



The Career Compass Professional Development Program, Instilling Integrity, Courage, Competence, and Accountability in all Undergraduate Engineering Students

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Abstract

Formalized professional development programs are taking on increased importance in engineering education in response to the needs and desires of the profession. Today's engineers are expected to be technologically competent. In addition, they must be able to lead, manage, innovate, and identify and solve problems. In response to these increasing demands on engineers, the College of Engineering at Villanova University developed a comprehensive professional development program called Career Compass. Career Compass is a three-year mandatory bearing-credit program. There is an optional fourth-year component. This program has four themes: The Engineering Profession, Setting the Stage for Personal and Professional Success, Post-Graduation Career Planning, and Effective Communication Skills for the 21st Century. This paper describes the development, content, management, and lessons learned from the first year of administering the program.

Introduction

This Evidence-Based Paper describes a professional development program developed by Villanova University. Technological advancements, globalization, and critical world issues are profoundly transforming the engineering profession [1]. Today's engineering graduates are no longer needed to perform routine assignments that can be accomplished by trained technicians or advanced computerized systems. Instead, both the public and private sectors are seeking engineering professionals who are driven to innovate, lead, and manage in ways much different than their predecessors [1]. The clear demand is for those who can quickly and efficiently create, identify, macro-design, construct, deploy, and operate technological responses to meet and exceed the needs to present and future generations.

In response to this rapidly changing landscape, Villanova University's College of Engineering has developed a comprehensive professional development program entitled Career Compass. This mandatory undergraduate program is designed to stimulate and develop broad-based innovative leadership and management skills within each student. In addition, Career Compass provides specific guidance in ethical behavior, group dynamics, networking, oral and written communication, and career planning and preparation.

Institutional Background

Villanova University is a comprehensive Roman Catholic institution founded in 1842 by the friars of the Order of St. Augustine. The University welcomes students of all faiths and is located in a western suburb of Philadelphia. The University offers a wide variety of degree programs through six colleges: the College of Liberal Arts and Sciences, the School of Business, the College of Engineering, the College of Nursing, the College of Professional Studies, and the Charles Widger School of Law. The College of Engineering offers five BS and nine MS programs through its four departments: Civil and Environmental, Chemical, Electrical and Computer, and Mechanical. The College also offers a PhD. The university's Carnegie Classification is a Doctoral University with moderate research activity (R-3). Currently there are 974 undergraduates in the College.

Overview of Program

Developed in conjunction with industry leaders, engineering alumni, faculty, and students, Career Compass is a series of six required courses and two optional courses. The first six courses are completed during the first three years of the undergraduate curriculum and the two optional courses may be completed during the fourth year. Program content is grouped around four major themes as follows:

1. The Engineering Profession
2. Setting the Stage for Personal and Professional Success
3. Post-Graduation Career Planning
4. Effective Communication Skills for the 21st Century

Career Compass is largely self-directed and does not have designated meeting times. The course is delivered in a variety of formats including online videos, professional events/presentations, in-person workshops, and an organized, guided mentors program. Students earn 0.5 credit per semester for a mandatory total of three credits earned for the first three years of the Career Compass program.

The overall goals of Career Compass are to provide professional guidance and to develop a sense of personal awareness within each student such that he/she proactively searches for and finds a post-graduation career path best suited to his/her professional interests and personal aspirations.

Development of the Career Compass Program

Currently, many technical institutions and colleges of engineering offer a range of professional development activities and programs [2], [3]. Over the past two decades, The College of Engineering at Villanova University has organized events generally centered around on-campus industry talks and presentations. Attendance at these events was voluntary and was not attached to any course offering. Also, over the past two decades, individual departments within the College established professional development initiatives. These initiatives have included mandatory courses, workshops, and/or industry presentations. Although these individual programs were effective and recurring; they were usually narrowly focused within individual engineering disciplines [1], [4]. There was no comprehensive, college-wide program providing a broad, career-based perspective for all undergraduates. In 2015, the College of Engineering decided to establish a comprehensive program to help students become more self-aware and to prepare them for a professional career regardless of their major field of study. Although this college-wide program relieved some of the professional development burden from individual academic departments, they may continue to offer their own professional development initiatives tailored to their specific technical needs.

