



2014 HAWAII UNIVERSITY INTERNATIONAL CONFERENCES  
SCIENCE, TECHNOLOGY, ENGINEERING, MATH & EDUCATION  
JUNE 16, 17, & 18 2014  
ALA MOANA HOTEL, HONOLULU, HAWAII

# A NEW CONTINUOUS LEARNING ENVIRONMENT MODEL TO IMPROVE STUDENTS' SKILLS AND PROFESSIONALS IN STEM FIELDS

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## **A New Continuous Learning Environment Model to Improve Students' Skills and Professionals in STEM Fields**

### Synopsis

The City College of New York in partnership with Hostos and La Guardia Community Colleges created The Alliance for Continuous Innovative Learning Environments in STEM (CILES) as model to increase the number of professionals in STEM fields.

# A New Continuous Learning Environment Model to Improve Student Skills and Learning in STEM Fields

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## 1. Introduction

The 21st Century economy presents major challenges and opportunities that are scientific and technological in nature: protection of a changing environment and climate, the green energy paradigm, the global communication revolution, and increased need for health care services, among others. The nation's global competitiveness is required to establish a well-trained population in the critical Science, Technology, Engineering and Math (STEM) fields to meet these challenges and stay competitive in the global markets. In comparison to the world, the United States is lacking production of STEM professionals. In 2001, about 2.7 million students graduated from high school of which about 1.7 million students enrolled in two or four-year colleges (National Center for Education Statistics, 2006). However, by 2007 only about 233,000 students earned a STEM bachelor's degree in the US (National Science Board, 2010) which represents only 15.6% of all bachelor's degrees. Meanwhile, China awarded half of its first university degrees in STEM fields (46.7%); South Korea awarded 37.8%; and Germany awarded 28.1%. Another substantial challenge is the retention rates in STEM among underrepresented minorities specifically are very low in comparison to the larger population. Close to 30% of those minority students pursuing STEM careers complete their degrees in six years.

## 2. Program Motivation

The 2011 six-year graduation rate for full-time, first-time undergraduate students who began their pursuit of a bachelor's degree at a four-year degree-granting institution was 59% (National Center for Education Statistics, 2013), but for minority groups it drops dramatically. In New York state, the average six-year graduation rate

is 58.1%, Whites 62.7%, Black 23.4%, Asian 59% and Hispanics 43.5% (The Chronicle of Higher Education, 2010). Hispanic four-year graduation rates in New York are 32% well below compared to Whites, 52% (Excelencia in Education).

Accordingly, the City College of New York in partnership with Hostos and LaGuardia Community Colleges created The Alliance for Continuous Innovative Learning Environments in STEM (CILES) as a model to increase retention and graduation rates at the partner institutions and to increase the number of professionals, particularly from minority groups, in STEM fields.

## 3. About the Alliance

The Alliance consists of institutions that are designated Minority and Hispanic Serving Institutions (MSI & HSI) by the US Department of Education, whom are facing similar challenges towards educating undergraduate students and are urged to encounter solutions to enhance student education.

The City College of New York (CCNY) is a senior college of the City University of New York (CUNY) system with more than 4,000 undergraduate students in STEM disciplines. Its overall population includes 32% Hispanic and 23% Black (as of Fall 2010). Similarly at LaGuardia and Hostos Community Colleges, 80% of the student population is from minority groups. Therefore, the Alliance is well-formed to directly impact underrepresented students at high risk. This undergraduate model was developed to enhance student skills, improve student learning, facilitate the transition from community colleges to four-year colleges, provide continuous academic support inside and

outside the classroom, and offer special services to faculty that support students.

#### 4. CILES Model for Undergraduate Education

The CILES model elements (Fig.1) were designed to increase the retention and graduation rates and as a result increase the number of professionals in STEM fields. All these elements together provide students with the tools and skills needed to succeed in the 21<sup>st</sup> Century.



Fig. 1. CILES Model for Undergraduate Education.

The five key elements are: a) articulation agreements between community colleges and senior college, b) continuous learning environments, c) early alert system, d) curriculum development, e) professional development and f) research. A brief description of how these elements contribute to improving undergraduate education follows.

##### a. Articulation Agreements

The articulation agreements aim to facilitate the transition of transfer students from community college to the senior college and as result increase the pool of students pursuing careers in these STEM fields.

