Content Knowledge of Teachers

Science, Middle and High School Emphasis

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2008 Math and Science Partnership Learning Network Conference

Claims-Based Outcomes: What do we know? How do we know what we know? What do we still need to know?

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ABOUT THIS SUMMARY

This documentation of the 2008 Math and Science Partnership Learning Network Conference offers a brief summary of the presentations that took place during one conference breakout session and focuses on questions, answers and discussions during the session.

Readers interested in pursuing information about the projects in this breakout session are encouraged to visit MSPnet to access full video recordings of the breakout session and accompanying PowerPoint presentations as well as abstracts posted in the Virtual Poster Hall.

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Learning Network Conference Breakout Session Number 18B

MSP Project:
Boston Science Partnership

A five-year partnership between the Boston Public Schools (BPS), the University of Massachusetts Boston (UMB), and Northeastern University (NEU).

The Program Evaluation and Research Group (PERG) at Lesley University is the external evaluator; Education Development Center (EDC) provides a research component.

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CONTEXTUALIZED CONTENT COURSES: LESSONS LEARNED AND IMPLICATIONS

Presentation Recap

Overview

The Boston Science Partnership, now in its fourth year, pursues the following goals.

Goals

- Raise student achievement of Boston Public School students in science (grades 6-12)
- Significantly improve the quality of BPS science teachers
- Increase the number of students who succeed in higher-level courses in science, and who are admitted to and retained in university science and engineering programs
- Improve science teaching in BPS and at the core partner universities
- Institutionalize these changes so that the Partnership's structure and work will be sustained.

Contextualized Content Courses (CCC) is one of several key strategies the BSP is using to reach its goals. Other strategies include Vertical Teaming (VT), Collaborative Coaching and Learning in Science (CCLS), and Support Students, Teachers and University Faculty (SUP).

Contextualized Content Courses involve BPS teachers and university STEM faculty in co-planning and co-teaching summer content courses that deepen science content knowledge of teachers.

Contextualized Content Courses (CCC)

- Connected to BPS science curriculum
- Teach high-level content while modeling research-based pedagogy
- Co-developed and co-taught by middle school and high school teachers and university STEM faculty

The work occurs in a diverse context. Of the 2007-08 student enrollment in the BPS, 41% are Black, 35% are Hispanic, 14% are White, 9% are Asian, and 1% are multiracial. In terms of student needs, 20% receive special education services; 18% are English language learners or limited English proficient; and 71% are eligible for free or reduced-cost lunch.

Examining CCC: Hypotheses and Results

Six claims are developed in this presentation. Each claim and knowledge result is outlined briefly below.

Claim One:

Middle and high school teachers consider Contextualized Content Courses to be a successful model for providing challenging content knowledge when particular course attributes are present.

The presence or absence of particular attributes can determine the level of satisfaction

and impact of a CCC for participants. These attributes are:

Attributes of Successful CCC Courses

- A balance of content, scientific process and teaching strategies
- Coherence among different aspects of the course (lecture, activities, and field trips)
- Models of good teaching practices by instructors
- Good planning and organization
- Clear objectives, expectations and goals
- Positive working relationships between the instructors
- Instructional team expertise
- Support by instructors for participant learning
- Creation of a supportive learning community
- Differentiated instruction for participants with different levels of background knowledge

Claim Two:

CCCs overall provide a positive professional development experience for Boston Public Schools teachers, including increasing their content knowledge and providing new teaching strategies.

BPS teachers experience numerous positive impacts from their participation in CCC courses. Increase in content knowledge leads to other benefits and improvements to their teaching. Many report an increase in their confidence as science teachers, citing more in-depth understanding of the content being taught. They feel more able to help students understand the content, are more knowledgeable about student misconceptions, and can better assess student understanding. Teachers report and are observed using new approaches and strategies attributed to the CCC including: increase in student-centered approaches, including hands-on inquiry; more use of the 5Es; greater connections between activities and content; more use of technology; new assessment strategies; and greater variety of teaching styles.

Other impacts include an increased understanding of the BPS curriculum across grade levels, knowledge of and access to more resources, and an increase in the sense of community with other BPS science teachers.

Claim Three:

Collaborations between BPS teachers and STEM faculty co-instructors provide an effective teaching model for the CCCs, and offer an array of positive impacts for all members of the instructional teams. These impacts translate into instructors' teaching and professional lives.

BPS instructors provide familiarity with the curriculum as well as knowledge of teaching strategies and the MS and HS teaching experience. STEM faculty provide deep content knowledge combined with the experience of working scientists. Learning experiences for instructors include special BSP PD workshops for instructors only as well as other BSP-sponsored events; seminars on teaching at UMB and NEU for STEM faculty; visits to each others' class-

Study Design, Data Collection and Analysis : Claims One, Two and Three

These preliminary claims are based on in-depth qualitative analysis of data collected over the life of the project by BSP's external evaluators, and triangulated through numerous observations, surveys, interviews, and focus groups related to the CCC, participating populations, instructors, and planners.

