AC 2011-2670: REGIONAL CENTER FOR NEXT GENERATION MANUFACTURING

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Karen Wosczyna-Birch, a national award winning Professor of Chemistry, is the statewide director for Connecticut's College of Technology, which includes all 12 Connecticut community colleges, six universities and partner high schools including the technical high school system. She is also the executive director of the Regional Center for Next Generation Manufacturing, a National Science Funded Advanced Technology Center, where she provides leadership for the advancement of manufacturing and related engineering and technologies. Karen also has expertise in providing professional development that includes strategies for the engagement and persistence of under represented populations in STEM disciplines. She has received awards from several organizations including the American Association for University Women (AAUW) for her work in addressing the need to increase females in engineering and technology fields as well as for her work in educating students with the skills required for the 21st century workforce.

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Engineering Challenge for the 21st Century

Introduction

The Engineering Challenge for 21st Century Program was primarily established to increase the number of high school student's opting to pursue careers in Science, Technology, Engineering and Mathematics (STEM) related disciplines, by showing that engineering and technology are interesting and fun. Another key component of this program is to create a positive learning and coaching experience so that the student participants realize that they have the potential to continue their education in engineering and/or technology related disciplines. Mostly geared towards inner city underrepresented students, 25-30 student participants are brought to a community college classroom environment where they are trained in the following technical and professional areas:

- Hands on project based learning
- Working on teams
- Understanding behavioral diversity using DISC
- Personal accountability
- Technical writing

Sponsors

The Program is funded by National Science Foundation's Advanced Technology Education Program (ATE). Other program sponsors include the United States Coast Guard Academy (USCGA) and the Connecticut Business and Industry Association (CBIA).

Program Structure

The Engineering Challenge for the 21st Century Program focuses on team-based activities that allow students to effectively develop the necessary skills to become qualified, productive and successful in engineering and technology disciplines of the future. To achieve this goal, the Program targets two important educational groups: 1) high school students, and 2) faculty from high schools and community colleges. Separate programs are structured uniquely for each of these groups.

1. Engineering Challenge for the 21st Century Program for Students:

The Program runs for four (4) consecutive Saturdays from approximately 9:00 AM to 4:00 PM. Each Saturday is structured so that each day is a new learning experience so that the students are able to remain focused on the subject matter.

Table 1
Itinerary

Day 1	- Introduction, Program overview, collection of administratively required paperwork and completion of individual DISC Behavioral Profiles by participants (two hours) - Introduction to technical writing (two hours) - Review DISC Behavioral Profiles and create team assignments - Team Assignment - first laboratory activity, teams of students complete rough draft of lab report and instructors review/provide feedback on draft lab reports.
Day 2	- Student teams turn in lab reports which incorporate instructor feedback as previously provided followed by classroom discussion. - DISC Behavioral Profiles, team building training and exercises (bird identification) are presented to assist in the understanding and enhancement of teams and team work. - Instructors review lab reports and provide feedback. - Lecture and group exercises on understanding the dynamics behind hydrogen fuel cells
Day 3	- Complete second laboratory activity with student teams preparing rough draft lab reports. - Complete professional skills training - Individual coaching of each student participant with a certified/professional coach. - Student teams build and work with hydrogen fuel cell cars
Day 4	- Finalize all lab activities - Finalize lab reports and presentations of findings made by each team - Additional team building exercises (i.e. California Earthquake Survival Simulation ©, Bushfire Survival Simulation ©) - Student participants complete an evaluation of the instructors and the program. - Complete 360º Feedback Evaluation/Surveys - Final program wrap-up - Pizza party!!!

