority to ESE that are currently unavailable, or only available through labor-intensive means.

Appendices

Appendix A: Modeling Procedures for Comparative Interrupted Time Series (CITS) Analyses

Modeling Procedure 1

For each academic discipline (i.e., ELA, mathematics, and science), a CITS model was developed to assess the impact of the Pre-AP intervention on (a) districts' average MCAS performance one year after the program began, and (b) the trend (i.e., the slope) of MCAS scores during the three-year period after the program began. Procedure 1 was used for all 75 of the CITS analysis models. The following equation represents Procedure 1:

$$Y_{it} = \beta_0 + \beta_1 Time_t, + \beta_2 Intervention_t + \beta_3 Time_t Intervention_t + \beta_4 Participant_i + \beta_5 Participant_i Time_t + \beta_6 Participant_i Intervention_t + \beta_4 Participant_i Time_t Intervention_t + u_i + e_{it}$$

In this model, Y_{it} is the outcome measure for a district *i* at time *t*. $Time_t$ is the time in years since the start of the study. $Intervention_t$ is an indicator of whether or not a district was participating in the intervention at time *t*. $Time_t Intervention_t$ is an interaction between $Time_t$ and $Intervention_t$. $Participant_i$ is an indicator for a district *i* that participated in the Pre-AP program (by academic discipline). $Participant_i Time_t$, $Participant_i Intervention_t$, and $Participant_i Time_t Intervention_t$ are interaction terms used in comparisons of multiple groups. Random effects were included to account for district and individual observation effects by adding a random error term for each district (u_i), and individual observations (e_{it}).

The β_0 to β_3 coefficients represent the control group; The β_4 to β_7 coefficients represent differences between the treatment and control groups. β_1 represents the slope, or trajectory of the outcome variable until the introduction of the intervention. β_2 represents the change in the level of the outcome variable that occurs in the period immediately following the introduction of the intervention. β_3 represents the difference between pre- and post-intervention slopes of the outcome. β_4 represents the difference in the level (intercept) between treatment and control prior to intervention; β_5 represents the difference in the slope between treatment and control prior to intervention; β_6 represents the impact of the Pre-AP program on districts' average MCAS performance or achievement gap one year after the program began. $\beta 7$ represents the impact of the Pre-AP program on the trend (i.e., the slope) of MCAS scores or achievement gap during the three-year period after the program began.

Two parameters, β_4 and β_5, play a role in establishing whether the treatment and control groups are balanced on both the level and trajectory of the outcome variable in the pre-intervention period. If these data were from a randomized controlled trial, we would expect similar levels and slopes prior to the intervention. However, in an observational study where equivalence between groups cannot be assumed, any observed differences will likely raise concerns about the ability to draw causal inferences about the relationship between the intervention and the outcomes (Linden and Adams, 2011). When the value for β_4 and/or β_5 is statistically significant, it indicates that, despite propensity score weighting, significant pre-intervention differences in Pre-AP and comparison districts' MCAS performance remained.

Modeling Procedure 2

As described in the findings section, Procedure 2 did not converge for the majority of models, suggesting that the data were better suited to analysis under Procedure 1. Therefore, all findings in the report are based on Procedure 1. Nonetheless, Procedure 2 is described here for interested readers.

For each academic discipline, a second CITS model was developed to assess the impact of Pre-AP training on districts' average 10th-grade MCAS performance one, two, and three years after implementation. UMDI used the following equation for the CITS model:

$$Y_{it} = \beta_0 + \beta_1 Participant_i + \beta_2 Time_t + \beta_3 Participant_i Time_t + \beta_4 YearOne_{it} + \beta_5 YearTwo_{it} + \beta_6 YearThree_{it} + \beta_7 T12_t + \beta_8 T13_t + \beta_9 T14_t + v_t + u_j + e_{it}$$

In this model, Y_{it} is the outcome measure for a district *i* at time *t*. $Time_t$ is the number of years since the start of the study. $Participant_i$ is an indicator for a district *i* that participated in the Pre-AP program (by academic discipline). $Participant_i Time_t$ is an interaction between $Participant_i$ and $Time_t$. $YearOne_{it}$, $YearTwo_{it}$, and $YearThree_{it}$ are indicators for whether district *i* at time *t* was participating in the Pre-AP intervention. $T12_t$, $T13_t$, and $T14_t$ are binary variables representing years 2012, 2013, and 2014.

The β_0 coefficient represents the intercept, or starting level of the outcome variable for the control group. The β_1 coefficient represents the difference in means between the 2008 (pre-treatment) outcome score of treatment and control districts. The β_2 coefficient represents 2008-2011 trend in the outcome measure for comparison districts. The β_3 coefficient represents the difference in the 2008-2011 trend in the outcome measure between treatment and comparison districts.

Accounting for all district outcomes across time, the β_4, β_5, and β_6 coefficients in the model represent the difference in differences of outcomes between the participating districts and comparison districts prior to and one, two, and three years after beginning participation in the Pre-AP intervention (i.e., the one-year, two-year, and three-year post-treatment effects).

β_7, β_8, and β_9 are the differences in mean outcomes for treatment and comparison districts in 2012, 2013, and 2014 respectively compared to the 2007–2010 outcome trend (i.e., what would have been expected of Pre-AP schools in these years in the absence of Pre-AP training).

Random effects were included to account for district, cohort, and individual observation effects by adding a random error term for each district (v_t), time (u_i), and individual observation (e_{it}).