- Observations: 27 CCC courses, 15 CCC instructor training sessions, 55 CCC participant classrooms, 2 project meetings with STEM instructors, 1 project meeting with BPS instructors
- Surveys: 233 CCC exit surveys, 137 returning participant CCC surveys, 23 CCC instructor surveys
- Interviews: 55 CCC participants, 16 CCC Stem instructors, 15 CCC BSP instructors, 21 BPS school-based administrators, 6 Science Dept. staff, 20 Leadership Team members
- Focus groups: 1 STEM faculty instructor, 1 BPS HS instructor, 1 BPS MS instructor, 2 graduate students involved with CCC

More Information

Visit Boston Science Partnership on **MSPnet** for additional information including the report: "Boston Science Partnership: Preliminary Evaluation Findings from Contextualized Content Courses," Program Evaluation and Research Group, Lesley University Centers and Institutes.

Study Design, Data Collection and Analysis:

Claim Four:
End-of-course district-wide assessments were used to measure differences in student achievement between three treatment groups: students whose teachers have been CCC co-instructors, students whose teachers participated in CCC, and students whose teachers had no involvement. Assessments are developed by the BPS Science Dept. and administered to students at completion of each term in science courses. Results were compared between groups to determine if students whose teachers had participated in CCC scored higher than those whose teachers were not involved. Similar baseline scores from the prior year to the first CCC were also compared. In addition, student scores from the state mandated MCAS science test were used to compare these same groups.

Claims Five and Six:
Project-developed, content-based pre- and post-tests were used to examine changes in teachers' content knowledge, retention of information, and the success of differentiating instruction within the CCC. Reliability and validity measurements of six of the tests after Years 2 and 3 indicated they were of high quality. Teachers were also tested 6-9 months after completing the courses. They were also given a list of state standards for teaching in the subject of the course and asked to check off which topics they had taught in the classroom since taking the summer course. Results of those indicating they had or had not taught the related material were compared to assess amount of knowledge retained over a longer period of time.

rooms; observation of co-instructors during CCC courses; creating and teaching CCC courses.

Both groups learned new teaching strategies from the experience of planning and teaching together, including new inquiry, hands-on and discussion approaches, which many have employed in their teaching.

BPS teachers have benefitted from professional growth and new professional relationships and have become more confident as teachers and leaders. They have learned content and the scientific inquiry approach from STEM faculty and pedagogical approaches and curriculum implementation across grade levels from BPS co-instructors and participants.

STEM co-instructors have gained exposure to new pedagogical approaches as well as new knowledge of and interest in K-12 science education. They now make connections across grade levels through college and incorporate more active learning in university courses, a change they attribute to CCC involvement.

Claim Four:

Teacher involvement in CCC, either as participants or instructors, can increase student achievement on related course content.

Students of teachers who were CCC instructors, as well as teachers who participated in CCC, scored higher on internal district end-of-course exams than students of teachers who did not participate in CCC. These large differences in the scores of students of middle and high school CCC participants and instructors and those of nonparticipants did not exist prior to the 2005 CCC courses. (*See the PowerPoint slides of this presentation for graphs and data regarding student scores.*)

Claim Five:

CCC produced continued measurable gains in content knowledge of participating BPS teachers. Preliminary findings also indicate successful differentiation of instruction in the lowest level biology and chemistry courses.

Overall, pre- to post-test changes in content knowledge are significant on research-quality science content knowledge measurement instruments for six courses. In Bio-I and Chem-1 courses, middle school and high school teachers had significantly different prior knowledge. Middle school teachers made greater gains, but both achieved significant gains. Differences between middle and high school teachers' post-test scores were not significant in either course, indicating that both courses succeeded in differentiating instruction enough that the middle school teachers achieved equivalent content proficiency. (*See the PowerPoint slides of this presentation for graphs and data regarding teachers' content knowledge gains.*)

Claim Six:

Teachers who teach more material related to their summer course during the year following the CCC experience significantly higher retention and understanding of the course material several months later than those who do not.

Preliminary results indicate a significant positive relationship between the amount of related science content taught by teachers and their understanding of the content they learned in the summer courses. Significant differences were also found between retention and understanding of the course material in teachers who taught 50% or more of the state standards related to the content of the course they took and those who taught less than that. In other words, teachers lose the content knowledge they gain during the summer unless they teach related material during the year following summer professional development. (*See the PowerPoint slides of this presentation for graphs and data regarding teacher retention and understanding of course material.*)

Conclusions and Implications

- The CCC model can be a useful professional development strategy for increasing teacher content knowledge, teacher use of pedagogical approaches encouraged by the district, and student achievement.
- Teachers who take courses most closely aligned with what they are or will be teaching soon after the courses maximize the retention of the course content.
- Collaborations between middle and high school teachers and STEM faculty can provide excellent teaching teams for the courses and result in many positive impacts for middle and high school instructors as well as for STEM faculty instructors.