Stipend Payments for the Students:

Students are paid a stipend for the time they invest in themselves in the Engineering Challenge for the 21st Century Program. Many of the students who sign up to participate in the Program do so for the stipend, but end up discovering that the real value rests in the Program and the experiences encountered. Each student is eligible to earn up to $300 for participating in the Program. The total stipend earned is calculated as follows:

Occurrence	Amount (earned or deducted)	Potential:
Per Session – Attendance	$45.00	$180.00
Unexcused Absence	($45.00)	Varied
Unexcused Tardiness	($15.00)	Varied
Perfect Attendance and Active Participation	$120.00	$120.00
Stipend earned for perfect attendance and active participation:		$300.00

Student Participants – Diversity Compilation (2006 – 2010)

Gender:	**Male**	234
	Female	161
	RESPONSE NOT PROVIDED	1
	Total	395
Ethnic Origin:	**American Indian or Alaskan Native**	7
	Asian	23
	Black or African American (not of Hispanic origin)	96
	Hispanic	111
	Pacific Islander (Native Hawaiian or other Pacific Islander)	4
	Caucasian	98
	Multi-Racial	55
Citizenship:	**U.S. Citizen**	310
	Permanent Resident	25
	Other Non-U.S. Citizen	5
Student participant did not provide a response.		7
Grade:	**9**	59
	10	34
	11	25
	12	23
English Language Learner (ELL):	**Yes**	80
	No	58
	RESPONSE NOT PROVIDED	3

2. Engineering Challenge for the 21st Century Program for Teachers:

The week-long Teachers Summer Dissemination Workshop is held in July at the United States Coast Guard Academy in New London, Connecticut. Over a week's time, interdisciplinary teams of high school teachers and community college faculty, from throughout the United States and Puerto Rico, work with the Engineering Challenge for the 21st Century and the United States Coast Guard Academy instructors who conduct a *"train the trainer"* session so that participants can learn the Program's pedagogy and methodologies. Where upon returning to their respective institutions, they are able to integrate what they have learned into their classrooms and laboratories. The participants also receive instruction regarding effective methods to assess and coach teamwork effectiveness and they get a chance to work with hands on technology and science activities such as building and testing robotic boats, bottle rockets and hydrogen fuel cell cars.

Sample Laboratory Activities:

Since the commencement of the Engineering Challenge for the 21st Century Program, different laboratory activities have been incorporated as a part of educational experience of the Program. Participants are instructed in the science and mathematics related to each laboratory activity, prior to the laboratory itself. A few examples of the laboratory activities utilized are:

- Testing the tensile strength and torsion of various metals and plastics
- Designing and building robots to deliver and open envelopes
- Virtual redesign of the throwing mechanism for a Trebuchet
- Mousetrap car redesign
- Assembly and testing of logic gates
- Moment of inertia and deflection to operate an electrical switch
- Measurements using a dial caliper and micrometer
- Basic stamp microprocessor (writing music by translating notes to frequencies)
- Electrical circuitry using breadboards
- US Coast Guard AROW program – water robotics
- Hydrogen powered fuel cell cars