Appendix B: Impacts of Pre-AP Training on MCAS Scores – CITS Parameter Estimates

Tables 1–10 present the CITS outcomes for student achievement on the 10th-grade ELA, mathematics, and science MCAS assessments. Results are presented for each academic discipline for all students (Table 1), student subgroups (Tables 2–4), achievement gaps (Tables 5–7), and districts with the highest implementation intensity (Tables 8–10).

For each model, β6 represents the impact of the Pre-AP program on districts' average MCAS performance or achievement gap one year after the program began. β7 represents the impact of the Pre-AP program on the trend (i.e., the slope) of MCAS scores or achievement gap during the three-year period after the program began.

Table 1: Impacts of Pre-AP Training on MCAS Scores of All Students, by Discipline

Parameter	ELA°	Mathematics∞	Science°
Intercept (β_0)	246.81*** (1.05)	250.21*** (0.87)	239.68*** (1.21)
Time (β_1)	0.97*** (0.27)	0.79** (0.24)	1.43*** (0.27)
Intervention Period (β_2)	2.94*** (0.47)	0.21 (0.55)	0.15 (0.44)
Time by Intervention (β_3)	0.69+ (0.36)	-0.94** (0.36)	-0.85 (0.57)
Participant (β_4)	0.95 (1.27)	-1.01 (1.09)	-0.26 (1.41)
Participant by Time (β_5)	0.13 (0.29)	-0.06 (0.26)	-0.19 (0.32)
Participation by Intervention (β_6)	0.96+ (0.58)	-0.38 (0.71)	-0.24 (0.59)
Participation by Time by Intervention (β_7)	-0.13 (0.43)	0.24 (0.41)	0.60 (0.66)

Note: Standard errors are presented in parentheses.
*** p <0.001, ** p <0.01 , * p <0.05, + p < 0.1
° After weighting, the treatment and control groups were partially balanced.
∞ Mathematics did not achieve full or partial balance after propensity score weighting. With a standardized bias of 0.26, the sample fell just short of the cutoff of 0.25 for reporting. As further explained in the methods section, findings are not reported for models that did not achieve full or partial balance. That rule is violated in this one case, however, in order to be able to report that no significant differences were found for mathematics.

Table 2: Impacts of Pre-AP Training on MCAS Scores of Student Subgroups, ELA						
Parameter	**White°**	**Afr. Amer./ Black°**	**Asian°**	**Amer. Ind. or Alaska Nat., Nat. Haw. or Pacif. Isl., Multi-Racial°**	**Female°**	**ELL°**
Intercept (β_0)	248.55*** (0.96)	240.70*** (1.93)	246.34*** (1.50)	243.51 (2.40)	248.87*** (1.08)	227.47*** (1.44)
Time (β_1)	0.75** (0.26)	1.36** (0.51)	1.36 (0.84)	1.63 (0.55)	0.92*** (0.25)	0.41 (0.79)
Intervention Period (β_2)	4.05*** (0.72)	3.57*** (0.84)	-0.18 (2.71)	1.00 (2.17)	2.98*** (0.32)	6.95* (3.32)
Time by Intervention (β_3)	-0.61 (0.55)	-1.69 (1.38)	0.01 (0.75)	-0.56 (0.94)	-0.73 (0.51)	0.39 (1.69)
Participant (β_4)	-0.97 (1.19)	-0.37 (2.18)	-2.01 (2.47)	0.11 (3.04)	-0.97 (1.29)	-1.89 (1.97)
Participant by Time (β_5)	0.36 (0.29)	-0.20 (0.59)	0.65 (1.00)	-0.31 (0.80)	0.08 (0.27)	0.65 (0.88)
Participation by Intervention (β_6)	-2.14** (0.79)	-1.06 (1.46)	1.07 (2.94)	1.57 (2.85)	-0.60 (0.51)	-4.23 (3.79)
Participation by Time by Intervention (β_7)	-0.19 (0.63)	-0.010 (1.47)	-1.51 (1.02)	-1.56 (1.16)	0.05 (0.56)	-2.25 (1.96)

Note: Standard errors are presented in parentheses.

*** p <0.001, ** p <0.01 , * p <0.05, $^{+}$p < 0.1

° After weighting, the treatment and control groups were partially balanced.

Table 3: Impacts of Pre-AP Training on MCAS Scores of Student Subgroups, Mathematics								
Parameter	**White°**	**Afr. Amer./ Black°**	**Asian°**	**Hispanic/Latino°**	**Amer. Ind. or Alaska Nat., Nat. Haw. or Pacif. Isl., Multi-Racial°**	**Male°**	**Low Income°**	**SWD°**
Intercept (β_0)	250.78*** (0.99)	241.98*** (3.23)	254.63*** (1.25)	239.19*** (2.73)	247.04*** (2.45)	249.07*** (1.74)	241.60*** (1.56)	230.33*** (1.00)
Time (β_1)	0.92** (0.31)	0.24 0.91	1.18** (0.45)	1.72+ (0.94)	0.97 (1.08)	1.13* (0.55)	1.29* (0.52)	0.60* (0.27)
Intervention Period (β_2)	-0.09 (0.68)	2.22 (1.71)	-3.72+ (2.18)	-0.28 (2.20)	0.69 (4.23)	-0.72 (1.04)	-0.50 (1.16)	1.07 (1.40)
Time by Intervention (β_3)	-0.98+ (0.52)	-0.42 (1.89)	-0.36 (0.87)	-1.52+ (0.79)	-1.27 (1.23)	-1.31* (0.61)	-1.04+ (0.63)	-0.30 (0.58)
Participant (β_4)	-0.52 (1.18)	-2.12 (3.55)	0.25 (1.97)	1.01 (2.96)	-1.78 (2.91)	0.21 (1.86)	-0.09 (1.69)	-0.01 (1.40)
Participant by Time (β_5)	-0.15 (0.33)	0.41 (.99)	-0.43 (0.62)	-0.88 (0.99)	0.17 (1.15)	-0.53 (0.57)	-0.39 (0.5)	-0.13 (0.35)
Participation by Intervention (β_6)	0.00 (0.78)	-1.92 (2.45)	3.95 (2.61)	0.49 (2.49)	-2.94 (4.44)	0.40 (1.18)	0.59 (1.34)	-1.31 (1.55)
Participation by Time by Intervention (β_7)	0.35 (0.57)	-0.89 (2.11)	-1.38 (1.12)	0.29 (1.02)	-0.56 (1.78)	0.61 (0.65)	0.20 (0.71)	0.59 (0.77)

Note: Standard errors are presented in parentheses.