Some of the faces of the Boston Science Partnership MSP

Christos Zahopoulos

Marilyn Decker

Robert Chen

Abigail Levy and Joan Karp

Grad Student Involvement

- We should say that there are graduate students also connected with each of the courses. We haven't talked about them here, but we've done focus groups with them and there is a whole program around the graduate students. - Joan Karp

- It's combining the existing K-12 program and these graduate students who are funded through BSP into the same professional development and the same experience in the classroom, so it's sort of a sustainable model. It's a successful model, and we want any money that we can get to support graduate students so that they can have that kind of experience. - Robert Chen

- And often they'll go into the classroom of the professor whose course they've been involved in over the summer. - Joan Karp

Questions and Answers

Eliciting Faculty Participation, Sustainability, Use of Grad Students

- How do you attract university faculty to something like this? - Participant

- There are a couple of things. One is that there is a big buy-in from the bottom and from the top of our university. We had a strategic plan for the research with six areas, and the faculty wanted to add a seventh. Forty-five out of ninety faculty members signed up for science education—this was years ago. Then we had a dean and a provost who were supportive of this kind of thing. So from the bottom up, the scientists were interested (not all of them, but about half) and from the top level they were interested in supporting this and getting some kind of a grant to support this effort.

  Right now the issue is money. What we are worried about, like all other MSPs, is money because if the money goes away there are instructors who have said, "I want to be able to continue to teach this course; we have to figure out a way to figure out how to continue this course."

  There are some that are going to go, but I think our goal is to sustain about half and I think we'll probably be able to make that. That's in the next couple of years. We have the buy-in from faculty, and now it's just a matter of monetary support. - Robert Chen

- Does the money go directly to the faculty to participate or to their graduate students? - Participant

- The money goes directly to faculty and to grad students. We have a set up for funding grad students to help with TA and some other things, but there are different models. You can get money through continuing education and get money from the tuition to come back and pay. The big problem is, does the department count it or not count it in the rewards structure? We're having a lot of discussions every year, especially the junior faculty, about how to reward that, how to write about it, and how the university culture might change to support the idea that yes, we do want to have this at our college. - Robert Chen

- We've had similar discussions at Northeastern University, but really the only way this will work for us will be through continuing professional studies, where the people receive extra compensation, but not at the same rate as they are when they teach the other courses. That's the model we've adopted. - Christos Zahopoulos

Faculty Mobility, Attrition

- Have you had any issues with teachers who have been in your program from middle school or high school and mobility—either mobility within the school district or mobility out of your urban district into suburban schools or private schools? - Participant

- We have a really close-knit group of young teachers. I cannot believe that we're keeping them. They went to Stanford and Harvard and Brown; many have been on our teacher leader program for five years now. They haven't left to go to the suburbs. They are such a tight-knit group that they've started hanging out at a local pub once a month to get together to socialize. To me, when you see all these young teachers who want to be with each other and hang out with each other, it's a really healthy community. The only thing that does occur is that they may get stolen within the district to become new teacher developers or assume other roles within the district, but we've had very little attrition. Abigail is actually doing a study of this, but when I look at the teacher leaders we started with when I came to the district in 2001, most of them are still there. - Marilyn Decker

AP Students & the Bridge Program

- I have a question about the AP students in your study. One issue is that a lot of AP students aren't passing the APs, even thought they're being offered. I know that some schools are moving towards a transition program in which they're taking courses at a college so that they can get mentored by their high school teacher, rather than relying on that one test at the end. What percentage of the AP kids your teachers are working with actually pass? - Participant

- [*Refer to PowerPoint presentation slide 32.*) One of the things we did to address this issue is that in mathematics, a faculty member from Northeastern University had done this really successful Bridge to Calculus program. We are replicating that model, and I've gotten an unbelievable response from headmasters to put Bridge programs in place in all of the district schools.

  During the last week of school in their junior year, the students go to one of our universities and start working on that AP subject. Then we bring the kids in for another five days right before the start of school. That is nine full days of instruction, which is huge and really gives kids a jump start on the academic year. Once a month during the school year we have labs at each of the participating universities. For the chem labs, for example, that are really difficult to do in an urban chemistry class, the kids go to the University of Massachusetts, to Northeastern, to Harvard.

  The kids' participation has been really strong. If they want to do the AP Bridge program they have to commit to it, so we're seeing some great data. The study that we did at the one school where we did it last year, there was something like a doubling of the pass rate. - Marilyn Decker

- Three years ago it was 7.5% and now 40% pass, and that is while increasing the numbers involved by 50%. And for the first time this past year there were two 5s and only one or

Observing Changes in STEM Faculty Practice

- Did you observe STEM faculty as well as BPS faculty to study changes? - Participant

- We will be doing so. Either the research will or the evaluation will. We're still figuring that out, but we've been observing the BPS teachers all the way along. - Joan Karp

- One of the research questions is about the relationship between these different strategies and their impact on faculty members' instruction, so we'll be exploring that very carefully in the next six months to a year. - Marilyn Decker

Universality/Transferablity of Courses

- One of the key questions I'm grappling with right now is, what is the universality of these courses? Are they only good for Boston because they use a particular kind of curriculum? Are they useful as they are to other systems that use similar approaches to teaching? Are they useful to teachers who are not teaching using these methods? This is a question I'd be interested in investigating in the future. This is not part of our research, it has just come up as our courses have become available to teachers outside of Boston. - Christos Zahopoulos

- We use all nationally developed materials so we know, certainly, that a lot of teachers are using these curriculum materials. - Marilyn Decker

two were passing with 3s. There was a K-12 fellow also supporting the students in that particular class, and there was also support from a retired teacher we'd been working with for a number of years. - Christos Zahopoulos

