Session Title:
Implementing "INTEGRATED SCIENCE: ENERGY"

MSP Project Name:
Boston Energy in Science Teaching (BEST)

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Project Session

Strand 2

Summary:
There is a critical demand for qualified STEM (science, technology, engineering and math) graduates to meet the national economic demands. Community colleges are addressing this need through partnerships with K-12 schools, universities, and industry. Collaborative initiatives include: aligning and developing relevant curricula, addressing competencies, and faculty professional development. Roxbury Community College developed and implemented a new highly successful course "Integrated Science: Energy". This is a student-centered college level integrated science (physics, chemistry and biology) laboratory course with the cross-cutting concept of energy. We aspired to align the course with the Next Generation Science Standards in K-12, facilitate meaningful connections across science subjects, and motivate students (non-science, education majors) for continued interest in science (STEM). Students want more of this class!

Section 1: Questions framing the session:

1. Is it sufficient to teach cross cutting concepts/themes (e.g. energy) across the science disciplines in K-12, as it relates to the Next Generation Science Standards? What is the added value to students' education to incorporate this integrated approach of teaching and inquiry-based learning at the college/university level?
2. Would implementing "Integrated Science: Energy" courses in the college curriculum increase the number of students interested and prepare them with the foundational science literacy competencies needed in STEM field/careers/programs?
3. What evidence would you gather and measure to demonstrate effectiveness and success of this model?

If there is time, the following are questions for discussion:

- What criteria needs to be in place and how do you foster successful and effective "integrated"-teaching, -learning, -collaborations, -leadership?
- Which courses would you integrate and what theme/cross cutting concept would you incorporate in a college-level Integrated Science Course? Why?
- What habits need to be instilled in changing the culture of the institution in order to successfully implement this model? Why?

Section 2: Conceptual framework:

"Boston Energy in Science Teaching, the Boston Science Partnership's Phase II project, is anchored in using energy as a cross-cutting concept. As a project, BEST defines effective teaching in science as facilitating opportunities for learners to explore concepts and connections across science disciplines. Our project's strategy is to use the cross-cutting concept of energy to facilitate these opportunities."

Roxbury Community College is an integral formal partner in Phase 2 of this grant, and has taken a slightly different approach to implementing the cross-cutting concept of Energy in their science curriculum. The College has a vital role in the "middle" of the pathway linking K-12 schools, universities and industries. The community college provides feedback to K-12 schools for college readiness, prepares students with the foundation and competencies (including science literacy) for successful transfer to university, required for the workforce and to be educated citizens and life-long learners. Community College faculty similar to university faculty are required to be knowledgeable in their respective content areas, and are not required to have the background in college teaching methods and pedagogy. The need for qualified instructors that are effective student-centered teachers that are knowledgeable in teaching, and their content, but also have breadth of knowledge in other science content areas, in order to make connections of concepts. RCC faculty actively participate along-side Boston Public School (BPS)Teachers and University Faculty (Northeastern University and University of Massachusetts, Boston). RCC faculty participated in the following activities: including taking one or two graduate courses/professional development: Energy 1- Contextualized Content Course and Energy 2- is focused on pedagogy and application of energy content across the major science disciplines and how these concepts are translated into the courses.

To provide a continuation of teaching and learning the cross-cutting concepts/theme of energy in the K-12 curriculum in BPS, which is aligned with the Next Generation Science Standards, RCC committed to implement a similar model at the college. RCC has a developmental/foundational, pre-college level course General Science, a survey course comprising topics in physics, chemistry and biology. With the encouragement of the division dean, RCC faculty BEST participants piloted lesson plans and activities learned from their PDs into their General Science courses in year 1 and 2 of the grant. With leadership of the dean, the faculty developed the course "Integrated Science: Energy" in year 2 of the BEST grant, using the Energy courses as models. The course (as a science course with lab elective) was approved through the college's governance

process, scheduled, advertised, and non-science and science students were recruited for the course. The course ran successfully this Fall 2012, and two sections (day and evening), with two different BEST instructors are scheduled for Spring 2013.

