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## **Bridging the Gap Between General Education and Accredited Engineering Technology Fields**

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# **Bridging the Gap between General Education and Accredited Engineering Technology Fields**

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## **Abstract**

General Education is a very important aspect of higher education. Instilled in many institutions via Student Learning Goals (SLGs), General Education provides guidelines for students to become well rounded individuals in a variety of disciplines that otherwise concentrate solely on discipline specific information. One of the strategies that can assist different disciplines in implementing General Education SLGs is Course Coordination. Many disciplines, especially in science and engineering go through accreditation processes. For instance, Computer Engineering Technology, is accredited by the Accreditation Board for Engineering and Technology (ABET). The disciplines that go through an accreditation process must comply with a set of standards. In the process of implementing Course Coordination SLGs in Computer Engineering Technology, we noticed that several of these standards were similar to the criteria used for accreditation. This paper proposes an initiative to bridge the gap between General Education and accredited Engineering Technology fields by creating a framework for other disciplines to use as a model. We show the feasibility of this framework with data collected from the Department of Computer Engineering Technology.

## **Keywords**

ABET, Accreditation, Course Coordination, General Education.

## **Introduction**

The New York City College of Technology (CityTech) is a senior college of the City University of New York (CUNY) with current enrollment of 17,282 students (63% full time, 37% part-time) and 1,512 faculty members (414 full-time, 1,098 part-time)<sup>1</sup>. CityTech is composed of three schools: School of Professional Studies, School of Arts and Sciences, and School of Technology and Design. The College experienced 50% growth in past 12 years and it now offers multiple degrees in several fields with 53% students being enrolled in associate and 47% in baccalaureate degrees.

Current national academic trends place general education in a broader context in student's overall education in their chosen major and across fields<sup>2</sup>. Following these trends, in 2009 CityTech introduced an initiative to improve its general education offerings and awareness<sup>3</sup>. Through faculty discussions, training sessions, college-wide events, symposia, classroom projects and other activities, the initiative seeped general education to all departments and majors in the College. One of the essential components for improving general education at CityTech became the course coordination effort. The General Education Committee created several subcommittees, among them the Course Coordination Working Group (CCWG). This working

group is responsible for developing the course coordination framework and overseeing the work of the Course Coordination Liaisons (CCLs) in all academic departments.

One of the departments that played a vital role in the course coordination efforts at City Tech was Computer Engineering Technology (CET). During the years 2014 and 2015 the CET department went through the Accreditation Board for Engineering and Technology (ABET) accreditation process<sup>4</sup>. At the same time, the CET faculty participated in the course coordination efforts. When implementing course coordination, they noticed a lot of similarities between course coordination and the accreditation processes. This paper presents the findings by CET faculty during the accreditation and course coordination process as well as a proposed framework for improvement. The paper is organized as follows. First, the Course Coordination process at CityTech is described in detail. Second, the overlap of CET department course coordination findings with the ABET accreditation process is examined. Then we present the results and analysis of the data collected during the period of implementing Course Coordination and the ABET accreditation. Finally, the conclusions and future work are presented.

### **Course Coordination Working Group at CityTech**

The Course Coordination Working Group<sup>5</sup> is a subcommittee of the General Education Committee (Gen Ed Committee) at CityTech. The Gen Ed Committee's mission is to define and re-envision General Education for all Departments at the College. The Gen Ed Committee work takes place on two levels, institutionally and departmental. Institutionally, the Gen Ed Committee frames the goals and desired outcomes of general education by drawing on the thinking of all departments as well as on the tradition of general education. It coordinates all Gen Ed work in the College under one umbrella, raises awareness, and represents Gen Ed to all campus constituencies. At the departmental level, Gen Ed Committee draws ideas from the departments and works with them to achieve integration of Gen Ed goals and outcomes into the curriculum and pedagogy of all college programs and courses.

The CCWG is in charge of creating college-wide framework that supports course coordination, integrates selected General Education Student Learning Goals (SLG) into all courses in all majors, and reviews the process on the cyclical basis in synch with the General Education Assessment cycle. The CCWG works directly with department Course Coordination Liaisons (CCL). These CCLs in turn work with course instructors, other members of their department, chairs, fellow liaisons, deans, members of Gen Ed and Assessment Committees and others to evaluate course content, course materials, pedagogical practices, and to create general education projects and assignments. This allows all participants to implement, reassess, and share effective course coordination practices. In Fig. 1 you can see a diagram of the relationship among the Departmental Course Coordination Liaison, the Gen Ed Liaison and the Assessment Liaison.

