# STEP to Success Conference- Presentation Abstracts

**Session 1**
Workshop 1 - Classroom Innovations

“**Cerberus”: MassBay Supercomputer Beowulf Cluster**

*Giuseppe Sena, MassBay Community College*

During the Summer & Fall of 2012 MassBay Community College worked on the design and implementation of the “Cerberus” Beowulf cluster. Cerberus is an 8-node dual-core Linux cluster with CUDA support; that can be booted from a network, or from a local hard drive. Cerberus is one of the few Beowulf clusters ever built by a community college in the US, and probably second in Massachusetts. This project is based on a professional development grant with the idea of creating labs and microlabs to introduce parallelism and distributed systems concepts into the CS curricula in our community college. We show several distributed applications running on the cluster; including galaxy simulation (n-body problem), numerical integration, protein folding, etc. We used the “Cerberus” Beowulf Cluster to developed two applications as a case study: 1) Distributed Mandelbrot set fractal. Fractals are recursive structures in nature, are an example of an “embarrassingly parallel problem”. There is no dependency between the data. 2) Distributed DES Brute-Force Algorithm (encryption & decryption). This algorithm uses a hash function to find the key. Once a slave finishes his work, it sends the result back to the master indicating if it was successful (found a key). If there is more work to do, the master sends another group of keys to the slave. Both applications follow a Master-Slave paradigm, and were written in C using the Open MPI library. We analyzed the performance using 1, 2, 4, and 8 nodes, and we visualized the output using GUIs developed in the Python programming language. A demo will be done to show the applications running live.

**Learning Community Experience in STEM Mass Bay**

*Marina Bograd and Susanne Steiger-Escobar; MassBay Community College*

In this session we will share our experiences with organizing and conducting a collaborative learning community where students participating in four different courses come together as a team to complete a common project. The Shopping Cart Experience at MassBay Community College gives participants an interesting contextualized learning environment where students achieve a common goal through team-work, experiential learning, and integrated curriculum across courses. Throughout the semester students from different majors enrolled in four separate courses to collaborate in a common project, by applying their individual knowledge and skills, simulating a real world experience. The goal of the project is to complete a functional Shopping Cart website using team’s resources. Each team consists of a project manager, web site developer, web designer and digital imager. The project can only be completed by the students working as a team since an individual student will not have all the expertise required to complete the project. Skills learned through this type of project include team work, professional communication and time management. Some of our common objectives include learning to collaborate with students from other classes and learn about other roles, career paths and skills as they collaborate with individuals with different expertise to create one project. This is not a traditional cohort learning community where students are enrolled in all the same courses. In the Shopping Cart Learning Community, students are free to enroll in one or more courses. This semester we introduced a common meeting hour to facilitate communication among team members and faculty. As a result we can observe a growing sense of community and engagement among students as well as increased ability to meet project deadlines. The common hour is just one of the changes that have been implemented this year to resolve challenges faced in the previous two years.

Workshop 2 - Academic Support/ Research

**The Extraordinary Power of Research Based Curriculum**

*Bruce Jackson, Dr. Mario Raya, M.D., Alberto Velez, Carolyn Lanskron, and Lindsay Grumbach; Mass Bay Community College*

In January 2011, President Obama recognized the Biotechnology Program at MassBay Community College in a ceremony in the Oval Office of the White House. The Biotechnology Program (Biotechnology, Marine Biotechnology and Forensic DNA Science) at MassBay is internationally renowned and one of the most celebrated undergraduate science programs in the United States. It is the first research-based curriculum in the nation and houses the world’s only degree program in Forensic DNA Science. The Biotechnology facility at MassBay is one of the most sophisticated undergraduate laboratories in the United States. It contains over $4.9 million dollars in state-of-the-art instrumentation and capital equipment. The well-equipped Biotechnology facilities at MassBay allow the exceedingly hands-on and highly interdisciplinary preparation of scholars for the life sciences workforce. In this regard, the program enjoys a one hundred percent job placement rate, with most scholars hired well before graduation. Approximately fifty percent of Biotechnology graduates pursue advanced STEM degrees at the world’s elite institutions, including Yale, Brown, Columbia, Cornell, University of Edinburgh (Scotland), Boston University, Brandeis, University of California, Davis, and the University of Massachusetts (Lowell, Amherst, Dartmouth). The Program has produced an unprecedented, for community colleges, 18 winners of the Barry M. Goldwater Scholarship (the nation’s highest undergraduate STEM award). Biotechnology Scholars conduct exciting internships at prestigious research institutions in 42 nations. One graduate and two current scholars of the Biotechnology Program will be the Presenters.

