4-8-2015

COSMIC (Center of Science and Mathematics in Context)

Roxane Johnson De Lear
University of Massachusetts Boston, Roxane.Johnsondelear@umb.edu

COSMIC (Center of Science and Mathematics in Context)

Roxane Johnson De Lear, Associate Director

About COSMIC

The Center of Science and Mathematics in Context (COSMIC) is a joint venture of the College of Education and Human Development and the College of Science and Mathematics at UMass Boston.

Mission & Goals

- Provide support for science and math teachers, through teacher training and professional development during their teaching career paths as novice teachers, experienced teachers, and teacher leaders.
- Develop and evaluate standards-aligned, inquiry-based curriculum and assessment materials for K-12 and university science and math courses.
- Provide professional development for K-12 and university science and math teachers to help them strengthen their pedagogical knowledge, content knowledge, and pedagogical content knowledge.
- Strengthen the pipeline toward science, technology, engineering and mathematics (STEM) careers, including teaching, from K-12 through the graduate level.
- Conduct research studies on the effectiveness of our interventions on high quality teaching of science and math and its impact on student achievement.
- Create partnerships with school districts, industry, government, and non-governmental organizations.

STEM Initiatives for English Language Learners (ELLs)

To provide a STEM-focused enrichment to RETELL, COSMIC and UMass Boston have created two graduate certificates in the Teaching of Math to ELLs and the Teaching of Science to ELLs. The programs provide teachers with standards-based instructional strategies that research has demonstrated are effective in improving ELL students' STEM performance.

Supporting Engineering Learning in Urban Elementary Schools

In this work-in-progress, we are developing and studying multimedia engineering notebook tools that support urban elementary students' engagement in engineering practices, particularly those that involve reflective decision-making with fellow students. Our work is a close collaboration with elementary teacher researchers, and we are in the first phase of a three-year project.

Supporting Large Scale Change in Science Education

COSMIC has teamed up with College Board to analyze the effectiveness of various types of Professional Development vehicles during the Advanced Placement Science Redesign. In addition to supporting the improvement of professional development of AP teachers by the College Board, the findings contribute to a better understanding of the relationship between professional development and student achievement more generally.

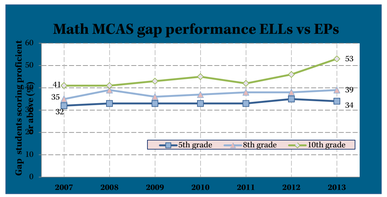
STEM Initiatives for English Language Learners (ELLs)

Center of Science and Mathematics in Context (COSMIC)
Department of Applied Linguistics

Goals and Objectives

- ✓ To provide support in effective mathematics/science instruction for teachers who work with ELL students
- ✓ To improve the academic success of ELL students in mathematics/science by increasing participating teachers' understanding of Sheltered English Instruction and of mathematics/science content
- ✓ To meet ELL students' language needs as they learn mathematics/science

Massachusetts' ELL Achievement Gap



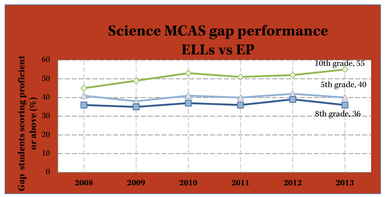
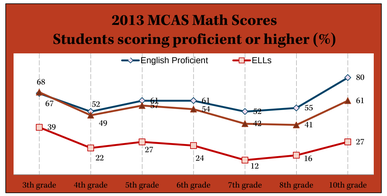


Fig. 1 The performance gap in math and science between ELLs and English proficient students (EPs) has been consistently wide.



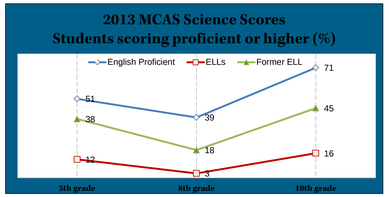


Fig. 2. Former ELLs' performance is substantially better both in math and science. This indicates that language support within the math classroom has the potential to help close the gap.

Information about Certificates

Both our Mathematics- and Science-ELL Certificate Programs provide teachers with advanced competencies in Math, Science, and ELL-related pedagogical strategies.