*** p <0.001, ** p <0.01 , * p <0.05, $^{+}$p < 0.1

° After weighting, the treatment and control groups were partially balanced.

Table 4: Impacts of Pre-AP Training on MCAS Scores of Student Subgroups, Science								
Parameter	**White°**	**Afr. Amer./ Black°**	**Asian°**	**Hispanic/Latino°**	**Amer. Ind. or Alaska Nat., Nat. Haw. or Pacif. Isl., Multi-Racial°**	**Female°**	**Low Income°**	**SWD°†**
Intercept (β_0)	240.02*** (1.19)	231.14*** (2.25)	240.98*** (2.21)	230.32*** (1.73)	238.23*** (1.59)	239.90*** (0.97)	231.83*** (1.15)	225.81*** (0.55)
Time (β_1)	1.50*** (0.23)	1.24* (0.49)	1.62+ (0.83)	1.97*** (0.38)	1.11 (0.81)	1.38*** (0.23)	1.73*** (0.25)	2.36*** (0.30)
Intervention Period (β_2)	0.09 (0.46)	1.97 (1.49)	-3.73 (2.96)	-0.15 (0.78)	1.54 (3.25)	0.01 (0.41)	-0.16 (0.58)	-6.06*** (1.48)
Time by Intervention (β_3)	-0.86 (0.54)	0.69 (1.4)	1.27 (0.94)	-1.37* (0.61)	0.36 (1.31)	-0.53 (0.43)	-1.14* (0.52)	-1.82*** (0.43)
Participant (β_4)	0.33 (1.39)	0.52 (2.59)	0.97 (2.66)	0.81 (1.91)	-1.57 (1.99)	-0.61 (1.24)	0.09 (1.29)	1.67+ (0.87)
Participant by Time (β_5)	-0.23 (0.27)	0.20 (0.64)	-0.46 (0.92)	-0.22 (0.45)	0.34 (0.88)	-0.11 (0.28)	-0.17 (0.31)	-0.80* (0.34)
Participation by Intervention (β_6)	-0.40 (0.66)	2.99 (2.04)	5.17 (3.25)	-1.82 (1.48)	-3.70 (3.77)	-0.04 (0.62)	0.08 (0.86)	1.86 (1.59)
Participation by Time by Intervention (β_7)	0.76 (0.64)	0.72 (1.66)	-1.33 (1.39)	0.39 (1.01)	-0.66 (1.59)	0.32 (0.57)	0.14 (0.70)	0.79 (0.54)

Note: Standard errors are presented in parentheses.

*** p <0.001, ** p <0.01 , * p <0.05, $^{+}$p < 0.1

° After weighting, the treatment and control groups were partially balanced.

† After weighting, model results indicate that there were significant differences in treatment and control groups' MCAS performance prior to treatment.

Table 5: Impacts of Pre-AP Training on MCAS Score Achievement Gaps, ELA		
Parameter	**White; Amer. Ind. or Alaska Nat., Nat. Haw. or Pacif. Isl., Multi-Racial°**	**Non-SWD, SWD°**
Intercept (β_0)	13.19*** (2.99)	49.18*** (2.75)
Time (β_1)	-3.33*** (0.81)	-0.11 (0.65)
Intervention Period (β_2)	6.38 (4.71)	-15.39*** (1.54)
Time by Intervention (β_3)	2.73 (4.04)	-1.65 (1.15)
Participant (β_4)	-2.39 (6.12)	2.91 (3.60)
Participant by Time (β_5)	1.42 (1.71)	-0.75 (0.94)
Participation by Intervention (β_6)	-5.31 (6.02)	7.37** (2.76)
Participation by Time by Intervention (β_7)	-2.22 (4.40)	1.46 (2.03)

Note: Standard errors are presented in parentheses.
*** p <0.001, ** p <0.01 , * p <0.05, $^{+}$p < 0.1
° After weighting, the treatment and control groups were partially balanced.

Table 6: Impacts of Pre-AP Training on MCAS Score Achievement Gaps, Mathematics			
Parameter	**Female, Male°**	**White; Amer. Ind. or Alaska Nat., Nat. Haw. or Pacif. Isl., Multi-Racial°**	**Not Low Income, Low Income°**
Intercept (β_0)	1.68 (1.45)	3.03 (4.82)	19.23*** (1.81)
Time (β_1)	-0.01 (0.51)	0.07 (2.02)	-0.10 (0.70)
Intervention Period (β_2)	0.86 (1.59)	-3.12 (8.05)	-0.99 (2.05)
Time by Intervention (β_3)	-0.36 (1.27)	4.01 (2.51)	0.52 (1.40)
Participant (β_4)	-1.14 (1.77)	3.70 (6.42)	-1.07 (2.64)
Participant by Time (β_5)	0.43 (0.60)	-0.24 (2.39)	0.09 (0.83)
Participation by Intervention (β_6)	-0.28 (1.99)	3.63 (9.27)	-1.96 (2.75)
Participation by Time by Intervention (β_7)	1.06 (1.39)	0.20 (4.01)	1.23 (1.81)

Note: Standard errors are presented in parentheses.
*** p <0.001, ** p <0.01 , * p <0.05, $^{+}$ p < 0.1
° After weighting, treatment and control groups were partially balanced.