**Undergraduate Research at Middlesex Community College**

*Jessie Klein; Middlesex Community College*

In order to meet the increasing need to provide research experiences for STEM students, Middlesex Community College offers a one credit undergraduate research course. This session will provide a discussion of how this course was developed, examples of research projects, issues around recruitment of students and faculty mentors, and sustaining the course.

Attendees will gain insight into the rewards and challenges of promoting authentic research experiences for community college students.

Workshop 3 - Supplementary Programs

**Web-based Interactive and Adjustable e-Learning Environment for Energy Education**

*Yakov Cherner and Gary Mullett; ATeL and Springfield Technical Community College*

The paper presents a multilayered, highly interactive, simulation-based, integrated, and adjustable online environment for STEM education in the areas of renewable energy sources, energy distribution, and control and efficient energy consumption. The environment consists of virtual labs (vLabs) designed to enhance the understanding of technical concepts and to teach fundamental scientific laws and principles in the context of their applications. vLabs allow students to explore the design and operation of solar power and heating systems, power control and distribution equipment, cyber-physical systems, home appliances, various light sources, and other power consumption devices, as well as relevant physical processes. Each online activity focuses on a particular task and specific learning objectives. They include highly interactive main and auxiliary simulations, step-by step instructions for students, worksheets, built-in lessons to facilitate “just-in-time” learning, embedded assessments, and other resources. The virtual labs can be combined with related hands-on exercises to form hybrid laboratories to be delivered via either online or on-site teaching methodologies. The authoring toolkit allows teachers with no-programming experience to develop new, and tailor existing, virtual activities to specific learning objectives and students’ background, to personalize student assignments and assessments, and to link vLabs with the teachers’ own favorite e-learning resources.

**A First Course in Engineering Design Based on an Energy-Centered Thematic Approach**

*Yiannis Levendis and Christos Zahopoulos; Northeastern University*

A proposed course that incorporates hands-on engineering design projects will be presented for possible incorporation in the freshman year of College. This course introduces the Engineering Design Process (EDP) early in the curriculum, while allowing for high flexibility and low-cost instruction. The development of engineering projects should (i) emphasize engineering design (ED), (ii) incorporate relevant math, science, technology knowledge/skills, and (iii) promote engineering practices, such as systems thinking, creativity, optimism, communication, and consideration of ethical issues, as well as safety concerns and cost. Projects are selected to not only get students interested in engineering but, also, to enhance and support enduring understandings of corresponding science topics. For instance, engineering projects addressing the issues of the growing demand for pollution-free energy, dwindling supplies for clean water and global environmental change are part of the Energy-centered thematic approach of this course. Projects on energy-efficient heating/cooling of homes, lighting, refrigeration of foods, cooking, cooling of refreshments, winterizing a house, desalinating sea water, etc., support and re-enforce the enduring understandings on the Law of Conservation of Energy and the concept of transformation of energy. Examples of such projects which have been extensively tested in Professional Development courses for Middle- and High-School Science Teachers will be presented.

**Session 2**

Workshop 1 - Classroom Innovations/PD

**A “High-Tech Tools and Toys” Summer Workshop for Community College Teachers**

*Stephen McKnight; Northeastern University*

With the support of the NSF CenSSIS Engineering Research Center and the DHS ALERT Center of Excellence, we have developed at Northeastern University (NEU) a “High-Tech Tools and Toys Lab” (HTT&TL) as a resource for teaching selected sections of a first-year “Engineering Problem Solving and Computation” course. In the course, student write programs in MATLAB and C++ to control laboratory instrumentation through A/D and GPIB-bus PCI cards in the computer backplane leading up to two major projects: (1) identifying an object obscured by opaque gelatin with 1 MHz ultrasound under water, and (2) color-sorting a tube of painted ping-pong balls using a videocam and a rotating stepper motor. The application of computer programming to real-time instrument control to accomplish a specific sensing and imaging task has created a rich learning environment in our first-year engineering program that is often cited by students as a highlight of their experience in the College of Engineering.