In 2015, a Career Compass Program Advisory Board was established which includes both public and private sector professionals from all major branches of the engineering profession. This board worked with faculty, staff, and students from the College of Engineering, including the Dean and Associate Dean for Academic Affairs, to develop a list of the primary topics that should be included in the Career Compass Program (Table 1). In addition to these topics, four core values were identified by the Advisory Board as being central to the operation and

implementation of the program. All services and skill sets provided to the students adhere to the core values of Integrity, Courage, Competence, and Accountability.

Table 1. List of Primary Topics by Year

Year in Curriculum	Primary Topics
Freshmen	Engineering careers Ethical behavior Learning styles Team/group dynamics Resume preparation Career goals Time management Technical writing Presentation skills
Sophomore	Technological advancement and society Leadership skills Management of self and others Effective listening skills Effective team and group dynamics Interviewing skills Proactive career searching
Junior	Inclusive career paths Self-awareness Conflict resolution Resume updates Advanced presentation skills
Senior	Next steps in career planning Advanced leadership and management skills Project management by industry Ethical behavior Self-selected activities

The Advisory Board meets once per year in June to plan out the activities for the following academic year and to provide advice on how to continuously improve the program. Realizing that this initiative is new, the Director, Assistant Director, and Associate Dean for Academic Affairs also meet regularly to discuss how to improve this program. Thus, the topics listed in Table 1 may change and evolve as the program continues to mature.

Management, Operation, and Delivery

Following the establishment of the broad guidelines and goals of Career Compass, specific plans were established for the effective day-to-day management, operation, and delivery of the program.

Management

Central to these functions was the funding and assignment of personnel. One college-level position was created and another staff member's role was redefined and elevated to include their new responsibilities for Career Compass. In addition, a teaching assistant was provided by the College. The Director of Professional Development and Experiential Education was a new position created to manage this program. The Director is responsible for creating, developing, implementing, managing, and executing all functions and aspects of Career Compass. The

Director is also responsible for all outreach aspects of the Program. This outreach includes interacting with representatives from industry, government, and other educational institutions and participating in applicable conferences and meetings focused on professional development and experiential education initiatives in engineering education.

Approximately 60% of the Assistant Director of Undergraduate Student Services and Operations' time is spent on Career Compass. The Assistant Director is responsible for administering the program, maintaining student progress records, and participating in all administrative program activities. Other clerical and secretarial functions are provided by the College of Engineering's administrative staff.

One year after implementation, a teaching assistant was funded by the College of Engineering to assist with grading and other administrative tasks.

Operations and Key Relationships

Career Compass is operated within the Office of the Dean, College of Engineering. The Director reports to the Associate Dean for Academic Affairs. During the second year of implementation, the Associate Dean for Academic Affairs established the Central Office of Resources for Engineers (CORE). The CORE administers a wide range of services to students, including tutoring. The CORE has been assigned a designated suite of offices and dedicated clerical and secretarial staff. The Director and Assistant Director's offices are located within the CORE area with full access to all other CORE initiatives and services. The inclusion of the Director and Assistant Director's office in the CORE was important because it sent a message to students, faculty, and staff that Career Compass is an integral part of the College.

Furthermore, it was critical that the faculty accept Career Compass as integral to the curriculum. To achieve such acceptance, members of the engineering faculty have been invited to participate in the program by preparing videos, and by participating in workshops, networking sessions, and in other approved Career Compass activities. This initiative has been partially successful to date and the Director continues to encourage faculty participation. This participation is extremely important as the program becomes fully integrated into day-to-day college operations.

One of the goals of Career Compass is to provide proactive career search services to students in line with their personal and professional goals. Villanova University already offers a full suite of career search services through its University Career Center. Therefore, it is essential that a close working relationship and full professional understanding exists between the Program and the Career Center. Such a highly productive and collaborative relationship has been established and continues to grow. Career Compass helps undergraduates discover and identify their true personal and professional interests and goals, while the Career Center helps to connect the students with organizations seeking their services.

For example, in conjunction with the Career Center, Career Compass developed and conducted a mock interview program during the fall 2017 semester for all sophomore engineering undergraduates. Through this collaborative effort, volunteers from many local companies and organizations conducted individual, on-campus, in-person, 30 minute mock interviews with all sophomores. The Career Center provided guidelines for these mock interviews and feedback was

provided to all students. Through this collaborative and very practical hands-on effort, all sophomores will be more prepared for future interviews for internships, externships, and entry-level career positions. Such an effort was possible and practical through continual collaboration between Career Compass and the Career Center.