Table 7: Impacts of Pre-AP Training on MCAS Score Achievement Gaps, Science						
Parameter	**Female, Male°**	**White, Asian°**	**White, Hispanic/Latino°**	**White; Amer. Ind. or Alaska Nat., Nat. Haw. or Pacif. Isl., Multi-Racial°**	**Not Low Income, Low Income°**	**Non-SWD, SWD°**
Intercept (β_0)	-0.85 (2.24)	3.82 (4.50)	17.66*** (3.08)	6.66 (5.48)	25.60*** (1.92)	42.50*** (3.83)
Time (β_1)	0.03 (0.80)	-1.34 (1.96)	0.59 (1.23)	1.05 (2.15)	-1.44* (0.63)	2.93* (1.14)
Intervention Period (β_2)	1.39 (2.79)	8.32 (5.37)	-5.31 (3.93)	-5.60 (7.86)	0.77 (2.03)	-5.17* (2.27)
Time by Intervention (β_3)	-1.19 (1.33)	-2.18 (3.75)	1.48 (1.75)	-1.04 (3.21)	2.20* (0.90)	-4.12* (2.00)
Participant (β_4)	-1.29 (2.61)	-5.63 (6.29)	3.43 (4.36)	5.05 (6.65)	-1.27 (2.77)	2.00 (4.21)
Participant by Time (β_5)	0.31 (0.90)	2.13 (2.44)	-1.07 (1.55)	-1.76 (2.43)	0.70 (0.82)	-1.71 (1.26)
Participation by Intervention (β_6)	-1.02 (3.27)	-12.29 (7.52)	5.04 (5.82)	8.96 (10.21)	-0.28 (2.91)	4.82 (3.19)
Participation by Time by Intervention (β_7)	2.05 (1.52)	-0.80 (4.28)	1.55 (2.51)	0.87 (4.28)	0.02 (1.47)	3.64 (2.43)

Note: Standard errors are presented in parentheses.
*** p <0.001, ** p <0.01 , * p <0.05, $^{+}$p < 0.1
° After weighting, treatment and control groups were partially balanced.

Table 8: Impacts of Pre-AP Training on MCAS Scores in Districts with Highest Implementation Intensity, ELA						
Parameter	**All Training, Student Density°**	**All Training, Teacher Density°**	**First Year Student Density°**	**First Year Teacher Density°,Δ**	**One or More Years of Training, Student Density°**	**One or More Years of Training, Teacher Density°**
Intercept (β_0)	246.46*** (1.94)	243.59*** (1.96)	242.07*** (2.60)	244.94*** (1.12)	245.77*** (1.67)	243.59*** (1.96)
Time (β_1)	0.92*** (0.23)	0.98*** (0.28)	1.65** (0.49)	0.81*** (0.18)	1.04*** (0.23)	0.98*** (0.28)
Intervention Period (β_2)	3.04*** (0.43)	3.22*** (0.47)	1.96* (0.80)	3.10*** (0.62)	2.89*** (0.45)	3.22*** (0.47)
Time by Intervention (β_3)	-0.51+ (0.20)	-0.50 (0.44)	-1.32* (0.65)	-0.21 (0.27)	-0.60* (0.28)	-0.50 (0.44)
Participant (β_4)	-0.99 (3.24)	-0.90 (2.94)	-0.91 (3.77)	-0.86 (2.10)	-1.16 (2.60)	-0.90 (2.94)
Participant by Time (β_5)	0.16 (0.35)	0.07 (0.38)	0.07 (0.66)	0.39 (0.31)	0.27 (0.33)	0.07 (0.38)
Participation by Intervention (β_6)	-0.54 (0.77)	-0.93 (0.76)	-1.30 (1.96)	-1.58 (1.21)	-1.01 (0.75)	-0.93 (0.76)
Participation by Time by Intervention (β_7)	-0.73 (0.65)	-0.40 (0.67)	-0.27 (0.73)	-0.55 (0.47)	-0.63 (0.60)	-0.40 (0.67)

Note: Standard errors are presented in parentheses.
*** p <0.001, ** p <0.01 , * p <0.05, $^{+}$p < 0.1
° After weighting, the treatment and control groups were partially balanced.
$^{\Delta}$To achieve partial balance, this model utilized the 10 highest districts on this implementation intensity indicator. Other models utilized the five highest districts.

Table 9: Impacts of Pre-AP Training on MCAS Scores in Districts with Highest Implementation Intensity, Mathematics						
Parameter	**All Training, Student Density°**	**All Training, Teacher Density**	**First Year Student Density**	**First Year Teacher Density**	**One or More Years of Training, Student Density°**	**One or More Years of Training, Teacher Density**
Intercept (β_0)	246.04*** (0.97)	246.87*** (0.91)	249.96*** (1.22)	248.53*** (1.10)	249.69*** (1.72)	245.96*** (0.93)
Time (β_1)	0.87*** (0.17)	1.06*** (0.18)	1.20*** (0.32)	0.81** (0.23)	1.27* (0.51)	1.08*** (0.22)
Intervention Period (β_2)	0.28 (0.40)	0.06 (0.44)	0.00 (0.591)	0.50 (0.49)	-0.48 (0.95)	0.12 (0.48)
Time by Intervention (β_3)	-0.81* (0.32)	-1.16*** (0.27)	-1.57*** (0.40)	-0.69* (0.30)	-1.47* (0.63)	-1.12*** (0.32)
Participant (β_4)	-0.74 (3.03)	-0.15 (2.63)	-1.48 (2.76)	-0.43 (3.34)	-1.37 (3.59)	-0.25 (2.23)
Participant by Time (β_5)	0.07 (0.34)	0.07 (0.33)	0.020 (0.45)	0.20 (0.33)	-0.13 (0.62)	0.10 (0.31)
Participation by Intervention (β_6)	-1.06 (0.65)	-0.99 (0.67)	-3.25* (1.367)	-2.32** (0.67)	-2.49 (1.56)	-1.41* (0.57)
Participation by Time by Intervention (β_7)	-0.55 (0.82)	-0.92+ (0.48)	0.48 (1.47)	-0.26 (1.49)	0.32 (1.04)	-0.53 (0.63)