- I think that story is well worth writing up and documenting. - Participant

- The big barrier for me to expand this program is lunch money for the kids. When all of the high muckety-mucks in Massachusetts are talking about the importance of science, I'm asking, "Can you give me lunch money? I've got 300 kids who want to take AP in the summer." - Marilyn Decker

Link Between Content Knowledge and Differentiation in Instruction

- In claim six you said that teachers improved content learning, and then there was a line about indications of successful differentiation in instruction. Did you find a relationship between content gains and a shift in pedagogy towards differentiation in instruction? - Participant

- We're going to look at that more closely. They talk over and over again about having more confidence because of the content and also, separately, about implementing more inquiry-based learning and more differentiated instruction. They haven't talked about it in conjunction. In the courses they learn both, so I'm not sure. - Joan Karp

- I hadn't thought about it, but I teach an education intro to environmental science course to a hundred, and the tail was up this year compared to past years. I'd been thinking a lot about this because of all the professional development about differentiation, so it may actually have an effect on my students, but there's no study yet. - Robert Chen

- We actually had professional development for the university faculty about differentiation in instruction. That's a big push in the district-wide special development as well. We're certainly not there, but what we've done is adopt the woman who does the professional development for those special education teachers and we've got her in our science program because, to a person, all of our science teachers say that's something they need help with. They all need help in how to differentiate instruction. - Marilyn Decker

- I've been teaching all of the contextualized courses, the physics ones, for years now, and as we learn more about differentiating instruction we use it more with the teachers. It's a learning process for us, the university faculty, as well. - Christos Zahopoulos

DO HIGHLY QUALIFIED SCIENCE TEACHERS PROVIDE HIGH QUALITY SCIENCE INSTRUCTION?

Learning Network Conference Breakout Session Number 18A

MSP Project:
Boston Science Partnership

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Presentation Recap

Background/Context

NCLB requires that all classrooms must be staffed with highly qualified teachers who have full certification or licensure, a college degree, and demonstrated content mastery of the subject being taught. This is more challenging in high school science, where science disciplines are compartmentalized and certification requires licensure in specific content areas. To be compliant with NCLB administrators face the burden of hiring teachers with specific content mastery and assigning them to teach only those specific subjects.

Data shows that out-of-field teaching in science has become a grave problem. At the same time, the question remains whether qualifications alone ensure that science will be taught well. Further, no commonly accepted definition of high quality science instruction exists.

In the Boston Public Schools (BPS), as in other districts, many new qualified science teachers have been placed in middle and high school science classrooms. It is not known to what extent their preparation and qualifications enable them to teach effectively. Knowing more about the relationship between teachers' qualifications and their instruction will inform the field in general and the way in which the BSP can target their professional development strategies.

Hypothesis

This presentation examines the relationship between teachers' qualifications and the nature of their science instruction.

Research Questions

- Do highly qualified teachers deliver high quality instruction?
- Do teachers who are *not* highly qualified deliver high quality instruction?
- What is the relationship between teachers' experience, grade level, qualifications, and their science teaching?

Study Design

This qualitative, descriptive study used data collected from 37 teacher interviews and classroom observations conducted with 10 middle and 27 high school teachers in 8 Boston schools. Interviews lasting 30-45 minutes employed a semi-structured protocol. Classroom observations lasted for an entire instructional session and employed the BPS's science observation instrument, which utilizes Bybee's 5E

Definition of Highly Qualified Instruction

- Boston Public School Science Department
- District Pedagogy - 5E Emphasis
- Observation/Evaluation Instrument

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Observation of:

- How teacher's instructional time was used
- How much of their instructional time was spent enacting district-specified pedagogy as compared to providing procedural instructions, lecturing, managing student behavior, and not being involved in the lesson at all.

Methodology

- Case study schools (n=8)
- Data collection: interviews, classroom observations, district employment data
- Data analysis:
  - By certification level
  - By grade level (middle school and high school)
  - By years of teaching experience
    - **Low: 1-2 years**
    - **Medium: 3-5 years**
    - **High: 6+ years**

Sample Analysis

- n=~50: all the science teachers in case study schools
- n=30: all the science teachers interviewed and observed
- n=19: Cert 3 highly qualified science teachers

Instructional Model (1997). The instrument was further modified by using MDRC's classroom observation protocol (Estacion, McMahon, Quint, Melamud, & Stephens, 2004) in order to systematically document the behaviors at left. In addition, 26 middle and high school administrators were interviewed using a semi-structured protocol.

Teachers' qualifications were measured according to their certification and assignment status as outlined below.

Working Definition of Highly Qualified Teachers

- Cert-0: Not certified to teach any subject
- Cert-1: Certified to teach a subject, but not science
- Cert-2: Certified to teach a science subject, but not the science we observed
- Cert-3: Certified to teach the science subject we observed

Teacher's experience was operationalized as indicated at left. High quality science instruction was based on the district's expectation that at least some class time should be spent on each component of the 5E model, although not necessarily equal or even very much time. Therefore, definition of high quality instruction corresponded to the number of components of Bybee's 5E model that were observed within a single classroom session. *(For further details of methodology and analysis, see the presentation abstract.)*

Summary of Results

(See PowerPoint of this presentation for data and graphs illustrating the results below.)

