



# SCALE Key Concepts



This series of articles illustrates key concepts of the SCALE five year National Science Foundation-funded project.

The SCALE partnership aims to improve K-12 mathematics and science teaching and learning working with four urban school districts: Los Angeles Unified School District, Denver Public Schools, Madison Metropolitan School District, and Providence Public School District. Other partners include California State University, Dominguez Hills; California State University, Northridge and University of Wisconsin-Madison. These articles reflect the major themes of the National Science Foundation's Math and Science Partnership (MSP) Program: Partnerships Across Institutions; Challenging Courses and Curricula; Evidence-based Design and Outcomes; Teacher Quality, Quantity and Diversity; and Institutional Change and Sustainability.

## SCALE Opens the Door to Higher Education Change

As SCALE enters its sixth year implementing math and science education reform in four school districts spread across the continent, it appears that the heavy oaken door between institutions of higher education and K-12 education has cracked open a bit. By creating “cross-cultural working teams,” the project triggered a “transformative culture” in the participating institutions of higher education. More than the sum of these factors, SCALE researchers say it is the confluence of an innovative reform effort and a special set of institutional forces that generated this change.

At the outset, the System-wide Change for All Learners and Educators (SCALE) set an ambitious goal: to improve math and science teaching and

learning from kindergarten through college and beyond as teachers enter classrooms. In conjunction with the Quality Educator Development (QED) grant program, SCALE introduced a multi-faceted, evidence-based professional development program coupled with an inquiry-based science curriculum adapted to individual needs at one of its partner institutions, California State University, Dominguez Hills. SCALE researcher Matthew Hora identified several factors supporting reform goals at the higher education level:

**“Change must be pursued simultaneously on structural, social and individual levels,” SCALE Researcher Matthew Hora said.**

- Administrative support for excellence in teaching and pedagogical reform
- An institution type (comprehensive) that lends itself to a focus on teaching
- A strong history of interactions with local K-12 districts
- A cohort of faculty in the mathematics and science departments committed to science, technology, engineering and mathematics (STEM) pedagogy

But Hora also identified some formidable barriers to enacting reforms at the higher education level—ones that have long been recognized in the higher education community. The following factors inhibited SCALE's reform efforts:

- A demanding faculty workload (four courses a semester)
- State policy that divided teacher preparation between education (pedagogy) and STEM (content) departments
- STEM faculty's lack of exposure to the learning sciences
- Professional disagreement between STEM and education departments
- Resistance to reform among science faculty due to the primacy of research
- Misalignment between recruitment, tenure and promotion policies, prevailing attitudes toward STEM instruction and institutional support for pedagogical reform

SCALE/QED worked on several levels to facilitate reform at CSUDH. STEM classes were revised, professional development offered for STEM faculty and inter-institutional collaborations between

## SCALE Key Concepts: The Evolution of SCALE Professional Development

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CSUDH and the local school district were initiated. “By skillfully engaging STEM faculty in cross-disciplinary working groups and in problematizing and re-conceptualizing their instructional practices, SCALE/QED actors enabled STEM faculty to make explicit and then change their cultural model for STEM instruction,” writes Hora in his report, *Factors Influencing Change Initiatives to Improve K-20 STEM Education at California State University, Dominguez Hills: Final Case Study of SCALE Activities* (2007). Hora uses “cultural models” theory from cognitive anthropology to analyze how individuals use deeply held belief systems to make sense of and act in any given situation (in this case STEM faculty teaching). This model was used because it offered a way to account for the influence of tacit assumptions held by faculty and explore cultural change at the individual level.

In terms of pre-existing structural support, CSUDH is a comprehensive university whose key focus is preparing students for teaching careers and its leadership has been very supportive of achieving excellence in teaching. In addition, there is a strong history of professional relationships with its local school district, Los Angeles Unified School District (LAUSD). Perhaps most important, there is a strong group of math and science faculty devoted to improving teaching and paying attention to pre-service education. These faculty were instrumental in revising curricula in the math and science departments.

CSUDH was also involved in recruiting graduating high school seniors interested in becoming math and science teachers and enrolling them in cohorts to provide social, academic and advising supports, ultimately increasing student graduation rates. In addition, close collaborations developed between higher education faculty from both math and science departments, and between K-12 and higher education faculty.

**For more information about concepts and ideas discussed in this article, click on this link:**

[http://www.scalemsp.org/files/research/Products/Factors\\_Influencing\\_Change\\_Initiatives\\_to\\_Improve\\_K20\\_STEM\\_Education\\_CSUDH.pdf](http://www.scalemsp.org/files/research/Products/Factors_Influencing_Change_Initiatives_to_Improve_K20_STEM_Education_CSUDH.pdf)

The SCALE/QED project addressed each of the identified barriers in their efforts to initiate change. But, as Hora points out in his report, reform efforts do not occur in a vacuum, which is why it is critical to understand the unique context of each reform effort. “Change must be pursued simultaneously on structural, social and individual levels,” Hora said. He also cautions that his report has focused only on CSUDH and is not intended to serve as a template for all reform efforts. Here are his recommendations for program replication:

- *Avoid Using Homogenous Explanations of Institutions of Higher Education Contexts:* Each IHE has its own culture or climate. In order for change to happen, a multi-faceted approach affecting different levels of the institution should be adopted.
- *Conduct Institutional Needs Assessments:* Any change effort should begin with an institutional needs assessment to identify potential barriers and opportunities that are unique to that institution.
- *Consider Requiring the Involvement of Education Faculty in the Partnership:* A more inclusive and collaborative effort reflects the belief that teacher preparation is the responsibility of the entire campus.
- *Focus Change Efforts on the Cultural Model for STEM Instruction:* Surfacing STEM faculty’s assumptions about teaching and encouraging them to “think like novices” through skillfully facilitated professional development can alter faculty cultural models of teaching and learning.

As the SCALE model has shown, change is possible when attempted in a deliberate, thorough manner and within the confines of an institution’s environment.

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