Constructing Community, Content, and Confidence (C3) to Enhance First-Year Success and Retention

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Abstract

The modern engineering cohort is much more diverse in terms of ethnicity, gender, preparation, and expectations than in previous years. This creates various challenges for engineering programs in terms of both student outcomes and retention. One approach to these challenges is presented here: a first-semester zero-credit seminar for all engineering students. The seminar seeks to build a foundation for student success in engineering, or elsewhere within the institution. The underlying premises and activities reflect national data and an understanding of adolescent development. Seminar is a partially flipped classroom with diverse activities that engage four types of students in C^3. Based on the full assessment data for the cohort, these four types are generally described as: I) discipline-informed and motivated, with a generally strong student skillset, II) motivated with a generally strong student skillset, III) motivated with a generally weak student skillset, and IV) poorly motivated with a variable skillset. The seminar successfully addresses the issues and needs of each group. It reinforces Group I without being perceived as "onerous busy work" while surreptitiously providing C^3. Group II profits from discipline specific information as does Group I. Exposure to content and confidence are the prime outcomes for Group III. Reflection Assignments are of greatest value for Group IV wherein they build confidence in their academic choice and personal capability. Assessment reveals that the zero-credit first-semester seminar has been successful.

Background

The Inamori School of Engineering (SoE) at Alfred University encompasses six engineering programs. Four are state-supported as part of the New York State College of Ceramics and two lie wholly within the private portion of Alfred University. Since tuition rates and the programs are substantially different, the incoming cohort is very diverse with a large component of "first in the family to college". Typically two-thirds of the approximately120 incoming students select a major prior to matriculation at the university. This self-selection is especially strong for the Ceramic, Glass, and Renewable Energy students; less strong for Materials and Biomaterials students; and often weak for Mechanical engineering students. Female students are generally very well self-selected and motivated. Male students overwhelmingly predominate among the undecided and Mechanical students and have very disparate levels of motivation. Groups I-IV and genders are thus unequally divided among the programs in a non-random manner. However, SoE has consciously created a single course, ENGR 160 First Semester Seminar, to efficiently maximize the possibilities for student success and persistence. This approach is founded on constructing Community, Content, and Confidence (C^3).

ENGR 160 is a zero credit course that meets once per week. It involves engineering/science cartoons, real-time topic selection, rapid feedback[1], and links to the 5E/7E model for effective learning[2,3]. It also serves as an early action indicator for

potential interventions. An extract of the syllabus is shown in Figure 1. Each assignment and topic is specifically constructed to advance C^3 with or without the need for external learning via the partially flipped classroom[4,5,6].

Date (R)	Topic	Activities
Week 1*	Introduction (Cards*)	00_168 Survey Bb & 01 Intro Bb due
Week 2*	Shibboleth*	168 Hour Excel due*—02 Helix Bb due
Week 3	Foundation--Programs	Cards Collected—03 Card Bb due
Week 4*	Groups*--Programs*	04 Acronyms Bb due
Week 5*	Language* --Oui / nein / si --Programs	Da / no – Spill Czech Jabberwocky— 05 Bb due
Week 6	Assessment or Career Fair	GPA Calculation*-06 Bb due
Week 7	Figures, Charts, Graphs	Thermo—07 Bb due
Week 8	Scheduling / Advising	08 Bb due
Week 9	Safety MSDS	*R2* and units ABET & SOE—09 Unit Bb due
Week 10*	Engineers in context	LD50—10 Safety Bb due **Reflective Paper One* due**
Week 11	McMahon Lecture	McMahon Lecture w/ ENGR 360—11 Famous Bb
Week 12	Envelopes & Ethics	*CO_2 and TP*—12 Finance Bb due
Week 13	The Present	13 SoE Assessment Bb due
Week 14	No class	14 Light Bb due
Week 15*	The Future	**Reflective Paper Two* due**— and Bb tba

Figure 1. Fall 2013 syllabus extract for ENGR 160. Weeks and/or topics discussed in this article are denoted with an asterisk.

Community

Engineering students are part of both their immediate community, i.e., peers and campus personnel, and the wider community of practitioners. Literature reveals that connection to peers is a strong indicator of student persistence and retention[7]. Linkage to a local group, i.e., a benefit of a small school experience, is also a significant expectation of most Alfred University students and is thus an important facet of the first semester experience. The initial course presentation—colloquially described as "Moose or Roadkill" encourages students to see themselves as select, important, and successful. It humorously presents the situation of high school pre-engineers who are often perceived as outside or low on the high school pecking order with moose and deer. Moose calves are gangly and later maturing than fawns; they are *different*. The misfit many felt in high school was because they were moose calves amongst a herd of mundane deer, i.e., they were being judged by inappropriate standards and were in the wrong environment. ENGR 160 encourages students to "embrace their inner moose" and grow in the appropriate environment. The reality of moose calves is that they mature into moose, i.e., geeky/nerdy high school students succeed in engineering practice (mature moose supremely capable in *their* environment and different from mundane deer).