Note: Standard errors are presented in parentheses.
*** p <0.001, ** p <0.01 , * p <0.05, $^{+}$p < 0.1
° After weighting, the treatment and control groups were partially balanced.

Table 10: Impacts of Pre-AP Training on MCAS Scores in Districts with Highest Implementation Intensity, Science						
Parameter	**All Training, Student Density†**	**All Training, Teacher Density°, Δ**	**First Year Student Density**	**First Year Teacher Density**	**One or More Years of Training, Student Density†**	**One or More Years of Training, Teacher Density°, Δ**
Intercept (β_0)	237.52*** (1.00)	236.24*** (1.10)	240.21*** (0.83)	240.28*** (0.75)	237.52*** (1.00)	235.87*** (1.19)
Time (β_1)	1.45*** (0.18)	1.39*** (0.14)	1.09*** (0.14)	1.33*** (0.13)	1.45*** (0.18)	1.57*** (0.18)
Intervention Period (β_2)	-0.61 (0.74)	-0.34 (0.44)	0.35 (0.36)	-0.09 (0.31)	-0.61 (0.74)	-0.67 (0.49)
Time by Intervention (β_3)	-0.56* (0.22)	-0.57** (0.21)	-0.46+ (0.24)	-0.78** (0.24)	-0.56* (0.22)	-0.90** (0.28)
Participant (β_4)	-2.60+ (1.46)	0.13 (1.81)	-2.28 (2.22)	-2.23 (2.00)	-2.60+ (1.46)	0.50 (1.86)
Participant by Time (β_5)	0.26 (0.50)	0.16 (0.33)	0.34 (0.60)	0.27 (0.55)	0.26 (0.50)	0.07 (0.34)
Participation by Intervention (β_6)	-0.59 (1.72)	-0.25 (0.98)	-0.66 (1.73)	-0.51 (1.64)	-0.59 (1.72)	-0.30 (0.99)
Participation by Time by Intervention (β_7)	-0.51 (0.40)	-0.89* (0.40)	-0.40 (0.47)	-0.75 (0.46)	-0.51 (0.40)	-0.07 (0.47)

Note: Standard errors are presented in parentheses.
*** p <0.001, ** p <0.01 , * p <0.05, + p < 0.1
° After weighting, the treatment and control groups were partially balanced.
Δ To achieve partial balance, this model utilized the 10 highest districts on this implementation intensity indicator. Other models utilized the five highest districts.
† After weighting, model results indicate that there were significant differences in treatment and control groups' MCAS performance prior to treatment.

Appendix C: MassCore Completion Rates and Trend Codes by District 2009–2014

MassCore Completion Rate Trend Codes		
Codes	**Label**	**Definition**
.	Uncoded	No other primary or secondary trend codes were applicable.
1	Limited data (years)	District did not report all six years of data.
2	Limited data (grads)	District did not have at least 20 graduates each year.
3	Consistently high	Greater than or equal to 80 percent each year, but not all 100 percent.
4	Consistently moderate	Between 50 percent and 80 percent each year.
5	Consistently low	Less than or equal to 50 percent each year, but not all 0 percent.
6	Spike up	Rate increased 30 percent or more in a single year, and then decreased 30 percent or more in a subsequent year.
7	Spike down	Rate decreased 30 percent or more in a single year, and then increased 30 percent or more in a subsequent year.
8	Major jump up	Rate increased 30 percent or more in a single year.
9	Major jump down	Rate decreased 30 percent or more in a single year.
10	Multiple spikes	In three consecutive years, rates increased, then decreased, then increased again; or decreased, then increased, then decreased again. Each change was at least 30 percent.
11	Steady increase	Rate increased at least twice, and never decreased.
12	Steady decrease	Rate decreased at least twice, and never increased.
13	All 100%	District reported 100 percent MassCore completion all 6 years.
14	All 0%	District reported 0 percent MassCore completion all 6 years.