- Data suggest that certification or teacher qualifications may be necessary, but are not sufficient to guarantee instruction in which teachers touch on each component of the 5E model during every class session.
- Data did not indicate that certification or experience was associated with increasing numbers of teachers enacting all components of district pedagogy.
- Regardless of certification, experience, or grade level, all teachers emphasized explain-related activities and varying but far fewer numbers of teachers were observed spending any instructional time on the remaining components.
- More experienced teachers spent less instructional time on lecturing and managing student behavior and greater amounts of time enacting district pedagogy than less experienced colleagues.
- Grade level was associated with both amount of time spent on district pedagogy as well as the number of teachers who covered components of it more evenly. Although middle school teachers spent more time on district pedagogy, more of them continued to focus their time on explain-related activities in comparison to high school teachers who, overall, spent less time on district pedagogy,

but more of them covered more components of the 5E model.

- Of the 37 teachers interviewed and observed, 17 of them were teaching science subjects for which they had no certification; however, observations found no discernible patterns that differentiated the instruction of those with more and those with less content knowledge.

Conclusions and Implications

Findings suggest that regardless of their qualifications/content knowledge, new teachers continue to require PD and other supports to ensure that they are able to enact district pedagogy skillfully and consistently.

At the same time, if experience increases teachers' ability to manage classroom behavior and avoid disruptions that reduce time available for instruction, the following questions arise:

- What is preventing the more experienced teachers from focusing more evenly on all aspects of the district's instructional model?
- Why does the explain-related aspect of the 5E model continue to receive most teachers' attention to the exclusion of other components of the model?
- What additional supports or adjustments could be made by the BSP and/or the district's science program to address these issues?

Interviews with teachers and administrators identified challenges that impeded teachers' abilities to enact the district's science program as intended. For example, both teachers and administrators cited lack of experience and pedagogical content knowledge as limiting factors.

Challenges that are not amenable to such interventions include lack of resources and challenging students. Teachers discussed students' lack of motivation and behavior issues as problematic while administrators discussed the heterogeneity of students and the complexity of teaching a diverse student body. Teachers (and not administrators) cited lack of time necessary to do their job well.

These systemic issues—time, resources, student characteristics—raise a challenging question for BSP and other MSPs: What can be done to ensure that the professional development and ongoing support provided by the project have enduring influences in light of the systemic challenges that teachers and administrators face?

Challenges Teachers Face
from interviews with teachers

- Time allocation and school scheduling of courses
- Lack of student motivation in science courses
- Lack of resources, tools, space, materials, appropriate classroom facilities

Most cited by grade level:

- HS teachers cite resources as top concern
- MS teachers cite time as top concern

By teachers' experience level:

- Highly qualified teachers cited student behavior, literacy skills, and lack of prerequisite science knowledge as top concerns

Issue for Further Discussion

There is a good discussion in the challenges that teachers do and do not recognize. When you ask teachers to identify the top challenges they face, they don't necessarily identify their own content knowledge. However, evaluation is beginning to show that with improved content knowledge, some of those other issues such as management of time can get better. So when you ask them, "What makes it hard?" they might not be identifying the root cause.

That's an issue, when we might know that having better content knowledge would be helpful in ways they might not expect. There is a challenge in convincing people that this is going to solve some of the problems that they might not realize they would solve.

Hiring Cert-0 Teachers

- Under what circumstances is a Cert-0 teacher hired? - Participant

- Right now there are pretty much no waivers. This was done before a lot of the new laws were put in place and before our HR department was completely overhauled. If you're not certified now, you're probably not going to get hired by the city of Boston. It also could be in a high-need area where they can't find anybody, but in general now you won't find Cert-O hires. - Marilyn Decker

- But this is not an uncommon problem. It's a desperate situation. - Participant

- One of the things about people leaving the profession is that it has gotten a lot harder to get tenure. There is a lot more scrutiny on beginning teachers and there are teachers that are invited to leave the profession and it's not a bad idea. Before, they'd go from school to school and now they're being told, "We don't want you here." - Marilyn Decker

Questions and Answers

Comparing Instruction by Teaching Experience

- Is there some reason to think that all teachers regardless of their experience are assigned similar types of classes with similar demographics and educational levels? - Participant

- No, there's no reason to assume that at all. But I think it is safe to assume that regardless of the students, they should be enacting the district pedagogy. - Abigail Jurist Levy

- There's very little leveling at all in the middle schools or high schools. The big draw is the exam schools, which are clearly very different in the way they run things. Some of the exam schools are doing the middle school district curriculum and they are doing some of the high school courses, but when you have the Boston Latin, you don't spend your time messing with the Boston Latin. What they've done is voluntarily come on board because they want to be part of the whole deal. But it's not like a suburban high school where you're going to have your advanced section. We don't really have that. - Marilyn Decker