As part of the course coordination process each department selects a faculty member to be the CCL. This faculty commits to a two-year term as part of the continuous cycle of defining, delivering, refining, and sharing effective course coordination practices with the Schools and the Gen Ed Course Coordination Working Group. The CCWG provides the departmental CCLs with a wide range of resources for them to use as they see fit in their particular disciplines. The resources include in-person meetings workshops, documents, and forms available online<sup>4</sup>. The

documents include meeting agendas, minutes, presentations, findings, and examples of course coordination exercises.



**Figure 1** – Diagram of the relationship and collaboration between the Course Coordination Liaison, the Gen Ed Liaison and the Assessment Liaison.

The Deans of each School also get involved and provide support by holding biannual meetings where ideas are exchanged and best practices are shared. The Dean’s meetings are well attended by departmental CCLs and by CCWG members. Course coordination at the departmental level starts with each CCL choosing one or more courses as well as one or more GenEd SLGs to be implemented in the chosen course(s). During the two-year cycle, it is the departmental CCL’s responsibility to implement the GenEd SLGs into the course(s) and assess the work with help and support from full-time and part-time faculty members who are teaching the course(s). This is accomplished by holding workshops (in-person or online), updating the syllabus, providing students with an assignment or project, changing or adjusting the topics covered in the course, utilizing rubrics, among other activities.

Every semester, there is one Dean’s meeting for every School with all the CCLs invited to participate. During that meeting, the CCLs report on the progress and difficulties they encountered. At the end of the two-year cycle the CCLs provide a final report. At that time, the CCLs and department chairs also decide whether they will continue for two more years or if they are going to be replaced by a new CCL. A diagram of the Course Coordination Process at CityTech is shown in Fig. 2. Currently, all departments at CityTech have CCLs involved in the second two-year cycle of course coordination. The Department of Computer Engineering Technology is no exception. This department in particular found some interesting parallels

between the course coordination efforts and the ABET accreditation process, which is explained in next section.



**Figure 2** - Diagram of the course coordination process at the New York City College of Technology

### Course Coordination at the Department of Computer Engineering Technology

As part of the process of Course Coordination, the Department of Computer Engineering Technology had to select a course and at least one General Education Student Learning Goal. Before making such selection, the CET Course Coordination Liaison held an in-person workshop with most of the department faculty participating. During the workshop the courses appropriate for course coordination efforts were identified. After studying the courses and the SLGs, several courses made the cut.

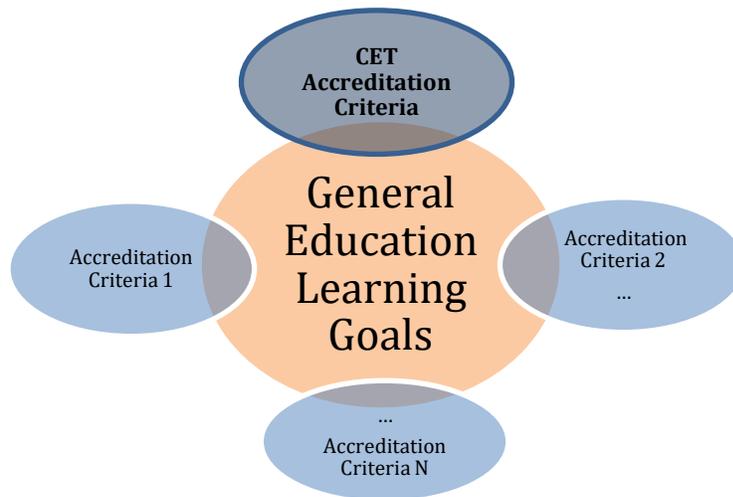
A careful look at the Gen Ed SLGs revealed an interesting pattern. Many of these learning goals were similar or consistent with criteria that are part of the ABET accreditation process. Being an engineering technology field, CET goes through a rigorous process of accreditation<sup>6</sup>. This process includes collecting statistics about certain core courses, mapping the criteria to different courses, and having at least one course that satisfies each criterion.

At the end of the workshop the CET CCL and other members of the faculty noted this finding. Then they worked on the courses identified and tried instead to find a mapping between ABET criteria and the chosen SLGs. In the process, they were able to match most of the criteria to items already considered during the accreditation process. As an example, one of the chosen Gen Ed SLG was Communication Skills, to be implemented in two lecture sessions of the course of Microcomputer System Technology. This Gen Ed SLG requires that students communicate in diverse settings and groups, using written (both reading and writing), oral (both speaking and listening), visual means, and in more than one language. We found out this Gen Ed SLG is similar to an ABET student general learning outcome. Specifically, ABET Criterion 3.g requires

that student demonstrates the ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature.

