Abstract Title: Student Success in the Boston Science Partnership: Eight Years of Data, Evaluation and Research

MSP Project Name: Boston Science Partnership (Phase I)

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120 word summary:

Over eight years of designing, planning, piloting and running a set of interventions, the BSP has aimed to improve student success by reaching their classroom teachers across the district. The theories of change employed by the project allowed attention to specific desired outcomes in the areas of access to and success with advanced course work (Advanced Placement courses), improvement on state test (MCAS) pass rates and percentages reaching the higher levels of achievement, improvement of teacher professional knowledge and skill, and increases in teacher licensure, leadership, and retention. Contextualized professional development increased the likelihood of success. Specific evaluation and research data point to significant outcomes.

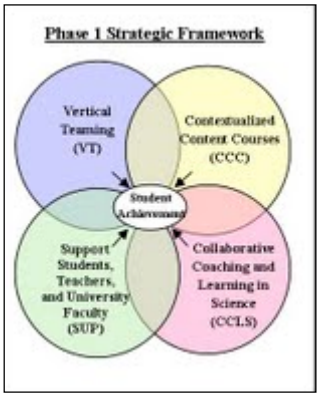
- Section 1: **Questions for dialogue at the MSP LNC**.

1. What are the indicators of success that would be compelling to the greater science education community? To those outside the science education community?
2. How do you show change in a three to five year time span?
3. What is the research design that can support project outcome goals?
4. What innovations can MSPs come up with to strengthen the findings coming out of MSPs?
5. Why can't the field show greater changes in student outcomes from MSP interventions?
6. How can MSPs (collectively or locally) become advocates for greater change to science achievement?

- Section 2: **Conceptual framework**. This section should include your project's definition of "student success" and an explanation about your project's design for measuring student success.

The most basic premise of the work that the Boston Science Partnership (BSP) has done for the past seven years is that improving teacher quality will lead to higher student achievement. In order to improve teacher quality, we developed four research-based professional development opportunities for grade 6-12 Boston Public School science teachers: graduate level contextualized content courses, vertical teaming, professional learning communities called Collaborative Coaching and Learning in Science (CCLS), and support for students, teachers, and university faculty, which includes the AP Science Support Program.

The BSP professional development strategies fulfill every definition of high quality professional development (Garet, et al,2001; among others). Through our research and evaluation findings we can link positive changes on student achievement to teacher participation in professional development opportunities .



The Boston Science Partnership makes an impact on student success by making a difference in the conditions for students to continue in their science education, gain scientific knowledge for general civic purposes and to gain a greater interest in science. Through the BSP we focused on the conditions necessary for students to succeed and the project took as actionable the "second order" efforts. For example, the project provided greater access to Advanced Placement courses, the teachers ready to teach them, and the pathways for students to be prepared once enrolled in AP science through the primary strategies of Contextualized Content Courses, Collaborative Coaching and Learning in Science and Vertical Planning. Additional indicators of those conditions include greater evidence of teaching using a 5E/ 7E model, increased content knowledge through enrollment in the BSP contextualized content courses. A host of supplemental activities also supported those outcomes and included involvement with Re-Seed, the AP Bridge program, and outreach to principals and other school administrators. The BSP has used multiple ways to understand student success: MCAS, AP access, AP pass rates, teacher content knowledge, robustness of teacher community that supports student learning, and BPS graduates majoring in STEM at the partner universities.

As a city-wide project, we aim to do no less than change the culture of science teaching and learning at the k-12 and higher education settings. The comprehensive focus on one entire district supports comprehensive changes to science instruction which has supported success for all students. This is the lasting, sustainable element to ensure student success beyond the life of the funding.

<u>Evaluation and/or research design, data collection, and analysis</u>

The Boston Science Partnership's evaluation of the first five years included interviews, (project-designed) surveys, and observations to formatively assess each major project strategy approach. The summative evaluation included extensive final teacher and STEM faculty surveys and analysis of student achievement on the state-mandated exam (MCAS.) The evaluation questions are:

- Has the BSP achieved its five project goals? How? What has been the influence of each of the primary strategies on achieving those goals?
- What is the design, implementation, quality and contribution of each strategy? What are the benefits, issues, lessons learned, sustainability factors and impacts?

The relevant research questions were:

- What roles do Vertical Teams, Contextualized Content Courses, and Collaborative Coaching and Learning in Science play in the development of highly qualified teachers?
- What roles do Vertical Teams, Contextualized Courses, and Collaborative Coaching and Learning play in the development of high quality instruction?
    - Do highly qualified teachers deliver high quality instruction?
    - Do teachers who are not highly qualified deliver high quality instruction?

Evaluation and research methods include both qualitative and quantitative methods including pre/post surveys, interviews, and observations; analysis of district employment and teacher qualification data; review of project artifacts, participation data, standardized test data, and other achievement data; and participation with the leadership team during regular meetings. Classroom observations were used to see the impact in the classroom

on specific strategies, such as use of the 5E/7E model and of active pedagogy modeled during the contextualized content courses, for example.