Significance of Findings

Relation of Qualified Teachers to Pre-test Levels of Students

- I think these are excellent research questions and great exploratory work, to try and sort out some of the differences between teachers. I have two cautions. First of all, regarding the question of different classes having different levels of students, we found nationally that the higher the certification of the teacher, the higher the pre-test scores of the students that they're teaching. There is a pecking order in school science departments, and the more qualified teachers get better students and can spend more time teaching science than in classroom management issues. So it's important to control for what students' scores are—science scores, reading scores, however you want to do it—just to get some handle on what their level is. Otherwise you might just be seeing the results of this internal pecking order and not a difference based on certification. - Participant

Statistical Significance

- The second issue is the significance of the findings. You're making some claims here about causality, and there are no error bars on your charts. - Participant

- Oh no, no, we're not making claims about causality. - Abigail Jurist Levy

- Well, I did some back-of-the-envelope calculations here, and your difference in size of bars has to be greater than 20% or 30% in many of these cases in order for them to be statistically significant. Those small differences of 10% and 20% are probably not significant. - Participant

- But I don't think we ever said anything about causality, nor did we say anything about

statistical significance. These are trends that we observed. - Abigail Jurist Levy

- Well you should because the results that aren't statistically significant should be emphasized and the ones with very small groups, like two or three teachers in a group, that's really meaningless because the error bars are enormous, so you really can't break it down that finely when you only have twenty-six teachers. - Participant
- I agree with you. I think when you start to look in your cell sizes the samples are small, so I agree with you a hundred percent. That's why we didn't talk about statistical significance and we didn't talk about causality. For exactly the reasons that you're saying, this is simply: This is the landscape, this is what we saw in these eight case study schools with 75% of the science teachers that we observed. As the samples get larger, as we begin a new round of data collection, we'll be able to do some other, more interesting things, but I think you're absolutely right. - Abigail Jurist Levy
- But even with small samples there are statistically significant results. - Participant

Comparing Teachers' Participation in PD

- Regarding the preparation of these teachers within the partnership, were all of these teachers partnership teachers? Can we assume they had comparable types of PD or content instruction for similar amounts of time? - Participant
- I don't think so. They were participants in BSP, but that participation could range from participating in one CCC or participating in a range, like a weekend Vertical Teaming workshop to two content courses over two summers. There was a real range of participation. That's another very interesting set of questions to look at when you have a bigger sample and bigger numbers within each level of participation. Then we can look at that as well. - Abigail Jurist Levy
- I'm the only one from the district perspective who gets to go out, and what I have to report is more anecdotal. You see improvements in teachers' practice, but it's me and how many thousands of teachers, so it's pretty hard to get out there very much. - Marilyn Decker

High School Dropouts: Causes and Impact

- Regarding the impact of NCLB and science education not being improved as a result, it made me think of the statistics in Massachusetts. The drop-out rate has gone up significantly, and I wonder how that also affects these statistics because clearly all of those kids who are dropping out aren't getting science at all. In some ways we're getting more AP kids. - Participant
- And the kids who are dropping out are not necessarily our low achievers. One of the

Percentage of Instructional Time

- What do you mean by "percentage of instructional time"? - Participant
- Were they enacting district pedagogy, were they doing procedural instructions, were they not involved? We were able to categorize the different types of instructional time and to use that in our observations. - Phitsamay Sychitkokhong Uy

Lecture versus Explain

- You're using a separate category for lectures, separate from district pedagogy (*see slide 13 in PowerPoint presentation*). Is your category "explain," which does appear as part of district pedagogy, something that is attached to inquiry? - Participant
- Good question. "Explain" is not lecturing. Ideally, it is student explanation and more conversation back and forth between the students, so it does relate to inquiry. - Abigail Jurist Levy

things we've talked about is that with the emphasis on college, some of the kids are translating that and saying, "I don't think there's any hope that I'll go to college, I guess it's not worth staying in high school." We've been having a lot of discussions in the district regarding how to deal with the drop-out problem, how to deal with college preparation in general. I'd had no idea that kids had translated it that way. It never occurred to me that by emphasizing college so much we've made kids think, well I guess a high school diploma is worth nothing. - Marilyn Decker

Pre- and Post-Testing of Teachers

- A lot of this resonates with the Cleveland Metropolitan School District. The confidence level is very high with teachers who are part of things. They feel more qualified. I wanted to ask what tool you used to test for teacher content knowledge. - Participant (Cleveland MSP)
- We brought a team of experts in to work on this, so we tried to make our questions as good as possible. As we tried to model good pedagogy we tried to assess our participants as often as possible and work with them, but the so-called "objective" instrument is the pre- and post-test. - Christos Zahopoulos
- We had ETS and other consultants work with faculty to help figure out how to design questions. It's not a trivial issue, though, you're right. - Marilyn Decker
- It's harder in our project because teachers are working towards licensure, so it's 25 to 32 semester hours of content. We decided to use the PRAXIS test as a pre- and post-test. The only problem we ran into was the low cut scores for passage, at least in Ohio. If teachers could pass the PRAXIS test on the pre-test, and knew that once they finished the coursework they could get licensed, they weren't motivated to take the post-test. They took it, but they weren't motivated to do better. - Participant (Cleveland MSP)
- We also had some courses that were invented. B.U. worked with us to construct a series of physics courses and what I've been surprised by is that even though teachers passed the MTEL test, they've continued with that sequence of courses. They're not as relevant to what they're actually teaching, but useful if they eventually want to teach an upper-level class. - Marilyn Decker
- I'm just curious—did you embed any pieces of any of the National Inventories on Conceptual Understanding in these tests? - Participant
- In my course, yes, for a number of years, almost fifteen years. And I also do it with retired scientists and engineers to calibrate the scale. - Christos Zahopoulos