In the summer of 2010 and 2011, two-week professional development workshops on the HTT&TL concepts were offered for community college teachers in conjunction with the NSF STEP-UP program. In June, 2010, four teachers from Middlesex Community College and two each from Mass Bay CC and Northern Essex CC worked through the existing NEU HTT&TL projects and explored alternatives that could be implemented in the participants’ community college courses with available resources. With support from the ALERT Education Program USB A/D modules were acquired and, through collaboration with the electronics and machine shop instructors at Whittier Vocational/Technical High School, stepper motor assemblies and 40 kHz ultrasound air transducer stands were constructed for each of the participating community colleges. In addition, a limited number of ThorLabs “no-moving-parts” spectrometers were acquired for the community colleges; MATLAB software to control the spectrometers was developed by an NEU graduate student. In the spring of 2011, students in a first-year engineering course at Mass Bay CC used MATLAB and C++ HTT&TL modules for hands-on study of stepper motor control, spectroscopy of plastic colored filters, and computer-controlled sorting of painted ping-pong balls.

The workshop was offered again in June of 2011 with participants from Middlesex, Northern Essex, and Roxbury community colleges. In the second offering of the workshop, the focus was on the development of HTT&TL projects that could be adapted for the community colleges. In the fall of 2011, Northern Essex CC offered two sections of a new course in “Introduction to Engineering” using MATLAB HTT&TL projects on speed of sound in air, an acoustic range-finder, computer control of stepper motors, and the use of spectroscopy to discriminate between olive oil, corn oil, soy oil, and motor oil. As a part of his sabbatical leave proposal, the author assisted in the delivery of the NECC course in the fall. This course is now embedded in the NECC pre-engineering curriculum with two sections of 16 students enrolled both spring and fall semester. In addition, the HTT&TL modules continue to be used in the spring semester Engineering Introduction course at Mass Bay CC.

The success of this program in transitioning hands-on, computer-controlled projects using advanced physical principles and engineering instrumentation from NEU to local community colleges is an example of the collaboration between the CenSSIS and ALERT research centers and the collaborations with local community colleges that has been developed through the STEP-UP program.

**Engineering Essentials and Design - the HTT&L course at NECC**

*Michael Pelletier; Northern Essex Community College*

This session presents Engineering Essentials and Design EST104, a project-based first-year introductory engineering course at NECC which emphasizes working in teams on hands-on projects that require using EXCEL and MATLAB. Assignments involve graphing data for Ohm’s Law and the speed of sound in air, distance measuring using ultrasound, programming in MATLAB to control the movement of a stepper-motor rotor and programming in MATLAB to analyze and identify the visible spectra of several translucent materials. Students are required to make presentations of the projects and the results obtained.

To document student success, data on student achievement in the course was collected for seven offerings of the course over three semesters: fall of 2011, spring of 2012, and fall of 2012. Additional data on course completion rates and student persistence in engineering was collected. All of the data collected on student success will be presented in this session.

In addition, an outside evaluator designed a self-survey to assess pre- and post- student attitudes toward certain skills thought to be enhanced by participation in the course. The results and analysis of these self-surveys will also be presented.

Supported by funding from Raytheon, in the fall of 2012, one section of EST104 was enhanced with a Supplemental Instruction (SI) leader while the other two sections were not. In the spring of 2013, three sections of EST104 were offered. Again thanks to Raytheon, one web-supported section was offered in the evening with an SI leader; one section was offered during the day as a hybrid course with an SI leader and the third section was web-supported with access to an SI leader. A preliminary analysis of these three approaches will be presented.

Workshop 2 – Classroom Innovations

**Department of Homeland Security Scholars**

*Chi-Yin Tse; Northeastern University*

Roxbury Community College (RCC), in collaboration with Northeastern University (NU), secured a Department of Homeland Security (DHS) grant to provide mentoring and financial support to its students, while offering professional development to its faculty. Based on academic performance and interest in pursuing STEM studies, DHS scholars were selected annually by RCC faculty and staff. Support to the DHS scholars has been provided by the STEM center through face-to-face meetings, seminars, and lab visits in addition to engaging in research through participation in the NU Research Experience for Undergraduates. In addition, the RCC faculty participated in the NU Research Experience for Teachers program. This year, the program has expanded during the academic year to allow DHS scholars to not only visit NU research labs, but to be able to participate in them as well. The first semester of the calendar year required DHS scholars to complete reading assignments based on the laboratory. A week prior to their visit, the RCC faculty member established a discussion group to go over the scholarly articles with the DHS scholars. The student interest and preparedness for these visits led to an expansion of the program during the second semester of the calendar year. The DHS scholars were afforded the opportunity to work directly in the laboratory environment under the direction of an IGERT fellow. This direct work has led to the expansion of interest, as each fellow is not directly linked to an area of interest of the scholar. This allowed for understanding a broader spectrum of research work and allowed the DHS scholars to see what other aspects of research they could be involved in for future reference.