MassCore Completion Rates by District, School Years 2009 through 2014							
District	**Trend Code**	**MassCore Completion (%)**					
		SY09	**SY10**	**SY11**	**SY12**	**SY13**	**SY14**
Abington	9	100	99	100	50	53	37
Abby Kelley Foster	13	100	100	100	100	100	100
Academy of the Pacific Rim	13	100	100	100	100	100	100
Acton-Boxborough	7	99	59	79	67	27	71
Acushnet	1	n/a	60	n/a	100	100	100
Adams-Cheshire	5	50	18	18	27	19	35
Advanced Math and Science Academy	1	n/a	n/a	100	100	100	100

Agawam	.	1	66	56	43	40	71
Amesbury	3	100	100	99	100	100	100
Amesbury Academy	2	100	100	100	100	100	100
Amherst-Pelham	7	99	100	0	0	48	41
Andover	13	100	100	100	100	100	100
Arlington	.	74	100	79	100	100	100
Ashburnham-Westminster	4	69	64	72	62	72	56
Ashland	.	66	92	87	84	82	81
Assabet Valley RVT	3	100	88	92	92	91	89
Athol-Royalston	3	100	96	100	100	100	97
Attleboro	.	100	100	100	84	96	79
Auburn	.	35	40	59	79	83	82
Avon	8	100	100	78	66	100	98
Ayer	1	100	3	41	n/a	n/a	n/a
Ayer-Shirley	1	n/a	n/a	0	19	28	33
Barnstable	5	0	27	25	0	2	0
Bedford	9	91	60	76	88	97	97
Belchertown	9	100	31	49	42	27	22
Bellingham	3	100	99	99	100	99	100
Belmont	3	100	99	100	100	100	100
Berkley	1	100	100	n/a	n/a	n/a	n/a
Berkshire Arts and Technology	2	100	100	100	56	86	92
Berkshire Hills	8	40	34	32	20	100	100
Berlin-Boylston	3	81	88	93	84	100	94
Beverly	9	100	53	72	72	96	98
Billerica	.	100	100	72	67	74	100
Blackstone Valley RVSD	.	78	77	86	88	94	96
Blackstone-Millville	.	100	100	100	72	100	100
Blue Hills RVT	7	100	100	96	39	28	100
Boston	9	100	33	36	32	39	38
Boston Collegiate	13	100	100	100	100	100	100
Boston Day and Evening Academy	13	100	100	100	100	100	100
Boston Green Academy	1	n/a	n/a	n/a	100	100	6
Boston Preparatory Charter	1	n/a	n/a	100	100	100	100
Bourne	13	100	100	100	100	100	100
Braintree	3	95	88	92	97	96	97
Bridgewater-Raynham	7	100	93	89	88	3	100
Bristol County Agricultural	10	0	100	0	0	100	100
Bristol-Plymouth RVT	13	100	100	100	100	100	100
Brockton	5	20	16	24	26	23	20
Brooke Charter School Mattapan	1	n/a	n/a	n/a	0	n/a	n/a
Brookline	3	97	93	97	91	93	91

Burlington	3	99	96	97	100	100	100
Cambridge	7	49	65	74	1	86	86
Canton	.	100	79	83	70	85	86
Cape Cod RVT	8	0	0	21	19	100	97
Carver	3	100	99	100	100	98	100
Central Berkshire	.	28	39	54	48	40	55
Champion Charter	1	n/a	n/a	n/a	n/a	n/a	n/a
Chatham	1	98	100	100	100	n/a	n/a
Chelmsford	13	100	100	100	100	100	100
Chelsea	9	100	100	91	87	74	2
Chicopee	10	2	46	49	100	18	40
City On A Hill	3	100	100	100	97	100	100
Clinton	.	100	99	78	58	79	64
Codman Academy	2	100	100	100	100	100	100
Cohasset	3	100	100	97	100	100	100
Community Charter School of Cambridge	2	100	100	95	100	100	100
Concord	1	n/a	n/a	100	n/a	n/a	n/a
Concord-Carlisle	13	100	100	100	100	100	100
Danvers	3	97	99	100	100	100	100
Dartmouth	7	89	0	74	88	88	95
Dedham	6	0	59	27	41	45	47
Dennis-Yarmouth	8	64	57	52	58	59	94
Dighton-Rehoboth	13	100	100	100	100	100	100
Douglas	6	0	67	59	57	63	34
Dover-Sherborn	13	100	100	100	100	100	100
Dracut	13	100	100	100	100	100	100
Dudley-Charlton Regional	9	100	40	43	44	48	55
Duxbury	3	100	100	95	100	100	100
East Bridgewater	7	100	54	17	99	100	99
East Longmeadow	3	89	90	84	86	86	83
Easthampton	7	99	100	31	99	100	92
Easton	13	100	100	100	100	100	100
E. M. Kennedy Acad. for Health Careers	6	20	100	0	0	0	0
Erving	1	n/a	n/a	100	n/a	100	n/a
Essex Agricultural and Technical	13	100	100	100	100	100	100
Everett	.	35	31	40	33	52	76
Excel Academy	1	n/a	n/a	0	n/a	n/a	n/a
Fairhaven	3	100	100	100	100	93	94
Fall River	5	3	0	14	27	28	28
Falmouth	11	4	9	12	31	42	61

Fitchburg	9	100	100	99	69	73	77
Four Rivers Charter	2	100	100	63	97	100	72
Foxboro Regional Charter	13	100	100	100	100	100	100
Foxborough	10	100	13	97	100	6	9
Framingham	8	2	0	0	0	2	94
Francis W. Parker Charter Essential	3	100	100	100	99	93	89
Franklin	8	0	88	100	100	100	100
Franklin County RVT	10	0	42	0	100	0	96
Freetown-Lakeville	.	45	35	53	38	35	18
Frontier	8	39	72	80	68	71	76
Gardner	9	84	32	25	43	22	6
Gateway	11	11	25	40	53	56	61
Georgetown	13	100	100	100	100	100	100
Gill-Montague	9	100	100	81	100	70	73
Global Learning	2	100	100	100	100	100	100
Gloucester	10	3	3	99	100	1	51
Grafton	6	62	100	78	91	83	98
Granby	3	98	100	99	100	100	100
Greater Fall River RVT	10	2	65	14	35	100	36
Greater Lawrence RVT	7	100	100	0	0	0	46
Greater Lowell RVT	9	100	100	100	100	91	5
Greater New Bedford RVT	8	0	96	97	99	99	98
Greenfield	9	100	99	100	99	45	69
Groton-Dunstable	3	99	100	100	100	100	100
Hadley	3	100	100	87	98	81	100
Halifax	1	0	0	0	0	n/a	n/a
Hamilton-Wenham	13	100	100	100	100	100	100
Hampden Charter School of Science	1	n/a	n/a	n/a	n/a	100	100
Hampden-Wilbraham	.	100	74	100	100	100	86
Hampshire	5	0	0	1	0	8	9
Hanover	3	100	84	100	100	100	100
Harvard	3	100	100	100	100	96	100
Harwich	1	48	80	75	56		n/a
Hatfield	13	100	100	100	100	100	100
Haverhill	8	4	1	37	52	44	45
Hingham	13	100	100	100	100	100	100
Holbrook	.	96	71	100	100	100	100
Holliston	3	94	95	95	97	96	97
Holyoke	9	100	29	28	22	24	26
Hopedale	13	100	100	100	100	100	100
Hopkinton	8	0	0	90	96	91	92