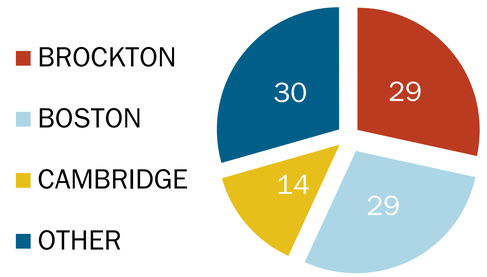
The Certificates are designed to extend the basic skills and knowledge gained by teachers who received the Massachusetts SEI Endorsement.

- ❑ **EDC G 672/673**: *Advanced Strategies for Teaching Elementary/Secondary Math to ELL and SPED students (3 Credits)*
- ❑ **MTT 580/581**: *Mathematics for the K-12 Curriculum/Number Theory for Teachers (3 Credits)*
- ❑ **APLING 603**: *Cross-Cultural Perspectives (3 Credits)*
- ❑ ***Elective** in Mathematics, Mathematics Education, or Language Teaching (3 Credits)*
- ❑ **EDC G 674**: *Advanced Strategies for Teaching Science to ELL and SPED students (3 Credits)*
- ❑ **PHYS 592**: *Integrating the Sciences Through Energy (3 Credits)*
- ❑ **APLING 603**: *Cross-Cultural Perspectives (3 Credits)*
- ❑ ***Elective** in Science, Science Education, Mathematics, Mathematics Education, or Language Teaching (3 Credits)*

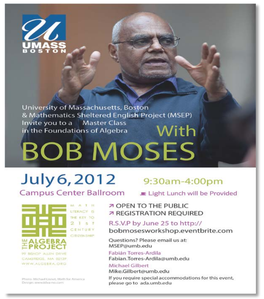
Full tuition for up to 125 teachers for each certificate is provided by US Department of Education Tittle III Grants T365Z120078 and T365Z110089. (PI. Donaldo Macedo, Dept. of Applied Linguistics)

Partner School Districts

No. Participating Teachers by District



Workshops and Conferences



July 7, 2014 Workshop: *"Effective science instruction for ELLs in elementary and secondary classrooms,"*
Prof. Okhee Lee, NY University and Rita Januszyk, Willowbrook Gower West Elementary School

Scholarly Contributions

Gilbert, M. & Torres-Ardila, F., *An investigation of multiple representations of Mathematical* , (PME-NA2013): Broadening Perspectives on Mathematics Thinking and Learning, Chicago, 2013.

Gilbert, M. & Torres-Ardila, F., *Providing Support for Mathematics Teaching to English Language Learner* , Annual meeting of the National Council of Teachers of Mathematics, New Orleans, 2014.

Gilbert, M. & Torres-Ardila, F., *Multiple Representations of Mathematical Concepts through a Semiotic Lens*, Annual meeting of the National Council of Teachers of Mathematics, New Orleans, 2014.

Torres-Ardila, F., *Teaching Science to English Language Learners (ELLs)*, Annual meeting of the National Science Teachers Association, Boston, 2014

Contact Information

Jack Levy.....tsell@umb.edu
Michael Gilbert .....msep@umb.edu
Fabian Torres-Ardila.....msep@umb.edu
http://www.umb.edu/cosmic/projects/stem_ell

Home

Supporting Engineering Learning in Urban Elementary Schools through Community-Based Engineering for Pre-Service Teachers and Multimedia Engineering Notebooks for Students

Kristen Wendell, Tejaswini Dalvi & Pat Paugh, UMass Boston
Christopher Wright, University of Tennessee Knoxville

CAREER: Community Based Engineering as a Learning and Teaching Strategy for Pre-Service Urban Elementary Teachers

Objectives

- Develop a model for incorporating community-based engineering experiences into urban elementary school classrooms and pre-service teacher education.
- Investigate how community-based engineering experiences impact new elementary teachers' science and engineering pedagogical content knowledge.
- Develop a novel Video Case Diagnosis assessment tool that measures teachers' abilities to identify and respond to students' science and engineering ideas and practices and a digital collection of community-based engineering instructional resources.

Phases

1. Baseline Observations and Development: 2013-2014
- Observe as expert in-service science teachers design and teach community-based engineering modules with students.
- Develop assessments to track novice teachers' pedagogical content knowledge for teaching engineering and science.
- Create instructional materials for pre-service methods course based on in-service teachers' community-based engineering modules.

2. Iterative Implementation: 2014-2015, 2015-2016, 2016-2017 - Implement community-based engineering modules with three cohorts of UMB elementary teacher candidates.
- Track these novice teachers' growth in doing and teaching engineering and science.