Therefore, Communication Skill can be used in both Gen Ed course coordination and ABET assessment. We asked the course instructors to implement Gen Ed Communication Skills in their written final report, oral presentation, and visual means such as preparation of Power Point slides for student's final project, a process similar to the one used during accreditation.

After this experience faculty from the CET Department Course Coordination Liaison and GenEd Liaison had the idea to propose a framework to the GenEd CCWG to bridge the gap between general education and the accreditation process for Engineering Technology fields. This framework started with the analysis of the intersection between CET's ABET accreditation criteria and the General Education Learning Goals. The proposed framework intends to analyze the criteria of each department that goes through an accreditation process and finds the accreditation criteria that coincide with the GenEd SLGs. With that information the Gen Ed SLGs can be refined, paraphrased, and improved to satisfy the needs of these departments. With the help of the CCWG we believe this work can be expanded in such a way that will benefit the College in general. You can see a diagram of the framework we envision in Fig. 3.



**Figure 3** - Diagram of the proposed framework

In order to better assess the feasibility of this framework we selected subset of the ABET criteria for accreditation of the Computer Engineering Technology Program and compared it with the GenEd SLGs. We also compared the performance of our students before, during and after the Course Coordination effort took place. In the next section we present the results and the analysis.

## Results and Analysis

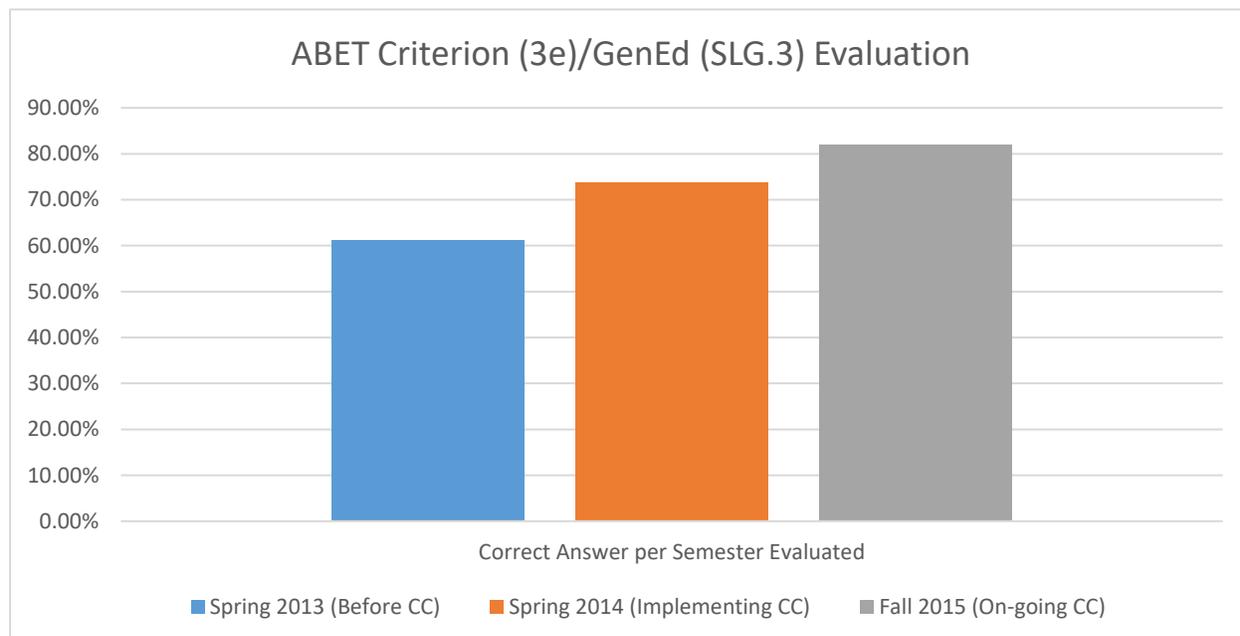
The ABET Accreditation Criteria <sup>7</sup> has several criteria to evaluate the different engineering technology programs. For the purpose of this paper we are interested in Criterion 3 – Student Outcomes. This criterion is divided in outcomes 3.a through 3.k. We compared the ABET Criterion 3 with the General Education Student Learning Goals <sup>3</sup> at the New York City College of Technology. We find out that for some of the ABET outcomes there is a corresponding SLG. For example ABET criterion 3, outcome (3.b) “an ability to design and conduct experiments, as well as to analyze and interpret data”, maps closely with the GenEd SLG.2 “gather, interpret, evaluate, and apply information discerningly from a variety of sources”. We performed this analysis between the other ABET outcomes of Criterion 3 and the GenEd SLG and the results of the comparison are displayed in Table 1.