"The BEST project will be comparing participants who participated in BSP PD (discipline based), BEST PD (concept based), and both BSP and BEST PD to see if one type of PD has a greater impact on teaching and student achievement than another. Implicit in our program and research design are our assumptions about effective teaching. These assumptions include:

- Professional development can lead to an increase in teacher effectiveness and this change in effectiveness can impact student achievement.
- It is beneficial to learners to think about science as a whole and the connections within it, as opposed to thinking and learning about science only in disciplinary silos.
- BEST does not think that energy is the only theme that is useful for effective teaching that results in connecting science across disciplines."

Section 3: Explanatory framework:

RCC BEST-faculty are included in the data gathering with the BPS teachers. In addition, we are conducting RCC student focus groups and surveys of student course satisfaction and reflections of the "Integrated Science: Energy" course, and comparing that to data from two other science courses: Nutrition and Biology 1 from Fall 2012. Preliminary results show that students satisfaction is high for the Integrated Science: Energy course and that students are interested in taking a second semester of Integrated Science. To date three RCC faculty have completed one or both graduate professional development Energy 1 and Energy 2, two additional faculty are scheduled to take the course in Spring 2013; two faculty participated in VT, two participated in teaching & learning seminars. We are working towards building a pathway and capacity for this project (General Science, Integrated Science: Energy, Integrated Science: Forensics (future goal), offering additional sections of the courses and increasing the number of trained faculty both in content and pedagogy.

Lessons learned: We have found that faculty that have an interdisciplinary background are interested in teaching integrated science-type classes. We have been able to identify and recruit instructors that would be a 'good fit' for this project, and participate in the PD.

It is a wonderful opportunity for community colleges to have alliances and partnerships with K-12 schools, universities and industry. It is important to clearly identify your collaborative respective roles, recognize the added value that each partner uniquely contributes to the group and implementation of the project (i.e. using cross cutting concepts in science courses and curriculum), but there is most importantly the opportunity to view the whole picture of providing a vision of the pathway of science literate citizens through strategic leadership, student-centered learning, and effective teaching.

Section 4: Discussion:

We believe that Integrated Science: Energy course is an important course for non-science majors, education majors and non-science majors. Through inquiry based activities, students learn how to make connections across the contents of the course of physics, biology and chemistry with the theme of energy. Future students graduating from K-12 schools that have implemented the Next Generation Science Standards, would be familiar in making connections across the science curriculum, and would be highly successful in taking a course, such as Integrated Science: Energy that implemented similar teaching and learning of cross cutting concepts. We project that science literate students will make the meaningful connections and appreciate the relevance of science in their lives, and will be educated citizens, teachers and parents for future generations. Student will not only have science competencies but also be interested in STEM fields and careers. We anticipate that community college faculty will be more effective in their courses through the professional development (Energy 1 and Energy 2), and by making connections across disciplines, and helping students to do the same, but the faculty will naturally embrace implementing these strategies in other courses they teach.

Section 5: How will you structure this session? What is your plan for participant interaction?

The session will be for 45 minutes and consist of the following major parts:

PART 1 (10 minutes): Do Now (participant warm up question)

- *QUESTION (Think-Pair -Share): Is it sufficient to teach cross cutting concepts/themes (e.g. energy) across the science disciplines in K-12, as it relates to the Next Generation Science Standards, to meet science literacy competencies for College Readiness?*

Presenters will provide an Introduction: Background and Purpose of Project

- *QUESTION (open Discussion): What is the added value to students' education to incorporate this integrated approach of teaching and inquiry-based learning at the college/university level?*

PART 2 (20 minutes): The presenters will share in dialogue with participants on planning, development and implementation of project, preliminary results, and discussion for the future.

LAB ACTIVITY (Team Work- participants will work in small group and engage in a lab from Integrated Science:Energy. Participants will share their experience (as if they are the students in the class) with their team-mates and with all the session participants.

PART 3 (5 minutes):

QUESTION (Debate/split into 2 groups one pro/ one con): Would implementing "Integrated Science: Energy" courses in the college curriculum increase the number of students interested and prepare them with the foundational science literacy competencies needed in STEM field/careers/programs?

PART 4 (5 minutes): ASSESSMENT

- *QUESTION (Write & Share in Small Lab Groups): What evidence would you gather and measure to demonstrate effectiveness and success of this model?*

Reflection and feedback from participants on presentation
PART 5 (5 minutes): Q & A