**Developing interest in STEM among urban students in a first-year college program**

*Molly Dugan, Silvani Vejar, Peter Plourde; Northeastern University*

Foundation Year is a first year college program at Northeastern University that serves urban students who are first generation or who may be underprepared for the demands of college. The program is designed to tackle barriers to students’ college success. The students take a traditional freshman year college curriculum but do so within a unique design that addresses students’ academic needs while simultaneously engaging them in college‐level content. Foundation Year admits a broad scope of students with high variability in their mathematical knowledge and skills. Foundation Year math faculty use innovative methods and pedagogical techniques to reach the range of students some of whom have strengths in math and for some college level math may be a barrier to college persistence and degree attainment. Many students express the desire to pursue STEM fields as an academic major and professional interest. Faculty and advisors work with students to demystify the curricular and academic requirements of STEM majors and to expose students to careers in STEM fields by inviting students to attend engineering symposia and conferences and connecting them to professional and academics in the field. The presentation will include a discussion of the design, implementation, and preliminary outcomes.

**Catching Stars**

*Dr. Tala Khudairi, Dean Science, Technology, Engineering & Math (STEM); Roxbury Community College*

The talent gap and demand for 1.2 million jobs in STEM fields are issues the nation is addressing. The Mass Space Grant Consortium NASA sponsored grant) has provided support for the past five years to RCC to recruit and retain students in STEM programs and careers through its popular "STEM Speaker Series". Learn the attributes of its success!!

Workshop 3 – Academic Support/Supplementary Programs

**Enhancing Student Success with Problem Based Learning and Process Oriented Guided Inquiry Learning**

*Kimberly Stieglitz, Farida Akhter, Zineb Berdjane, Bruce Brender, Rajeswari Sundaramoorthi, and Ching Yim; Roxbury Community College*

In the spring semester of 2012 we began an initiative at Roxbury Community College to incorporate current pedagogy into our study sessions to improve student performance and retention. We attempted to implement Process Oriented Guided Inquiry Learning (POGIL) and Problem Based Learning into our Chemistry study sections. Participating instructors taught facilitated study groups (FSGs) for their own science sections. The courses selected were Principles of Chemistry I and General Chemistry I. Participating faculty prepared a teaching module and we reported our results to the faculty at the end of the semester for professional development days. There were variable results comparing exam scores and FSG attendance. In some sections of General Chemistry attendance clearly correlated with exam performance when either the POGIL or PBL methods were implemented. We often observe a cluster of excellent scores and a cluster of poor scores in these courses. Current studies are focused on how to close this gap in student performance. Students who have poor attendance in general (at- risk students) are not being reached by the FSGs and are therefore unable to benefit from this academic support. In sections where the majority of students were motivated the data showed a clear correlation in FSG attendance and exam performance, but other sections the two parameters did not correlate. In conclusion, this spring semester (2013) we have begun applying POGIL within the lecture time to reach all students registered for our classes with equity. We are collecting data on student’s attitude towards the subject material and performance in these courses before and after the POGIL experience. We are currently seeking external funding to support these efforts.

**A STEM with a bright new humanities bloom**

*Barbara Ann Kearney; Mass Bay Community College*

For the first time this semester MassBay STEM students indicated that selecting one of my distinctive ePortfolio Freshman English composition sections, over a more “traditional” one, was a conscious, deliberate choice to fulfill their core program requirement. EPortfolio pedagogy, with its emphasis on integrative learning, offers STEM students an occasion and opportunity to re-frame the interests, pursuits, accomplishments and knowledge associated with their science majors, in the “creative” context of the humanities. The metaphor –ePortfolio as a “STEM with a bright new humanities ‘bloom’” --is invoked to explore how ePortfolio as a mode of learning not only nourishes the (scientific) imagination, but also prepares STEM students for broader collaboration and discourse about science and technology. We will share examples of artifacts and assignments, which, to paraphrase the words of Valerie Strauss, exemplify how STEM and “blossom” can “motivate each other”. Participants will gain appreciation for how ePortfolio--- by now a well-established “best practice” – is highly adaptable and flexible, and, among other benefits, offers promise in promoting STEM student engagement with broader audiences, and in altering his/her experience with “success” in English Comp, as well as being of relevance to future educational pursuits, or career development.