ABET Criterion 3 Student Outcomes (a-k)	General Education Student Learning Goal
(3.a) an ability to apply knowledge of mathematics, science, and engineering	(SLG.1) Employ scientific reasoning and logical thinking
(3.b) an ability to design and conduct experiments, as well as to analyze and interpret data	(SLG.2) Gather, interpret, evaluate, and apply information discerningly from a variety of sources
<b>(3.e) an ability to identify, formulate, and solve engineering problems</b>	<b>(SLG.3) Use creativity to solve problems</b>
(3.k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	(SLG.4) Resolve difficult issues creatively by employing multiple systems and tools

**Table 1** –ABET Criteria 3 Student Outcomes (a-k) Mapping to General Education Student Learning Goals

The Department of Computer Engineering Technology, continuously collects data for the ABET accreditation process. During the year 2014 the CET Department was also implementing Course Coordination and SLGs into different courses. We decided to select one of the courses already being evaluated for ABET purposes, to compare the performance of the students before and after Course Coordination. The selected course was CET 3510 – Microprocessor System Technology. During 2014 and 2015 we continued collecting data for this course. This time we were not only evaluating the ABET outcomes but the GenEd SLG as well. We collected data for the semester before the Course Coordination effort began, the semester when Course Coordination was being implemented, and the semester after the Course Coordination effort was already running. We evaluated specifically the ABET outcome (3e) “an ability to identify, formulate, and solve

engineering problem” with the SLG.3 “Use creativity to solve problems”, as highlighted in Table 1. To evaluate this outcome, we formulated a set of questions related to these topics and incorporated them in the final exam. We calculated the percentage of students that answered the questions correctly and therefore satisfied the outcome. Then we proceeded to compare the results that are shown in the chart in Fig. 4.



**Figure 4** - ABET Criterion (3e)/GenEd SLG.3 evaluation chart

As shown in Fig. 4, we evaluated data from three different semesters. The first semester was Spring 2013. During that semester we collected data solely for ABET accreditation purposes since Course Coordination effort has not started yet. During the Spring 2014 semester the Course Coordination effort was being implemented and collected data reflected the ABET criteria as well as the GenEd SLGs. During the Fall 2015, the Course Coordination effort was on-going and collected data once again reflected ABET and GenEd criteria. This allowed us to compare the results between previous semesters.

As shown in Fig. 4, during the Spring 2013 semester 61% of students answered the questions correctly. The number of correct answers increased in Spring 2014 to 74%, an increase of 13 percentage points. During that semester the Course Coordination was being implemented, faculty engagement increased and efforts were made to teach the material more consistently among the different sections. After getting the feedback from other faculty members, the course improvements were made and they included changing the textbook and upgrading the software used in class. The outcomes of these improvements and the implementation of Course Coordination efforts have shown positive changes as reflected in the Fall 2015 semester. As seen

in the chart in Fig. 4, the percentage of students answering the questions correctly increased, reaching 82%. This is an 8% increase compared to when course coordination was being implemented and a 21% increase when compared to the period before Course Coordination. Based on the results of this data we believe that the Course Coordination efforts helped faculty to be more aware of what they were teaching and more focused on certain topics which in turn helped students to improve in this particular ABET outcome and its equivalent GenEd SLGs.

## **Conclusions and Future Work**

The New York City College of Technology General Education Committee formed a Course Coordination Working Group responsible for defining a framework and implementing General Education Learning Goals across all disciplines. The Department of Computer Engineering Technology was one of the departments participating in college-wide course coordination efforts. During that time, the CET Department also went through the process of accreditation with ABET. During the Course Coordination process, the faculty noticed a lot of similarities among the General Education Student Learning Goals and the ABET criteria. The faculty worked on mapping the selected courses and goals with the criteria they already evaluated for ABET accreditation. This led to the creation of a framework to facilitate the mapping between General Education and accreditation standards. Our preliminary results have shown that during and after the implementation of the Course Coordination efforts and the awareness of SLGs, the students' correct answers related to the outcomes increased.

In the future, the Department of Computer Engineering Technology plans to work with the Course Coordination Working Group and go over the entire list of General Education Learning Goals as well as the full list of ABET accreditation criteria. The idea is to identify all criteria that was already evaluated and add to the General Education Student Learning Goals those that are not. The future plans include using this information to provide General Education Learning Goals to all CET courses. We envision expanding this work to other STEM disciplines and departments that go through the accreditation processes.

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