Hudson	3	100	82	89	92	98	99
Hull	3	100	100	100	100	98	100
Innovation Academy	1	n/a	n/a	97	95	91	92
Ipswich	13	100	100	100	100	100	100
King Philip	3	98	100	100	83	100	100
Kingston	2	0	0	0	0	0	0
Lawrence	3	100	100	99	97	99	100
Lee	9	100	100	23	12	13	6
Leicester	3	100	100	99	100	100	100
Lenox	.	100	100	71	100	74	76
Leominster	13	100	100	100	100	100	100
Lexington	3	99	99	100	100	100	99
Lincoln-Sudbury	13	100	100	100	100	100	100
Littleton	3	100	100	100	100	100	99
Longmeadow	9	100	87	56	60	64	60
Lowell	5	19	41	13	18	21	21
Lowell Middlesex Academy	2	100	0	100	100	100	100
Ludlow	5	7	13	16	27	10	11
Lunenburg	3	100	100	100	100	100	98
Lynn	5	37	32	11	9	15	18
Lynnfield	8	0	0	1	88	88	97
MA Academy for Math and Science	13	100	100	100	100	100	100
Malden	5	36	35	35	42	34	41
Manchester Essex	3	100	100	99	100	100	100
Mansfield	13	100	100	100	100	100	100
Marblehead	3	100	100	100	100	98	98
Marion	1	n/a	n/a	n/a	n/a	n/a	100
Marlborough	3	98	97	89	95	85	84
Marshfield	3	100	99	100	100	100	100
Martha’s Vineyard	13	100	100	100	100	100	100
Martha's Vineyard Charter	2	100	100	100	100	100	100
Masconomet	9	100	99	99	100	100	63
Mashpee	.	100	85	89	61	89	83
Massachusetts Virtual Academy	1	n/a	n/a	n/a	n/a	n/a	100
Maynard	13	100	100	100	100	100	100
Medfield	5	10	3	2	4	5	3
Medford	5	33	50	40	39	49	47
Media and Technology Charter	5	10	0	0	3	0	0
Medway	.	100	100	100	100	77	97
Melrose	.	79	87	91	96	98	97
Mendon-Upton	11	41	46	52	57	65	73

Methuen	4	67	69	79	53	68	65
Middleborough	.	31	56	59	53	66	61
Milford	13	100	100	100	100	100	100
Millbury	3	100	100	98	100	99	100
Millis	8	0	0	97	90	100	100
Milton	3	98	100	100	100	100	100
Minuteman RVT	.	75	100	100	100	100	100
Mohawk Trail	3	86	89	94	84	80	100
Monomoy Regional	1	n/a	n/a	n/a	n/a	76	70
Monson	7	100	69	34	28	75	73
Montachusett RVT	13	100	100	100	100	100	100
Mount Greylock	9	100	100	100	100	17	27
Mystic Valley Regional Charter	13	100	100	100	100	100	100
Nantucket	7	100	25	14	13	28	98
Narragansett	9	100	100	100	100	100	1
Nashoba	3	94	97	100	99	100	100
Nashoba Valley RVT	13	100	100	100	100	100	100
Natick	.	44	63	66	83	72	78
Nauset	4	58	71	74	79	70	70
Needham	7	100	99	100	0	95	99
Neighborhood House Charter	1	n/a	n/a	n/a	n/a	n/a	n/a
New Bedford	5	37	20	18	25	20	25
New Leadership Charter School	1	100	100	100	100	100	n/a
Newburyport	3	100	100	100	100	100	99
Newton	3	100	100	100	82	86	92
Norfolk County Agricultural	13	100	100	100	100	100	100
North Adams	4	63	69	58	60	60	69
North Andover	3	99	100	100	100	100	100
North Attleborough	.	88	86	78	82	82	85
North Brookfield	10	100	28	85	74	63	100
North Central Charter Essential School	9	100	100	37	43	29	47
North Middlesex	13	100	100	100	100	100	100
North Reading	3	100	99	100	100	100	100
North Shore RVT	13	100	100	100	100	100	100
Northampton	14	0	0	0	0	0	0
Northampton-Smith Voc. Agricultural	7	100	100	91	25	79	59
Northboro-Southboro	5	1	1	0	0	0	0
Northborough	1	0	0	0	100	100	n/a
Northbridge	3	94	100	100	100	100	100
Northeast Metropolitan RVT	.	45	58	63	46	40	72