**Session 3**

Workshop 1 - Academic Support/Professional Development

**Supplementary Instruction to Increase Success in Computing/STEM**

*Renee Fall, University of Massachusetts Amherst, Commonwealth Alliance for Information Technology Education (CAITE), School of Computer Science, with Erik Risinger, Greenfield Community College, Doug Wilkins, Greenfield Community College, Aparna Mahadev, Worcester State University, and Kenneth Rath, SageFox Group*

Since 2009, more than 90 gateway computer science courses at ten Massachusetts public 2- and 4-year campuses have benefitted from Supplemental Peer Instruction (SI), sponsored by the Commonwealth Alliance for Information Technology Education (CAITE). Participants in this session will learn about SI as a promising intervention to increase pass rates and grades, examine models for implementation and assessment, talk with faculty and a student who have participated, and consider if and how to start SI or similar forms of peer-led academic support on their own campuses.

CAITE, funded by the National Science Foundation, has been working to increase student diversity, retention, and success in computer science and information technology. While little research has examined the success of SI in computer science in particular, SI has shown great promise at improving student outcomes in STEM fields in general. Assessment of CAITE’s implementation of SI shows more than 50% of SI participants who were surveyed reported increased confidence in their knowledge and ability to succeed, desire to learn and continue to the next level, and enjoyment of information technology. Students who participated in SI also generally had higher grades than those who did not participate and were typically more likely to pass the supported courses. Anecdotal evidence also suggests peer-led SI also serves an informal advising function and builds community among students at different stages in the major, with potential impacts on retention.

In this session, you’ll learn the elements of SI and evidence of its impact in gateway computing classes. Community college and four-year faculty, as well as a student SI leader, will reflect on Supplementary Instruction on their campuses. Discussion will focus on SI as a best practice and adapting SI to other contexts.

Workshop 2 - Professional Development

**A New Culture of Learning in STEM Education**

*Jalal Ghaemghami, Randall Foote, Tom Macdonald, Lauren Chomiczewski, and Zineb Berdjane; Roxbury Community College*

The study explored the need to alter the traditional learning environment and relationships, roles of faculty and students in higher education programs, especially in the STEM division. Faculties at community colleges are highly conscious of the process and value creating an interactive learning community among themselves as well as with students, and are interested in incorporating online discussions into their course work. This requires of each faculty to develop a solid understanding of ways to foster students becoming independent learners through using online discussions.

In our recent Learning Community, five faculty members from Roxbury Community College have been able to share lessons learned through an engaging practice both online and face-to-face. We have collaborated in recognizing the need for a new culture of learning that assures setting practical guidelines for online discussions, making connections between classroom practice and the professional use of the content of lesson during an asynchronous discussion. The discussions forum becomes an extension of instructional practices that supports dialogue, reflection, and self-assessment by faculty learners. From our own experience of working together, we have come to believe that a successful mechanism or pathway toward this support mechanism can be to form workgroups, Faculty Learning Communities [FLC]. It is our understanding that incorporating online discussions will secure a better awareness of the effective use of technology in a learner-centered education system. This approach will assure success for development of independent learners among community college students specifically those studying in STEM disciplines.

Participants will receive practical guidelines about building teamwork and successful planning for formation of a Faculty Learning Community. Such a community may choose to strengthen communication skills among faculty, to increase efficacy of collaboration in a multidisciplinary environment, and to identify productive approaches to implement utilization of online discussions or social media in communication with learners.

**“How People Learn”**

*Christos Zahopoulos; Northeastern University*

Over the past couple of decades, a lot of work has been done on How People Learn and its implications on Effective Teaching & Learning. More specifically, a lot of research has been done in the cognitive, learning, and brain sciences, which has given many new insights about how humans organize their knowledge, how experience influences understanding of new concepts, how individuals use different strategies to learn, how people acquire expertise and how knowledge is transferred. A series of workshop seminars on “Research Findings on How People Learn and Implications to University Teaching and Learning” were offered to STEM faculty at Northeastern University (NEU) and at the three Community College partners (Mass Bay, Middlesex and Northern Essex). These seminars served as a catalyst for the establishment and/or expansion of faculty learning communities. This session will provide a brief overview of the content, approach and outcomes of these seminars.