The CILES program envisions two new articulation agreements between the CCNY and each partner institution; La Guardia Community

College and Hostos Community College for the Earth System Science and Environmental Engineering (ESE), and Earth and Atmospheric Science programs. The two community colleges created new associate degree programs in ESE and the respective articulation agreements were signed early this year. Community college students will benefit tremendously from these agreements as they will take courses already approved by the senior college and will have a secure spot at the senior college which will provide a smooth transition.

##### b. Continuous Learning Environments

The CILES program created the continuous learning environments for all STEM students in need using virtual technology, mentorship, and on-demand space, connecting students and faculty across the Alliance. The virtual learning community provides the space for students to receive needed direct and timely mentorship and tutoring from upper classmates and/or faculty in a setting familiar to the students in key disciplines such as math, physics, chemistry, and programming. The mentors and tutors are assigned virtual sessions where they provide assistance to students in need. The learning communities are further supported by breakout learning rooms for students to use on demand to meet their learning needs. Breakout rooms are fully equipped with the proper information technology to allow communication across campuses. Tutors and mentors may use breakout rooms to conduct their sessions, which are supplemented by whiteboards and erasable walls. These spaces help strengthen academic connections between peer-to-peer, student-mentor, or faculty-student.

##### c. Early Alert System

An Early Alert System (EAs) will be developed to track students with low academic performance in real time. Some of the variables used to measure student performance are attendance, homework, projects, midterms, and tests. Students with low academic performance are considered students at risk and are invited to attend tutoring sessions in person or virtual supported by the continuous learning environments. The EAs notifies the students, the

faculty and the tutoring center. The tutoring is scheduled and provided by upper class students, masters and doctorates. This new tool allows continuous academic performance monitoring and real time intervention to enhance student performance. The EAs is key and unique to the CILES model as it is directly supported by physical and virtual infrastructure and can be implemented across disciplines.

#### d. Curriculum Development

CILES faculty is continuously working on revising and updating the curriculum to reflect the set of skills students need to succeed and lead in the 21<sup>st</sup> century. These skills are: critical thinking, team player, interdisciplinary learning, problem solving, research, and solid academic background. Students work in cross campus interdisciplinary projects supervised by a team of faculty from the two-year and four-year colleges.

Furthermore, the CILES program reviewed two core courses of the ESE program, the Earth System Science and Engineering, and the Systems Analysis of the Earth course.

#### e. Professional Development

A motivated and well-trained faculty is key to succeeding in the overall goal of increasing retention of STEM Hispanic and low income students. One of the services CILES provides is training faculty and graduate student mentors across the Alliance in the use of the virtual learning environments and in developing hands-on and multidisciplinary training via summer workshops. We bring together all prospective participating faculty (from CCNY, HCC, and LaGCC) for a week-long workshop. At this workshop, faculty receives practical training in: the use of the virtual learning environment, assessing lecture material and student success when using virtual tools; and developing interdisciplinary laboratory-based projects for sophomore, junior, and senior students, including assessment of the success of these projects. The workshops are led by experienced faculty in each of the areas indicated.

#### f. Research

The CILES program engages students in research to further develop critical thinking, and technical and research skills. CILES partnered with various existing programs for undergraduate research available at CCNY, particularly the CREST Research Experience for Undergraduates (CREST-REU) program and the New York City Research Initiative (NYCRI) program.

Students involved in research early on in their careers are easily developed into logical thinkers and are more likely to pursue graduate studies (Hathaway et al. 2002 and Russell, Hancock & McCullough 2007).

### 5. Faced Challenges

Initially the program moved very slowly. There are many factors involved to successfully implement such a complex program. Following is a summary of the challenges faced:

- The articulation agreements involved the creation of new associate degree programs, and this required not only approval at different levels at each institution but also a coordination of different departments; sciences, mathematics and engineering. In addition, mapping the courses that will be articulated required input from faculties in different departments. Also, new courses were developed at the cc level to be able to have new programs.
- The construction of the infrastructure that supports the continuous learning environments and the program curriculum involved the institution management of facilities and a very comprehensive construction process with many high level requested approvals.
- One of the ongoing program challenges is the cross-institution communication in order to share student confidential information.

### 6. Future Work

The CILES program will offer the new associate degree programs in Fall 2014. The virtual platform to support the continuous learning environments and the early alert system tool will

be in pivot mode to support the new program by Fall 2014.

## 7. References

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