Relationship to ABET Educational Outcomes

The Director, Assistant Director, and Associate Dean for Academic Affairs are working with the ABET coordinators from each of the four departments within the College of Engineering to determine if/how they would like to use the work products from Career Compass for assessment. Most of the departments use a model of introduce-reinforce-satisfy for the ABET outcomes. Only work products that satisfy the outcomes are assessed. As Career Compass continues to develop, we will work with the ABET coordinators to provide any work products they deem worthy of assessment. Career Compass does support the achievement of several of the Criteria 3 outcomes (Table 2).

Mentoring Program

The benefits of mentoring to students is well established [4]. A mentoring program was developed to help prepare students for entry level positions along their chosen career paths. This mentors program is mandatory for all sophomores and juniors.

Mentors

Mentors are volunteering alumni from Villanova University's College of Engineering. To date, approximately 254 alumni have volunteered to participate. The average class size is approximately 250 students. For the fall 2017, 254 alumni mentors were needed to initiate the program. At steady state, this program will require approximately 500 to 550 alumni mentors for students in both the sophomore and junior classes. The goal is to assign one student per mentor so that individual and professional relationships may develop between students and their mentors. Following the junior year, students and mentors may continue their professional relationships. It is hoped that that these relationships will develop into internships, externships, and/or entry level professional positions.

There are attempts made to pair students and mentors based on selected majors, geographical locations and gender. Since mentors are volunteers, it has been found that, although this pairing approach was attempted, it's not always possible to build pairs based on the above listed criteria. The only pairing effort that has been strictly achieved, thus far, is gender-based. Recent literature indicates that female students prefer female mentors. This gender-based pairing effort has been successful.

Success of the overall Mentors Program will be measured through evaluation of student responses to specific survey questions asked at the conclusion of the sophomore and junior years. These questions will be developed by the Director of the Career Compass Program in conjunction with the Office of Planning and Institutional Research (OPIR) at Villanova University.

Table 2. Relationship of Career Compass Topics to ABET Educational Outcomes

ABET Outcome	Career Compass Assignments	Notes
2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	Viewing required videos, completing assigned quizzes, attending required broad-based engineering presentations and participation in the mentoring program	Career Compass will support the achievement of this outcome; however assessment will still be required in design classes
3) an ability to communicate effectively with a range of audiences	Communication is a major theme for the junior year using a program recommended and organized by The Center for Speaking and Presentations. This program will include instruction on the following: Personal Speech Style Proper Breathing & Voice Projection Eye Contact & Attire Management of Speaking Anxiety Power Point Design & Visual Aides Non- Verbal Indicators (movement, posture, etc.)	Career Compass will support the achievement of this outcome; however assessment will still be required in department-specific classes
4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	Students view three videos on ethical and professional responsibility; one each year for three years. Successful completion of associated quizzes for each of these videos in mandatory. These videos are prepared by professionals providing varying viewpoints on ethical and professional responsibility. During the sophomore year, students attend an in-class session where the National Society of Professional Engineers (NSPE) Code of Ethics is introduced. All students participate in case study discussions regarding ethical and professional responsibility issues during this in-class session. All students are required to attend two presentations per semester given by external professionals in varied fields. Most of these presentations are structured to address the global, economic, environmental, cultural, and social context of engineering solutions. In addition to attendance, all students are required to prepare a 1-2 page summary of these presentations and to submit them for grading.	Work products from Career Compass may be used by the departments, if desired
5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	Group and Team Dynamics are covered by having the students view a video on this topic and taking and passing a required quiz. All students are routinely involved with group and team activities in their standard engineering courses.	We are working to determine if including an introduction of 360° evaluations in Career Compass will allow departments to better assess this outcome in later years

Structured Initial Interaction

Being mindful of the mentors' limited time, Career Compass provides a basic structure for student-mentor interaction. For each of the four semesters (two sophomore year and two junior year) during which students and mentors must interact, a series of three emails are sent from the students to their mentors. Mentors are encouraged to respond by given due dates. Following responses from their mentors, students are required to write and submit summaries of their exchanges. The subject matter and the specific text for each of these emails is provided to the students by the Director of Career Compass. Students can choose to use the exact text provided; however, they are free to alter the text, but not the basic intentions or the specific subject matter. The subject matter for the six emails, in the form of abbreviated student questions to their mentors for the sophomore year, are:

- After graduation what career paths did you consider?
- How did your selected career path lead you to where you are now, professionally?
- What did you do during your undergraduate years to help you on your current career path?
- Have you observed both effective and ineffective Project Teams?
- How do you and your organization address the issue of 'inclusion'?
- What about Group Dynamics? What do you do and/or what does your organization do to make groups much more effective?

