

Executive summary: year 5: NSF i-3, precursor to the Center for STEM Learning at CU-Boulder

In its fifth year, the University of Colorado Boulder's NSF i³ effort, "Towards a Center for STEM education," has made great strides.

As of December 2012 the CU NSF i³ effort Integrating STEM (iSTEM) transitioned to become the **Center for STEM Learning (CSL) of the University of Colorado Boulder campus**. Establishing a center has been a key objective of the CU NSF i³ grant.

The mission of the CSL is to improve science, technology, engineering, and mathematics (STEM) education at the University of Colorado Boulder and to serve as a state, national, and international resource in STEM education.

We achieve this mission through: the creation of an infrastructure of institutional support in order to transform STEM education; the support of education research within and across STEM fields and departments; and K20 teacher recruitment, preparation, and professional development. CSL facilitates change in STEM education by integrating an interdisciplinary community of scholars, promoting, sustaining, and evaluating existing reform efforts, sponsoring new programs, advocating for diversity and access, influencing relevant policy, fundraising, and communicating with the public.

Below is a summary of some of the accomplishments of this effort.

Building the national reputation of CU Boulder as a leader in STEM education.

- In Jun 2013, **CU-Boulder was selected as a project site for the Association for American Universities (AAU) STEM Education Initiative**. CU was selected as one of 8 lead demonstration sites nationally, or 31 applicants and 62 member institutions. Summary of this project is below.
- The **Association of Public and Land-grant Universities (APLU) draws on the expertise of individuals and programs at CU-Boulder** (for its work on the Science and Math Teacher Imperative, the Math Teacher Education Partnership, and the efforts to address the Next Generation Science Standards), and is now launching an initiative to create a national network of Centers. **The CU-Boulder CSL is helping to frame APLU's network of STEM education centers and will serve as a national hub.**
- **Members of the CSL advise national leaders and organizations** (including: OSTP, NSF, APS, ACS, ASEE, NAS, SABER, AAU, & APLU) **on the role and promise of university-based national centers for STEM education**. The Center staff have acted in an advisory capacity to approximately a dozen other such centers as they work to establish themselves, drawing from our center's model. Organizations include Penn State, Florida International, Arizona State, Rochester Institute of Technology, Colorado State, University of Maryland System, Auburn, Michigan State, and North Dakota State.
- CSL staff members are heading an effort for **scaling one of CU Boulder's successful programs**. Five universities throughout the nation are slated to serve as CU Boulder satellite sites for **running regional versions of the successful National Colorado Learning Assistant workshop in 2014**.

Building a statewide reputation of CU Boulder as a leader in STEM education.

The CSL serves the interests of the state and builds growing ties throughout the state and the government.

- **CSL staff members have served on: the Governor's Taskforce on STEM education**, which is creating state-wide STEM education roadmap, on the state's application to the federal Race to the Top and grassroots efforts throughout the state (e.g., Colorado STEM Network).
- **CSL/iSTEM also founded and developed the largest regional program in STEM education**, the Boulder Area STEM Education Coalition (BASEC), which is part of the Colorado STEM Network.
- Center and affiliate STEM Education efforts at **CU-Boulder have been showcased in sessions of the Board of Regents and at the Joint Education Committee of the Colorado state legislature.**
- CSL staff and the Boulder STEM community **are advising the CU-system President's Taskforce on New Technologies in Higher Education.**

Building the campus infrastructure for STEM education.

- Through the development of the center infrastructure, **more than 75 CU-Boulder programs devoted to STEM education have been identified**, a preliminary needs-analysis conducted, and key stakeholders have been brought in to shape the structure of the CSL.
- Seed development efforts have included regular (weekly to bi-weekly) meetings of a **project management team to design the center.**
- There have been regular (bi-weekly to monthly) meetings among University Communications, Strategic Relations, Government Relations, and the Center staff. These coordinated efforts have **helped establish a brand, an identity, and a commitment to STEM education at CU**—developing branded materials, web-presence, talking points, brochures, staff roles, and language for CU and national efforts.
- **STEM education is now identified in the university's strategic plan for the coming year.** [see provost's strategic initiatives 2013-2014]

Building the campus efforts for STEM education.