- Section 3: **Explanatory framework**. This section should describe what you are finding, or are set up to learn, about student success, and how it is informing, or will inform, your MSP work.

The Boston Science Partnership operates with a number of assumptions (or theories) of change related to student success and making the changes to institutions and teacher expertise that operationalize those theories. Related to k-12 student achievement, they are:

1. **Providing high-quality professional development experiences to BPS science teachers to raise their quality and qualifications will have a positive impact on student learning outcomes.**

   A higher percentage of students whose teachers participated in BSP passed the 8th grade state science exam than those taught by teachers who did not participate in BSP. Moreover, teachers who participated in more than three BSP events over the course of the project had the highest percentage of 8th grade students who passed (62%), and the largest increase in percentage from 2005 to 2009 (27%). 8th grade students who had teachers who did not participate in BSP passed at a lower rate in 2009 than in 2005. This pattern was true for racial and other sub-groups, as determined by the BSP evaluation.

   Research based on MCAS achievement shows similar results for some high school test-takers. For high school biology and chemistry test-takers, a greater percentage of these students scored proficient or advanced and a smaller percentage failed compared to students prepared by teachers who did not participate in content-specific BSP activities. And for high school students, excluding physics, the percentage of students passing their chosen science exam was significantly higher for those students prepared by BSP participants compared to those prepared by non-participants (70% vs. 55%).

2. **Contextualizing the PD provided to teachers will help ensure transfer to classrooms.**

   Teachers value the close connection of the PD to their practice and curriculum. They reported an easy transfer of new content and practices gained in the PD activities to their teaching, which was confirmed by limited classroom observations. This carryover includes increased implementation of mandated curriculum, more use of 7Es (district-endorsed) pedagogical practices, improved labs and ability to connect activities with content, better understanding of student misconceptions, improved assessments and use of assessments, better understanding of the need to differentiate instruction, and a general increased focus on student learning and ability to support student learning for a wider range of students. Teachers also report increased collaboration with other teachers beyond the PD experiences.

3. **Maintaining and building BPS teacher leadership will expand capacity and resources for current and future BPS science education efforts.**

   The BSP provides numerous opportunities for teachers to hold leadership positions, such as through facilitating CCLS groups, co-instructing university-based courses, supporting the AP Science Support Program, or through Noyce-funded, year-long fellowships. In all of these roles, teachers expand their own knowledge and skills, support their peers, and "bring others along" to providing instruction to students.

The impacts of this leadership include: additional impact of PD as participants reach their non-participating peers; examples to others in the district (and beyond) that leadership in science is important; sustainability of strategies; and longevity of teacher tenure since teachers find additional professional rewards through the leadership opportunities. Teacher retention may turn out to be another benefit of the combination of activities—of the 184 teachers of science who responded to the summative survey, 70% checked that they would *definitely* want to keep teaching science in BPS for the next 3–5 years, and another 18% checked *probably*. BSP research on teacher turn-over shows that for a cohort of new hires between 2003-2004 and 2005-2006 BSP participants were 4.6 times more likely to stay in the district than non-participants after three years. This compares favorably to other studies of urban teachers, where up to 56% of teachers leave the profession within three years (Boyd, 2007). In addition, BSP participants were about five times more likely to obtain a new science license, and they were about six times more likely obtain a license for a science subject they were assigned to teach than their non-participating peers.

4. **Expanding direct supports for AP students and teachers, a greater awareness of the AP program, and better student preparation before reaching AP courses will increase access to and success with this level of academic work.**

   Boston increased AP student enrollment over 100% in five years by expanding equity of opportunity for AP within exam school and to non-exam schools, and greater equity among racial groups. Additionally, schools focused on the "pipeline to AP" for ALL students through articulated methods and rationale. The project prepared 65 Boston teachers to teach AP science through urban-oriented AP Summer Institutes. These, and other, efforts contributed to raising the "ceiling" for students through expanded access to higher level courses and opportunities that support careers in science.

5. **An interrelated set of project activities will produce synergies that add benefits beyond those provided by each activity alone.**

   Researchers at EDC complemented the evaluation findings with deeper examinations of the causes and meaning of the interventions employed by the Partnership. In one examination of the success rates of students by participating teachers, those teachers who took a content-related course prior to the students' exam in that same subject showed marked improvement in student scores. The data show that the percentage of students who passed the biology, chemistry, and unified science tests was significantly higher for those with a "BSP teacher." In biology, the discipline with the greatest difference, 70% of the students with a BSP teacher passed the state test, while 55% of those with a non-BSP teacher passed. Moreover, a greater percentage of students taught by BSP teachers scored in the highest achievement categories, and a smaller percentage of students taught by BSP teachers scored Failing/Incomplete.

   The project also tracks additional indicators of student success such as participation in and scores on the SAT II subject tests and applications to, acceptance to and enrollment in college science majors at the two higher education partners in the project. These supporting data show positive results and a greater commitment to science education among Boston's young people.

References

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