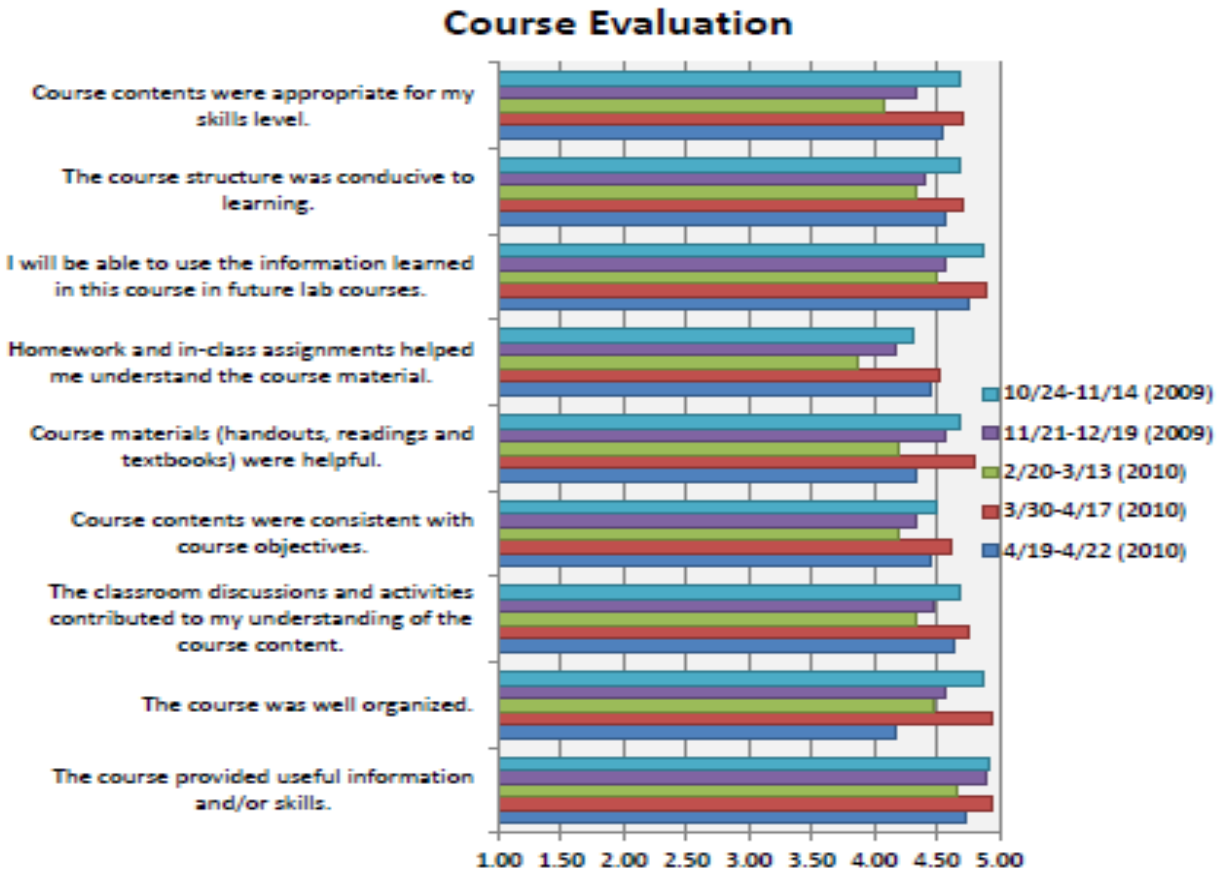
Program Evaluation

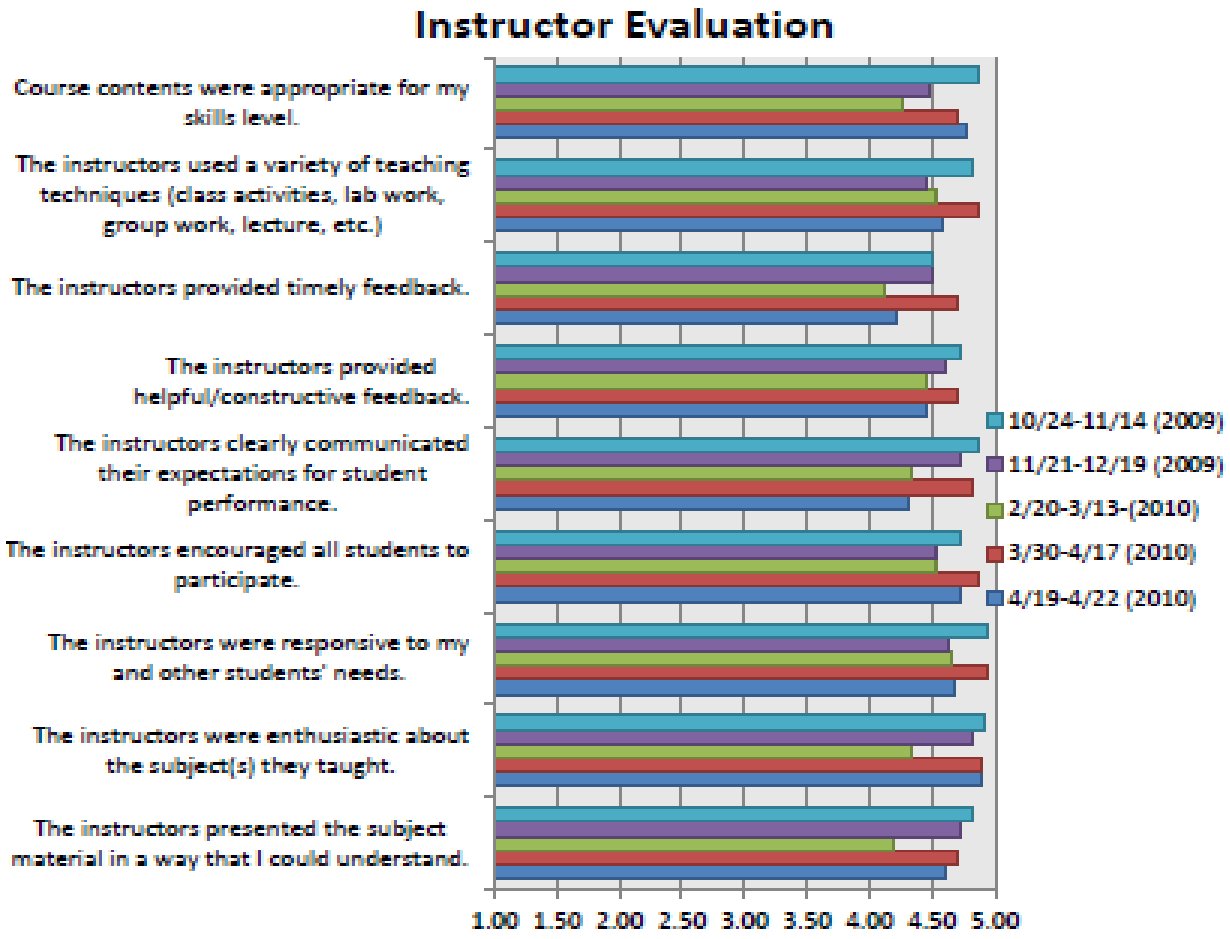
The Engineering Challenge for the 21st Century Program has a very comprehensive evaluation which