**Session 4**

Classroom Innovations

**Open Classroom, Student Presentations Engineering Design Laboratory**

*Chitra Javdekar; MassBay Community College*

Freshman engineering experiences are critical from the perspective of overall development of students and for student retention. MassBay Community College (MBCC), Massachusetts, in conjunction with High-Tech Tools & Toys Laboratory (HTT&TL) an educational initiative of the Center for Subsurface Sensing and Imaging at Northeastern University (NU), implemented “Engineering Computation using Application Software,” a freshman engineering course in which students learned MATLAB programming through real-time control of instruments to optically discriminate and color-sort objects such as colored ping-pong balls. The course modules are designed to engage students early in their academic pursuits by giving them opportunities to experience the excitement of using high-tech tools and technology. The goals of the course are engineering problem solving, learning basic computation skills, and discovery. Students expected to work both independently and collaboratively, and are required to present their findings several times during the class. Since the first introduction of this course in the engineering programs at MassBay, the enrollment has tripled in this course during the current academic year. The initiative is supported by the NSF-STEP UP (STEM Talent Expansion-University Partnership) grant and the Department of Homeland Security ALERT Center of Excellence.

This open classroom will provide examples of past and present student work, their reflections on the course modules, lessons learned, and will feature the demonstration of ping-pong ball sorting setup.

**Artbotics Workshop**

*Suzanne Steiger-Escobar*

The Artbotics program, a collaboration between the University of Massachusetts Lowell and the Revolving Museum in Lowell, MA “ is designed to allow students to explore the intersection between Art and Computer Science, especially Robotics, through project-based learning, public exhibitions, and service-learning experiences.” [1].

In 2009 and 2010 I attended the Summer Artbotics Educator Workshops, and, as a recipient of Arbotics kits, began to incorporate materials and methods of the program into my teaching and outreach events. I developed different versions of the program to meet time constraints.

A 3-hour lab version was developed for a CS0 laboratory, a non-programming course taken by non-cs majors. Students were grouped in teams of 2 and had to design, build and program projects in a 3 hour session. The labs were engaging, students work persistently and almost all are able to complete projects successfully.

A 50-min version was developed for high school outreach events. Students were grouped in teams of 2 and due to time constraints; they were given a choice of 2 projects to work on. Students selected materials, colors, decorations and movements. Programs were downloaded and edited if necessary but not created for this version.

A 2.5-day version was offered as an option for our High School Summer Bridge Program. Students selected a theme for the entire class. They were grouped in teams of 2 and had to design, build and program their projects. All projects were showcased at the end of the week.

The intent of these workshops and labs has been to present the creative and fun side of computing. Students collaborate to design and create an art project; they learn to design within the mechanical constraints imposed by the electronic and electro-mechanical components available to build their project; they learn about sensors, motors, and a programmable “cricket”; and they learn how to use the components to animate their projects.

[1] H.A. Yanco, H.J. Kim, F.G. Martin and L. Silka, “ Artbotics: Combining Art and Robotics to Broaden Participation in Computing”, In Proceedings of the AAAI Spring Symposium on Robots and Robot Venues: Resources for AI Education, 2007.

**Film**

Philip "Uri" Treisman, Professor of Mathematics and Public Affairs, University of Texas at Austin

**Innovation as Ornament and the Challenge of Improvement at Scale**

Compelling economic forecasts indicate that our country will need to produce, over the next decade, one million more college graduates in STEM fields than would be expected at current rates. Fortunately, everywhere and all the time armies of responsible faculty members and administrators are working to improve their undergraduate programs with the goal of increasing the number and diversity of STEM graduates. Many of these academics recognize that the health of their disciplines depends on developing a next generation of STEM professionals that represents the full diversity of our society. Yet progress is disappointedly slow--despite the enormous energy expended on the task. How might we proceed differently so that necessary change occurs at scale? And, what new arrangements must be created to allow those working at different levels of the educational system to collaborate on meeting national and disciplinary goals? These questions and suggested answers are the heart of the talk.