3. Synthesis: 2017-2018
Final data analysis, publication, and dissemination of sample curriculum modules through Community Based Engineering Website.

Impact

A teacher education program that leverages engineering design and community resources for more effective formation of teachers for underserved urban elementary schools.

Research Questions

During the course of community-based engineering experiences, what is the evolution of novice urban elementary teachers':

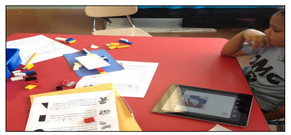
- Understandings of engineering and science practices?
- Identification and response to students' engineering and science ideas and practices?
- What discursive resources for engaging in reflective decision-making do elementary school students bring to engineering design activities?
- How do paper-based and digital engineering notebook tools support and extend elementary school students' engagement in reflective decision-making throughout engineering design activities?

Partners

Boston Public Schools Science Department
BPS Teachers from:

- **Dever Elementary School**
- **Roger Clap Innovation School**
- **John F. Kennedy Elementary School**
- **Charles Sumner Elementary School**
- **Charles Taylor Elementary School**
- **Josiah Quincy Lower School**
- **Winship Elementary School**

National Science Foundation awards DRL-1253344 ($598,269), DRL-1316762 ($262,806)



Multimedia Engineering Notebook Tools to Support Engineering Discourse in Urban Elementary School Classrooms

Objectives

- Identify the discursive resources that elementary students bring to engineering design.
- Explore how multimedia engineering notebook tools support students' reflective decision-making and engineering solutions.
- Work with teacher partners to develop and disseminate paper-based and iPad-based engineering notebook tools that support engineering discourse practices.

Phases

1. Baseline Observations: 2013-2014 - With teacher partners, analyze video from their classroom engineering units to identify where students need support for engineering discourse.

2. Development: 2014-2015, 2015-2016 - Develop paper-and-pencil notebook tools for engineering discourse.
Develop and test digital (iPad) notebook tools for engineering notebooks

3. Iterative implementation: 2014-2015, 2015-2016 - Test and revise both kinds of notebooking tools during Engineering Is Elementary units.

4. Synthesis: 2015-2016 - Final data analysis, publication, and dissemination of notebooking tools through Elementary Engineering Discourse Website.

Impact

- New theory and empirical evidence on discursive practices of successful pre-college engineering
- Increase in teachers' knowledge of how to identify and build upon the linguistic resources that students bring to engineering design processes.
- A network of elementary educators who are using engineering notebook tools to support reflective decision-making in engineering design

Home

Supporting Large Scale Change in Science Education: Understanding Professional Development and Adoption Variation Related to Revised Advanced Placement Curriculum (PD-RAP)

UMASS BOSTON

Partners: CollegeBoard EDC Learning transforms lives. Award No. 1221861 cosmic Center of Science and Math in Context

Home

Background and Purpose

- Advanced Placement (AP) exams and curricula in Biology, Chemistry, and Physics are undergoing revisions in response to NRC report in 2002 calling for changes in AP and International Baccalaureate (IB) courses.
- Revisions in the AP curricula call for scientific inquiry & reasoning, depth of understanding, and reduce broad content coverage goals.
- AP is a "high stakes" exam; teachers have strong incentives to align instruction with test.
- Teachers are expected to engage in a range of PD options to learn how to teach the revised curriculum.
- The purpose of this 3-year, mixed-methods study is to identify the choices of professional development (PD) that teachers make in preparing to teach the revised AP curricula. Additionally, how do teachers' PD choices relate to improved practice or student outcomes on the AP exams?

Research Questions

PD Patterns

- What are the patterns (type, number, and combinations) of professional development choices that teachers make when faced with large-scale curriculum reform?