At the time of writing, 225 of 256 sophomores have effectively participated by submitting documentation. There have been a few instances where mentors have not responded prior to the established due date and a few instances where students have not sent out the required emails prior to the established due dates. Broadly observing, the mentoring program is moving effectively toward its goal of providing real, personal, and professional advice for undergraduates which should help them define their individual paths forward.

Optional Preparatory School Mentoring

The concept of experiential education is a key component of Career Compass. Well-rounded engineering education results from various delivery forms including personal interaction directed toward technical subjects of interest.

Toward offering such opportunities to students, Career Compass is establishing collaborative relationships with two to three preparatory schools located in the general geographical region. This program will be voluntary and will be restricted to junior engineering undergraduates. Mentoring training will be provided during the spring semester of the sophomore year to students volunteering to participate.

Students volunteering to participate, who have completed the required mentoring training, will be assigned to groups of about five preparatory school students; one junior per group, under the direction of a faculty member from that institution. These juniors will be asked to provide leadership, management, and technical guidance to their preparatory school team members. Most of the interaction will be online. However, it is anticipated that in-person sessions will be held at the preparatory school locations at the beginning and end of applicable academic semesters. Through this mentoring opportunity, volunteering junior engineering undergraduates will gain

substantial experiential education by actively doing, not by passively reacting. Initial plans are to provide the required mentoring training during the spring 2018 semester and to initiate preparatory school mentoring activities during the fall 2018 semester.

Public and Private Sector Interaction

Clear, sustained, and vibrant interaction with the public and private sectors is essential to the success of Career Compass [5]. Such interaction is currently occurring through several channels:

- Interaction with the Career Center via resume preparation, prototyping, mock interviews, internship opportunities, and entry level position opportunities.
- A series of approved, on-campus presentations from representatives from many organizations in both the public and private sectors. Engineering students must attend a minimum of two of these events per semester and must submit one page summaries of their attendance at these events.
- Participation in the Engineering and Construction Contractors (ECC) Association in *Closing the Gap*, which is a major initiative in the *Capital Projects Industry*. This initiative is designed to help prepare entry-level engineers to assume leadership and management roles early in their professional careers.
- Participation in numerous regional professional industry organizations to keep current regarding the requirements and interests of both the public and private marketplaces hiring entry level engineers.

Pre-Assessment and Post-Assessment Survey

To measure progress and continuous improvement, the Director and Assistant Director worked with Villanova University's Office of Planning and Institutional Research (OPIR) to develop and administer Pre-Assessment and Post Assessment Surveys. The results of these surveys will be used to improve the program. A summary of the results from the surveys administered to the freshmen in the fall of 2016 is provided.

The Pre-Assessment survey was conducted at beginning of the fall semester of the inaugural year of Career Compass. Freshmen had a short time period to complete the survey, with multiple reminders 100% (256) students completed the survey. A total of 17 days were required. The Post Assessment survey was conducted at end of spring semester of the inaugural year. Freshmen had a longer time period to complete the survey, with multiple reminders 99% had completed the survey. Only one person did not complete the post assessment survey.

Responses to Selected Specific Questions and/or Topics

There were 13 questions in the survey. The results from five of the questions will be discussed here.

One of the goals of Career Compass is to increase students' awareness of the breadth and depth of their chosen profession. To achieve this goal, freshmen watch three videos entitled *What is Engineering*, *The Greatest Engineering Achievements of the 20th Century*, and *The Influence of Science, Engineering and Technology on Science and the Natural World*. Online quizzes must be successfully completed for each of these videos. All freshmen are also required to attend the annual Patrick J. Cunningham, Jr. and Susan Ward '80 Endowed Lecture. This annual lecture is

given by a prominent individual in the engineering profession. To determine the effectiveness of these activities, students were asked “How knowledgeable are you about the engineering profession?” and the results are shown in Figure 1. An overall movement from 12% very or extremely knowledgeable to 27% very or extremely knowledgeable was realized as a result of this program.