Free MOSART Content-Knowledge Tests Available

- I just wanted to note that we have developed tests for K-4, 5-8, and 9-12 based on the NRC content standards for teachers. They're free because we've developed them under a RETA project. Anybody who needs subject-matter knowledge assessment tests is free to use these—the MOSART tests. - Participant (MOSART)
- Do we have to use all of them or just the ones we want? - Christos Zahopoulos
- You can use any of the ten you want, however many times you want. They're all online. - Participant (MOSART)

Enactment of District Pedagogy by Grade Level—Variations in Class Size

- I was interested in your results in terms of enactment of district pedagogy by grade level (*see PowerPoint slide 26*). I wondered how much of the difference in results could be accounted for by, for example, inadequate materials in high schools. If you're a middle school teacher, you're likely to be engaged in the first three parts of the pedagogy (engage, explore, explain), given that you have a limited time teaching.

  Does the length of the lesson in middle school compare directly to the one in high school? That would impact the shape of that graph. If the lessons were longer in middle school, I'd expect those bars in the last two parts of pedagogy (extend and evaluate) to increase a little bit. - Participant (Cleveland MSP)

- There is no standard class in the Boston Public Schools, there's no standard length, and we have every known configuration in middle school, high school and K-8 known to mankind. We have some high schools that have 45-minute periods, we have other high schools that have 80-minute periods, and we have a mix of everything in the middle schools.

  What I will say is that we've had a lot of PD in math and physics that focuses specifically on that pedagogy. In the middle school I actually see more fidelity to the actual curriculum, but in terms of all the components, I think they're hard-pressed to get it all in because of the time constraints. - Marilyn Decker

- That's what I was wondering, if the faculty providing materials is actually going to give you that result. - Participant

Capturing What Goes on in the Classroom

- I would be interested in asking this group how you all are capturing what actually goes on in the classroom. To me, that's the hardest piece of all of this. - Marilyn Decker

Combined Observation and Portfolio Strategies

- We're a newer MSP so I think with the standard of proof we have to meet a higher bar in terms of more data. Not necessarily better data, but more data. One thing we're doing is that each teacher is observed three times a year and we chose the COP, but then we also created another observation instrument based on the CREDE Standards, looking at culturally responsive instruction.

  This is in rural areas in Montana and we have multiple sites. In my area, which has two reservations, we have three people involved in this. They go through training together and there are good training materials with the COP. We are also using a very streamlined version of Hilda Borko's Scoop procedure for teacher portfolios. The full version is quite extensive and I think our teachers would rebel, so we made it a streamlined version. - Participant

STEM Faculty Conducting Classroom Observation

- In our case we were able to convince our professors to actually visit the classrooms. Not too many have done it, but at least ten have and have reported back to us, and there are going to be other, continuation visits. That's how we're doing it. Many of the professors have never been in a classroom, and that changes them totally, just being there. - Participant

- We made that a requirement for all of the STEM faculty that teaches. We did that for the first year and the second year they said, "Okay, that's enough, now we know." - Christos Zahopoulos

Problems/Challenges Using the Survey of Enacted Curriculum

- We tried to use the Survey of Enacted Curriculum and I didn't have enough money to pay the teachers enough to make them do the survey. Fifty bucks a pop is not going to cut it—they won't do it for that. - Marilyn Decker

- Not only that. We're also using the Survey of Enacted Curriculum, and we found a pattern where certain savvy teachers discovered that if you answer "No" to all of the questions you don't have to spend as much time. - Participant

Survey of Enacted Curriculum

- In Cleveland it's self-reported, but we use the Survey of Enacted Curriculum and we do that every year. We've got a longitudinal thing. Cleveland State got some money to do some observations and had the faculty teaching the courses going out and observing, and what they found for the most part was that the teachers were not lying in the self-report. If the teachers said they spent 20% of their time on something, that is what the faculty observed. But they were also trying to get an idea of the impact of the courses on change in teacher practice, and they said that was more hit or miss. For example, they'd go to teachers who were observed before the course started and after, and they'd see some teachers with whom there was a dramatic change and others where there was none. But you do need a lot of people to do that in an urban area. - Participant

Two Sources: Students and Teachers

- We get data from two sources. One is we ask the students as well as the teachers. On questions on the test we ask students what is happening in the classroom, how often they have a lab, how much small group work, and so on. We have both students and teachers report so that we can see what level of accuracy there is between them.

  Second, we take the test that the kids take and ask the teachers to do three things: answer the questions themselves to see if they know the science; predict what fraction of the students in their class will get the question right (do they know how much their kids know); and third, which is the misconception? For each of these questions there's a strong misconception. Are they aware of what the misconception is? If they can't find it on the test item, they're not going to find it on the kids. So that is three ways we test these things with teachers remotely. We don't go in and observe. It's a lot cheaper to do it on paper. - Participant (MOSART)

Developing Useful Course Materials for Others to Use

- There is another question I have for this group. I know that a lot of the MSPs are developing courses. What documentation should we provide in order to make these courses useful to others, if there is such a need? Do you see a need for that? Should there be some kind of a booklet? We asked the faculty members and others in our MSP, what can we produce at the end that would be useful to anybody else? To be honest with you, we have not really come up with anything that is acceptable.