Northern Berkshire RVT	13	100	100	100	100	100	100
Norton	3	100	100	100	100	99	100
Norwell	13	100	100	100	100	100	100
Norwood	13	100	100	100	100	100	100
Old Colony RVT	9	100	100	100	0	0	0
Old Rochester	.	48	66	62	54	56	63
Oxford	7	100	35	72	45	65	66
Palmer	8	4	99	79	100	92	93
Pathfinder RVT	5	6	7	2	4	0	0
Peabody	.	100	99	73	84	75	86
Pembroke	13	100	100	100	100	100	100
Pentucket	4	60	53	56	64	59	78
Phoenix Academy	2	0	0	0	0	0	100
Pioneer Charter School of Science	1	n/a	n/a	n/a	97	100	100
Pioneer Valley	9	100	53	40	28	42	37
Pioneer Valley Performing Arts	3	99	100	100	100	100	100
Pittsfield	.	35	61	71	65	64	63
Plainville	1	n/a	n/a	n/a	0	n/a	n/a
Plymouth	.	74	88	88	73	74	75
Prospect Hill Academy	3	100	90	98	100	100	100
Provincetown	1	100	88	100	100	100	n/a
Quabbin	13	100	100	100	100	100	100
Quaboag	8	24	100	100	100	100	100
Quincy	3	90	94	90	90	90	86
Ralph Mahar	9	100	100	100	100	62	66
Randolph	5	20	22	1	4	31	11
Reading	.	71	82	79	69	73	69
Revere	13	100	100	100	100	100	100
Rochester	1	n/a	0	n/a	n/a	n/a	n/a
Rockland	3	100	99	100	98	100	100
Rockport	3	100	100	100	100	99	100
Sabis International	13	100	100	100	100	100	100
Salem	4	63	57	69	57	63	64
Salem Academy Charter	2	100	100	68	96	100	100
Salem Community Charter	1	n/a	n/a	0	0	10	100
Sandwich	3	100	100	100	100	100	98
Saugus	8	0	0	0	0	75	97
Scituate	.	100	88	82	93	100	73
Seekonk	3	99	91	87	96	97	95
Sharon	6	0	95	62	62	75	100
Shawsheen Valley RVT	.	46	66	72	81	76	68
Shirley	1	n/a	n/a	n/a	n/a	n/a	n/a

Shrewsbury	13	100	100	100	100	100	100
Silver Lake	4	56	61	50	56	68	63
Smith Leadership Academy	1	n/a	n/a	n/a	n/a	100	n/a
Somerset	1	100	75	76	n/a	n/a	n/a
Somerset Berkley	1	n/a	n/a	n/a	70	76	78
Somerville	11	31	48	50	54	55	55
South Hadley	.	100	100	74	59	62	63
South Middlesex RVT	10	100	0	41	53	99	93
South Shore	12	100	100	100	79	69	67
South Shore RVT	10	100	16	100	18	73	100
Southborough	1	0	0	100	n/a	100	0
Southbridge	.	79	50	65	67	81	87
Southeastern RVT	3	100	100	95	98	96	93
Southern Berkshire	13	100	100	100	100	100	100
Southern Worcester County RVT	13	100	100	100	100	100	100
Southwick-Tolland	7	100	96	29	29	67	59
Spencer-East Brookfield	10	30	43	56	26	60	95
Springfield	8	8	38	32	36	85	80
Stoneham	11	77	83	87	99	100	100
Stoughton	.	52	62	71	94	79	50
Sturgis Charter	3	100	100	100	100	100	95
Sudbury	1	0	n/a	n/a	n/a	n/a	n/a
Sunderland	1	n/a	n/a	n/a	n/a	n/a	n/a
Sutton	3	97	92	96	92	97	92
Swampscott	3	97	100	100	100	100	100
Swansea	13	100	100	100	100	100	100
Tantasqua	4	66	75	63	63	63	64
Taunton	9	100	99	0	0	0	0
Tewksbury	13	100	100	100	100	100	100
Tri-County RVT	3	85	91	93	100	100	100
Triton	.	74	99	100	100	99	100
Truro	1	n/a	n/a	n/a	0	n/a	n/a
Tyngsborough	11	56	74	85	99	100	100
UP Academy Charter of Dorchester	1	n/a	n/a	n/a	n/a	0	n/a
Upper Cape Cod RTSD	3	99	100	100	100	100	100
Uxbridge	3	100	100	99	100	100	100
Wachusett	9	100	99	85	97	86	41
Wakefield	13	100	100	100	100	100	100
Walpole	9	100	1	1	7	1	1
Waltham	.	100	99	93	67	65	68
Ware	10	95	46	38	64	11	100
Wareham	7	100	50	4	35	42	66

Watertown	.	64	88	62	81	78	60
Wayland	13	100	100	100	100	100	100
Webster	9	99	96	36	44	48	71
Wellesley	7	100	2	100	100	100	99
West Boylston	3	99	100	100	100	100	100
West Bridgewater	3	100	100	97	100	100	100
West Springfield	5	33	33	37	49	22	46
Westborough	13	100	100	100	100	100	100
Westfield	.	53	65	46	72	74	71
Westford	13	100	100	100	100	100	100
Weston	3	95	92	94	94	91	96
Westport	9	100	62	84	80	81	82
Westwood	3	97	92	93	93	92	96
Weymouth	5	18	16	19	24	24	28
Whitman-Hanson	.	100	100	71	85	100	89
Whittier RVT	13	100	100	100	100	100	100
Wilmington	3	82	100	100	99	100	100
Winchendon	9	100	17	23	21	21	28
Winchester	3	100	100	82	100	91	93
Winthrop	3	99	100	100	98	98	100
Woburn	3	98	96	99	100	100	98
Worcester	5	1	0	13	4	4	28

Note: Data fields marked “n/a” indicate that no data were provided for that year.