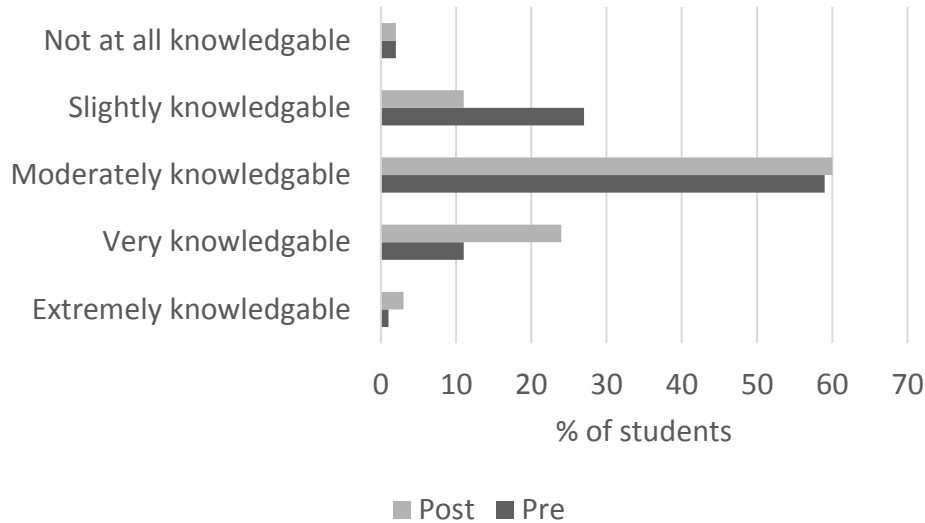


Figure 1. Result from Pre- and Post-Assessment Survey Question on Knowledge of the Engineering Profession

Another goal of Career Compass is to help students successfully transition into the working world after completing their education. To achieve this goal, students interact directly with the University Career Center, prepare resumes which are critiqued and routinely updated, interact with career professionals through mock interviews, and attend an in-class Prototype Session entitled *Career Goals and Aspirations*. Students were asked to rate their confidence in highlighting skills and experiences on their resumes and how well they understood Career Services on a five point Likert scale (Figure 2). Both of these areas showed improvement. In addition, students were asked about their future careers (Figure 3). The results of this question indicate that students are gaining clarity in their career goals and plans.

Students were also asked about what activities or events had the greatest impact on their learning. The greatest impact after the first year of Career Compass resulted from tangible activities including resume preparation, attendance at approved Career Compass events, and attendance at ‘prototyping’ sessions jointly organized and scheduled with the Career Center. The least impactful were the online modules and quizzes.

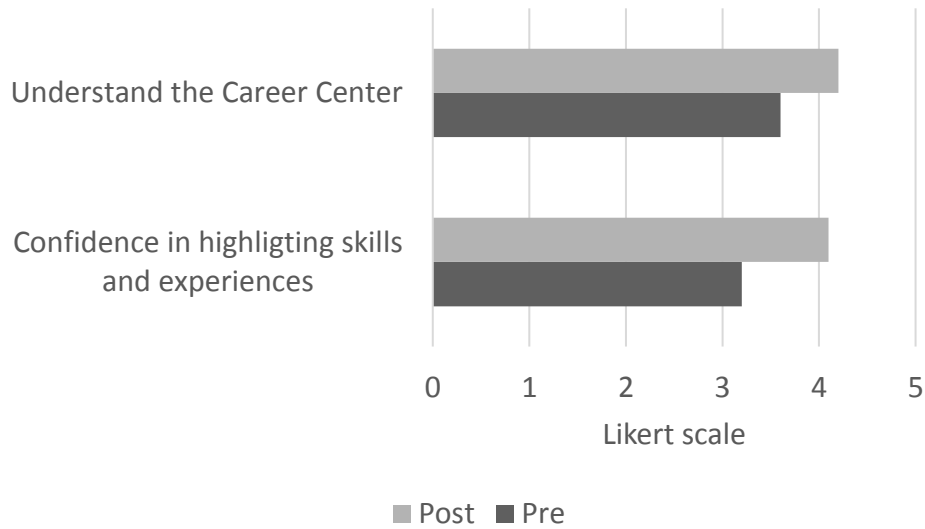


Figure 2. Results from Pre- and Post-Assessment Survey on Understanding the Career Center and Confidence in Highlighting Skills and Experiences on Resumes (0 = not at all and 5 = a great deal)