The Center and iSTEM precursor have had vast impacts on CU-Boulder based STEM.

- This effort has supported **more than 35 faculty and graduate students with Chancellor's Awards for Excellence in STEM Education** (the award itself is a product of infrastructure building).
 - These awards have supported the **educational transformation of more than a dozen educational environments**, supported 20 graduate students in STEM education research (**with 12 PhDs so far, and at least 4 new lines of PhD research in departments on campus**), and provided seed funding for more than 15 faculty to engage in STEM education research and transformation.
 - These **awardees have subsequently brought in 10 NSF Awards (over \$5 M)** on research related to and drawing from their Chancellor Awards.

- Development and expansion of the **Discipline-Based Education Research** community on campus, which now **includes hundreds of faculty, staff and students, across dozens of departments and programs** and at least six colleges on campus.
- Two annual symposia (bringing hundreds of campus community state and national stakeholders), mini-symposia on targeted areas (such as teacher professional development), a dedicated staff, web-portal / presence, and advising on individual efforts, all serve to **develop campus community and identity around STEM education.**
- **Support of interdisciplinary partnerships and new programs.** For example CSL sponsored efforts linking: physics and social psychology; engineering and education; and among outreach, education, arts & sciences and engineering. CSL advised on and will partner with the newly formed General Engineering + program. Two significant grants (~\$3-\$4M) are slated to run through the Center as it is established, and four more grants have been submitted to the NSF running (at least in part) through the Center.

Future prospects for the Center for STEM Learning

National attention to STEM education will likely continue and grow, CU-Boulder is positioned to lead. This Center for STEM Learning will provide capacity for such leadership (e.g. the CSL serves as host to the CU-Boulder AAU STEM Education Initiative project site). In the short term, the CSL will continue and expand the productive elements of efforts outlined above. Additional efforts will focus on development (STEM education is a largely untapped area of extra-mural funding from foundations and individuals in the state) and communication, building campus community and participation (through the Fellows and Affiliates program) and expansion of programmatic activities and impacts. In the longer term, the Center is positioned to grow into an Institute (should this be an institutional priority). As an institute it would continue to promote the development of all faculty, establish more faculty lines in discipline-based educational research, grow graduate and postdoctoral work in STEM education transformation and research, and yield the associated outcomes of a nationally productive Institute which serves the university, the region, the state, the nation and the world.

**Professionalizing educational practice through measurement and assessment:
materials, infrastructure, and cultural support**

The University of Colorado Boulder (CU-Boulder) builds on more than a decade of educational transformation to address the calls to systematically transform undergraduate education. The outcomes of this three-year project include:

- using more effective measures of educational practice than are currently employed;
- providing resources for promoting evidence-based measures of educational practice in seven or more departments across campus;
- collaborating with the faculty senate and provost to modify the cultural value of teaching, defining and valuing excellence in educational practices;
- linking to other AAU (and non-AAU) institutions for tailoring tools and practices in a national movement; and
- developing IT infrastructure that can facilitate access to, use of, and interpretation of results for faculty and institutions.

This AAU effort supports both grass-roots, faculty-led efforts and administration/campus wide, top-down support. This approach will empower faculty and departments to use more effective measures of educational practice, justify how and why these measures are used, and act on the findings of these measures to support the systematic improvement of education. Faculty and departments will be supported both within departmental structures and through institutional reward systems that value educational practices, including the faculty promotion and tenure process.

The project runs through and will be sustained by the Center for STEM Learning (CSL), which brings together leading figures from STEM disciplines, education researchers, and administration from across campus. The effort addresses calls both from within the university and extramurally to promote and demonstrate impacts of modern evidence-based educational practices.