is to be completed by each participamt on the following three (3) criteria:

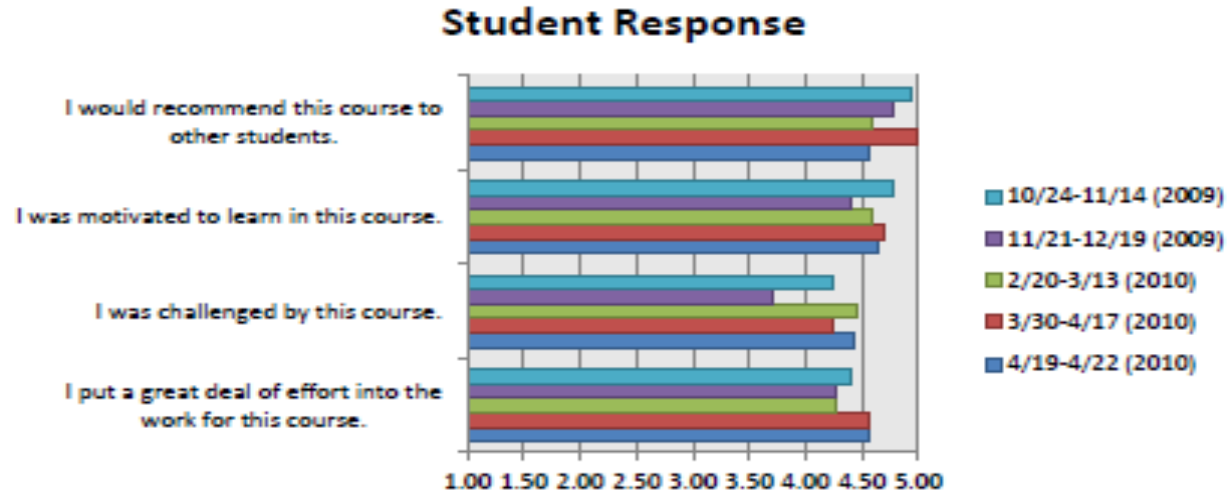
1) Course Evaluation
2) Instructor Evaluation
3) Student's/Teacher's Response