PD Patterns and Student Outcomes

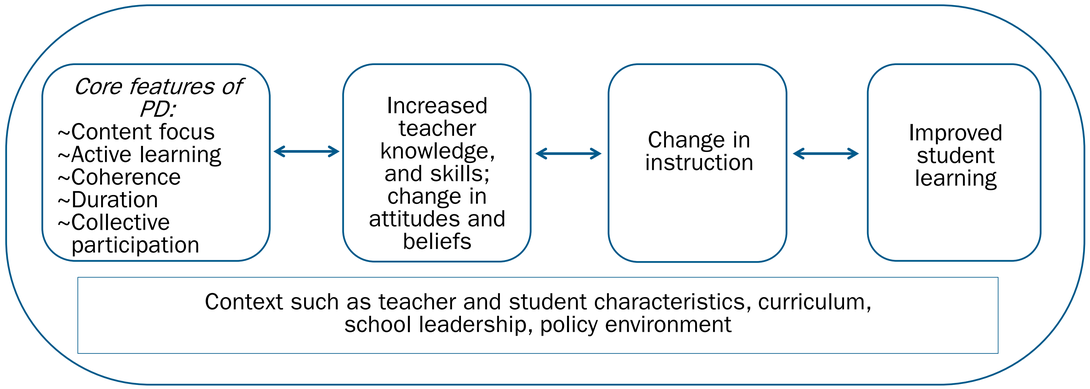
- What is the relationship between the professional development patterns that various types of teachers choose and their students' outcomes?

AP Teacher Communities (APTC)

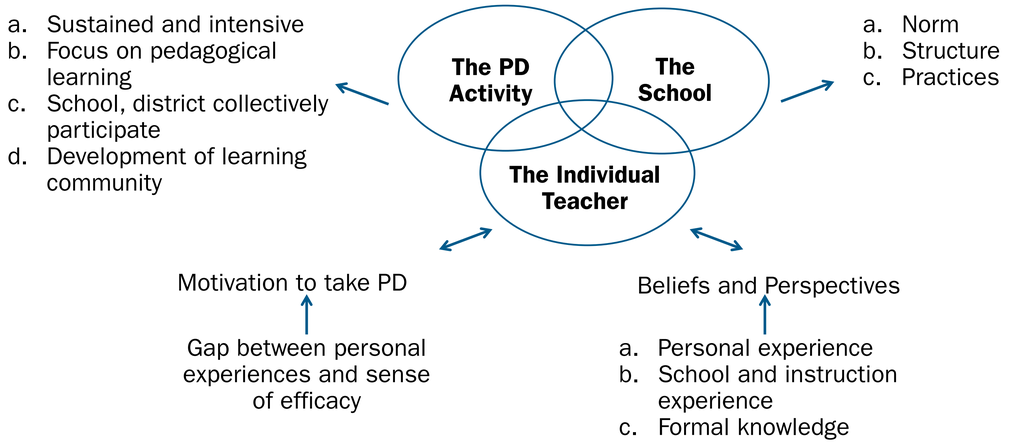
- In what ways do these online communities complement and extend top-down forms of the PD offered by College Board?
- How can these online communities be made more effective in serving their participants?
- How can these online communities be designed for scale, so that even at high levels of activity by many people, participants feel they have a voice and receive personalized responses to their questions and contributions?

Theoretical Framework

Logic model for the impact of teacher professional development (Desimone, 2009)



Dynamic Model of Teacher Learning and Change (Opfer & Pedder, 2011)



Method and Data Sources

2013	2014	2015
AP Biology	AP Biology	AP Biology
	AP Chemistry	AP Chemistry
		AP Physics

Survey

- Teacher and teaching characteristics (Demographics, School Context, Teaching Background, PD Participation, PD Attitude, Course Instruction, Challenges, Stages of Concern)

College Board

- School characteristics (Demographics, Socioeconomic status)
- APTC activity of AP teachers
- Student AP scores from examinations
- Student characteristics (Demographics, Other achievement scores)

Next Steps

Case Studies (n=150) and Focus Groups (18)

- Teachers' perceptions of their experiences in preparing and teaching redesigned AP curriculum
- Administration of 2014 AP Biology and Chemistry surveys and 2015 AP Biology, Chemistry, and Physics surveys
- 2nd set of interviews for case studies (after the AP Exams)
- APTC data analysis
- Focus groups with AP Biology, Chemistry, Physics teachers

References

- Desimone, L. (2009). Improving impact studies of teachers' professional development: Toward better conceptualizations and measures. *Educational Researcher*, *38*(3), 181–199.
- National Research Council. (2002). Learning and understanding: Improving advanced study of mathematics and science in U.S. high schools: Report of the content panel for biology. Washington, DC: Committee on Programs for Advanced Study of Mathematics and Science in American High Schools, National Research Council. Retrieved from http://www.nap.edu/catalog.php?record_id=10365
- Opfer, V. D., & Pedder, D. (2011). Conceptualizing teacher professional learning. *Review of Educational Research*, *81*(3), 376–407. doi:10.3102/0034654311413609