  We said okay, maybe we can have guides for potential instructors with details of what is going on every day, other than a syllabus. But then there was the idea that people will start from scratch anyway, they won't pay attention to this. So I'd be interested to hear whether any of you struggled with this. Maybe

you came up with a better answer than we could.

The thought was to come up with some common format, as common as we can, and then upload it, and then people can have access to it. Would that be useful? What would be useful to others? - Christos Zahopoulos

Documenting the Process of Involving Local Teacher Leaders

- Is there some value in having the instructors and people who design the courses involved as well, including the teacher leaders? Maybe as an alternative to offering a product of a finished curriculum or course, you could document the advantage of that process of involving local teacher leaders who are familiar with the local curriculum and the needs of the district in the course design. - Participant

A Process Manual

- It strikes me that a lot of what you've reported is that the value of these courses is the co-development of them, so if you give somebody a manual that's already been developed, you're probably going to sap that course of a lot of its value for the teachers of it. I would actually want to see more of a process manual, something about how you should run a course like this, and what you do to provide training to people to help them work effectively together so that we can replicate that collaborative process rather than replicate the results. - Participant
- Related to the process, how did you make decisions and what those decisions were as to what content to include and what content to exclude? It seems like everybody is struggling with this depth versus breadth issue, and when you're designing a course you have to make decisions around that. I think telling people the process for making the decisions, what you chose to include and why, and what you chose to exclude and why, is helpful to the next group designing the course. - Participant

Effective Dissemination Among STEM Faculty

- The other thing is where and when to disseminate. One of the things that we've found is that STEM faculty are very reluctant to talk about pedagogy in their professional societies. We're trying to make them more comfortable with it. It's much easier to accept information regarding how to develop models and courses and content for teachers when they're getting it from a peer in a professional society who is actually teaching teachers, not just from us distributing it among MSPs. It's our science faculty that is actually going to change their own culture. - Robert Chen

Identify Effective Activities/Pieces

- If you find activities or pieces of the curriculum you use in these courses that are successful in producing conceptual change or in producing significant learning, document those as individual pieces. Say, here is an activity that, if used with teachers, will generally produce good results and good learning. - Participant

Think Like a Consumer

- I would suggest is that you ask yourself as an instructor, what is it that you would want and use and what is it that you would not use if somebody else put something like this together? - Participant

Documenting What Happens as New Faculty and Teachers Enter the Process

- What we have done in an effort to move towards sustainability is to have more STEM faculty who weren't involved in the original process teaching these courses. So we have had turnover on the faculty side and on the teacher side. We know going in that this course is a big deal, so there's a one year prep time. It might be a new team, it might be a new teacher with an old team, it might be a new faculty instructor with experienced teachers. So they have been in rotation and in each course where there's a new member, the course does change a little bit towards ownership of that new person. So it's not like the model can be, "This is the model and I'm going to teach that model." There is some buy-in by the faculty and some change. How much that is in each case is a bit more complex. - Participant

- Describing that is really critical so that it's not a matter of someone else coming along and saying, "I'll just take this course." They need to know, wait a second, before you take this course, this is what happens. Or else your work is going to be replicated in ways you would never want it to be. - Participant

About Teacher Involvement in the Process

- You've said you involved teachers in the process of developing this. How involved were they? - Participant

- Very! - Multiple BSP Members

- The idea is that they sit down as professionals on an equal footing. The only thing we did conclude is that we did at least have to name somebody who was in charge, a professor of record. But the idea was that we did not want teachers to take the "I'll set up the lab" role. We were very explicit about that, that we were all professionals and expected teachers to contribute to the design of this. When the course was being delivered we avoided the: "I'll give my brilliant lecture in the morning, and then in the afternoon we'll do activities." I think we were largely successful in avoiding that. - Marilyn Decker

- There was also an understanding that twenty minutes is too long for any single instructor without a break, and ten minutes is pretty much it. So there was a lot of integrating between teachers. We actually had three STEM faculty—a biologist, a physicist, and an environmental scientist—and it kept going back and forth among the four of us. All four of us were there at every minute of the course, so it wasn't, "This is your day, this is your day, that's the teacher's day." It was all four of us as equal instructors. - Robert Chen

Studying the Impact of the Course on those Involved/Not Involved in the Process

- It would be an interesting supplement to this work to take these courses and give them to another group of teachers without them being developers as part of this process. Then look at the difference between those teachers who were part of the process and those who weren't. Then you'd be able to tell if it was the course itself or the process. - Participant

- As a matter of fact, what we are involved in doing is trying to find exactly that: How useful is this to other teachers? - Christos Zahopoulos

- But how useful is it to other instructors of teachers? If somebody would agree to take the manual and implement that and compare it to what you did and whether it's process or product. - Participant

- And let's say you did that and it didn't work. That doesn't mean you've failed, it means your brilliance is in the process. - Participant