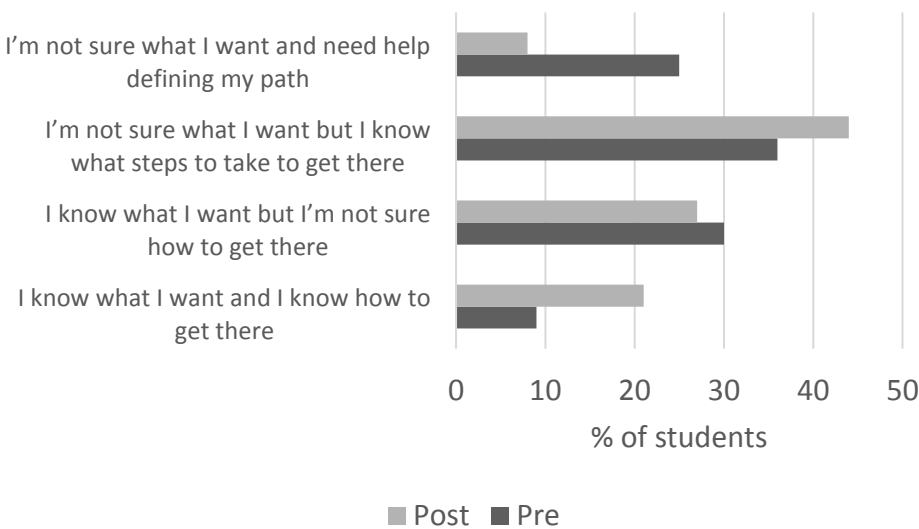


Figure 3. Results from Pre- and Post-Assessment Survey on Career Paths

Improvements Based on Results

The Director, Assistant Director, and Associate Dean for Academic Affairs reviewed the results of the survey, including the comments, and used these as a basis for making several substantive improvements to the program. These changes were:

- All videos were shortened to 20 minutes or less with most videos being 15 minutes or less.

- Quizzes were moved outside of the videos. Originally, all comprehension quizzes were embedded in the videos. This required students to re-watch an entire video if they got a question wrong.
- The program became a series of required credit-bearing courses.

The most critical change was moving the program inside of the normal academic curriculum. The original approach of making the course a requirement for graduation, but not an actual course was confusing and de-legitimized the program. In addition, numerous freshman expressed the valid observation that a program that is mandatory for graduation should be credit-bearing. Therefore, in fall 2017 six new courses, each worth 0.5 credits, were created for the Career Compass program. These three credits must be successfully completed (e.g. earning a Satisfactory) for a student to graduate. Students must complete all assignments and earn at least an 80% on all quizzes to earn a Satisfactory grade. An optional fourth year of programming is being developed, so it will be possible for students to earn elective credits senior year.

In the future, only post-assessment surveys will be conducted in the sophomore, junior, and senior years. The post assessment survey includes the selected assessment questions and career perspective questions. The results of these surveys will be used to improve the program.

Continuous Improvement

Continuous improvement of any emerging program is critical to its success. In this case, continuous improvement is achieved through the following processes:

- Annual Advisory Board meetings in June. At these meetings, decisions from the previous meeting are revisited, implemented activities are described, problems are discussed, and specific solutions are identified for implementation. The Advisory Board then moves onto the next year's Program for discussion. The leadership and management offers a plan for the next year and the overall Advisory Board provides their input. The result is a plan for implementation for the next year's activities.
- The leadership and management staff meet monthly with the Associate Dean for Academic Affairs in the College of Engineering. At these meetings, the program is discussed, future activities are planned, and near-term problems are addressed and solved.

The concept of continuous improvement is vigorously stressed with the students throughout Career Compass. This concept is also directly applied to the administration of this Program. All individuals involved in Career Compass, the college administration, the Director and Assistant Director, the Advisory Board members, and engineering students, have real, valid, and respected voices in its growth and implementation.

Through firm dedication to the concept of interactive continuous improvement, Career Compass will move forward through the four year roll out and will become more effective as each subsequent year passes. It is expected that Career Compass the outset of the 2020 Fall semester will be substantially different and more effective than the program that was originally developed and implemented at the outset of the Fall 2016 semester.

Lessons Learned

Career Compass was initiated in fall 2016 for the incoming freshman class. It was designed to be rolled out over a four year period. The class of 2020 will be the first class to complete the entire program. At the time of writing, two classes are enrolled in Career Compass; freshmen and sophomores. Here are the broad lessons learned thus far.

- Professional development programs should be credit bearing if they wish to be taken seriously by students, faculty, and staff.
- Videos should be 15 minutes or less in duration.
- Students perceive real value in their interactions with the Career Center.
- The mentoring program is successful with numerous students expressing very positive interaction with their assigned mentors.
- Attendance at approved professional development events is regarded as very valuable by the students.
- The students desire more in-person contact with the Career Compass leadership.

Acknowledgements

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