The following illustrations reflect the evaluation compilation of the student programs and teacher programs respectively.

Part I – Student Program

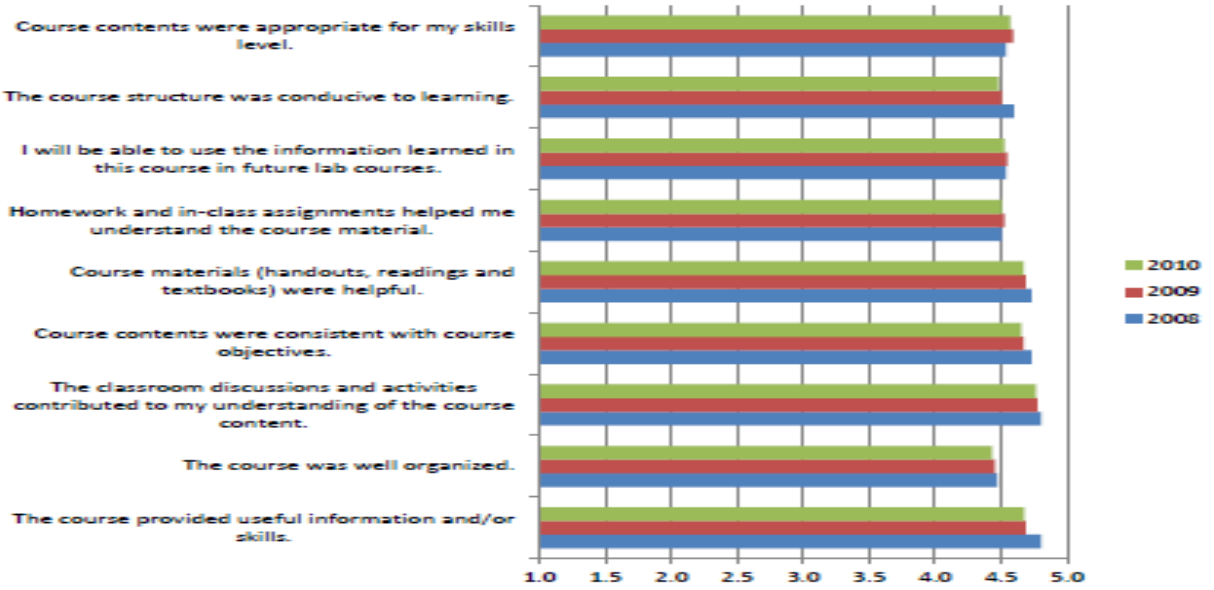




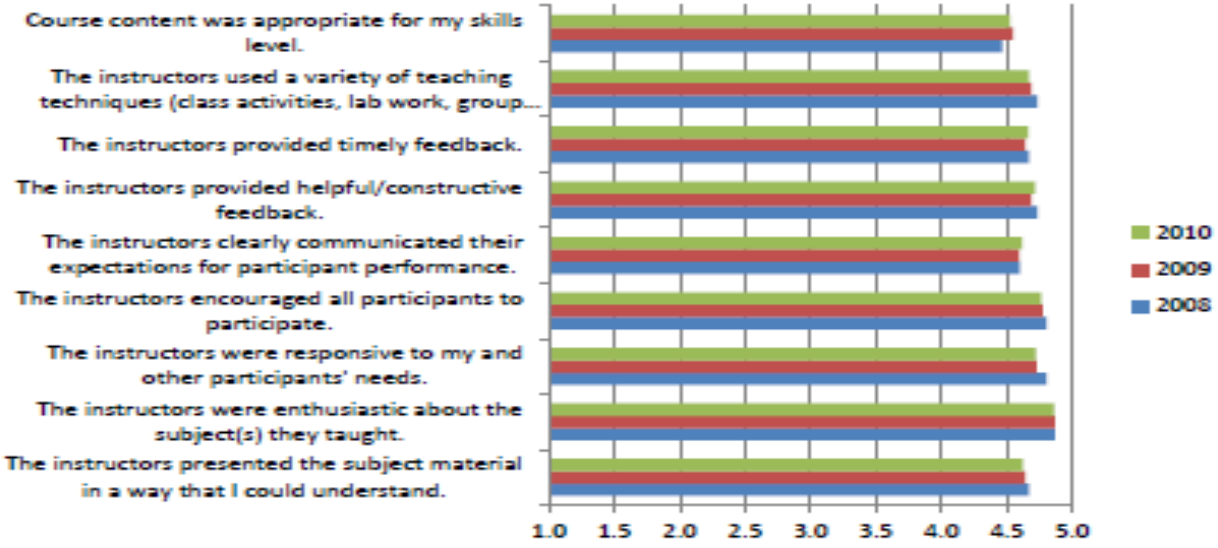


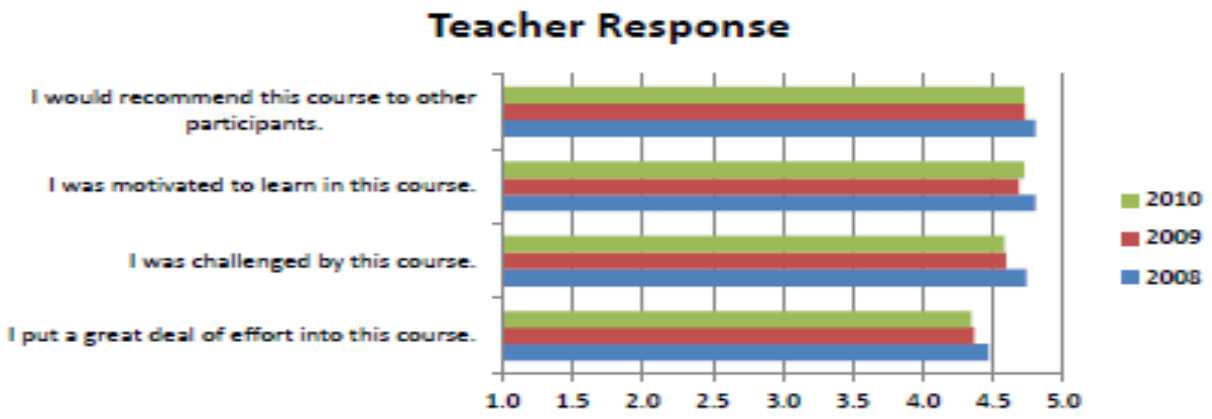
Part II – Teachers Program

Course Evaluation



Instructor Evaluation





Conclusion

The engineering challenge program has been successful in engaging both students and teachers in a hands on project that includes professional skills. As illustrated in the evaluation tables, the average score reported for all components of the program was a minimum of 4.3, with 5 being the highest score and 1.0 the lowest score. The project staff is currently tracking the student participants with respect to their career paths. Preliminary data has reported that high school students who have participated in the engineering challenge program have pursued STEM career paths. It is anticipated that the final results will support the antidotal data that the engineering challenge program is impacting students and their career choices.