The Cards assignment forces self-selection of a small community. Students choose a group (2-5) and complete an independent scavenger hunt to various key campus

locations, i.e., SoE Dean, Engineering Library, Registrar, Wellness Center, and Academic Services. The card assignment also requires attention to detail and introduces the concept of checklists, i.e., a common military/engineering technique that boosts task-compliance while lowering performer stress. Community is expanded via a series of presentations from students and faculty of the various programs. These emphasize the unique, but interconnected, nature of the programs and reveal ways for new students to engage with student clubs and national student chapters.

Content

The primary content portions are related to engineering specifics, e.g., the distinguishing background of engineering thought and approaches. One week of ENGR 160 is devoted to "language" and another to "shibboleths"—two distinguishing features of engineers Greek letters and units or process and fundamental software. With the reduction in Greek life on many campuses, student awareness of Greek letters has diminished. This is a particular impediment for first-in-family students acclimating to instructors with diverse accents or with special learning issues[8]. Introductory engineering texts[9,10,11], often list the letters, but they are seldom pronounced or used in a way that engages students.. Fundamental process and software involve time management via the 168-hour assignment and the regular weekly Blackboard assignments augmented by basic Excel™, or the "flipped classroom" component needed to complete some Blackboard assignments[6]. The 168-hour survey (see Figure 2) and the accompanying hour-by-hour schedule for a week reveal that participating engineering students (primarily Groups I and II) are much more academically engaged than the broad national cohort of students. It is noteworthy that the ENGR 160 students anticipate sleeping for one third of the week in contrast to the national cohort which plans only six hours of sleep each day (a level of sleep inconsistent with long-term health, personal safety, and performance). Individual 168-hour schedules are selected for real-time anonymous presentation to highlight the disparities in presentation, realistic constraints, and practicality. The overall results of this assignment emphasize the commitment needed to master engineering content and suggest a path to success.

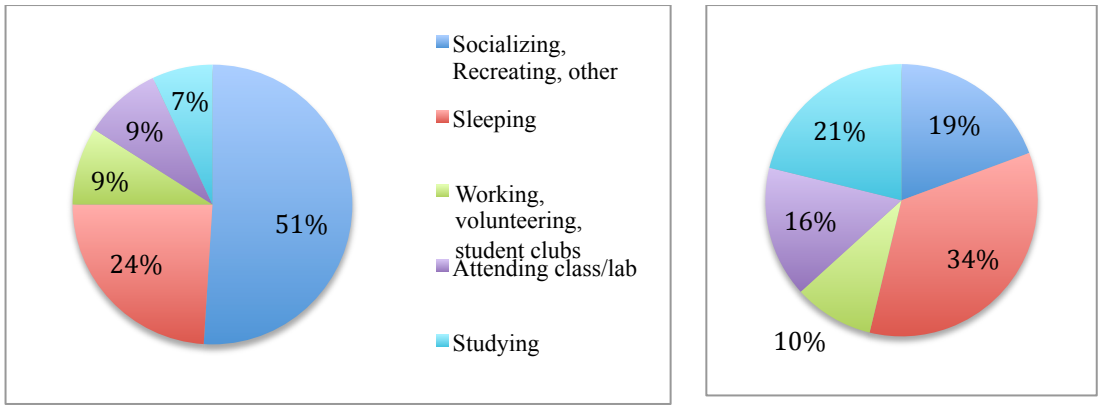

Figure 2. Student responses for percentage of the 168 weekly hours committed to five key college categories. National engagement data from NSSE[7] (left) and ENGR FA2011-2013 Groups I & II primarily.

As shown in Figure 2, many of the habits / processes are already embedded in student groups I & II and hence much of ENGR 160 is not seen as enforced busywork. However, some skills are becoming less prevalent among successive engineering cohorts. For many students, especially in Groups III and IV, Excel™ has become more important over the last five years; fewer incoming students have basic spreadsheet and plotting skills. They consequently lack previously common skills related to drag & drop and have a very limited visual concept of polar plots or semilog plots. Retirement of the last cohort of high school teachers steeped in sliderule usage has also resulted in an increasing usage of insignificant digits amongst students—necessitating explicit activities that emphasize both engineering notation (distinct from scientific notation) and significant digits.Content assignments involve calculation of midsemester and final GPA's for imaginary student Ahbi N. Ghineer and colleagues. These reinforce Excel™ skills and provide direct, authentic experience with the University's Academic Policies.

Confidence

A key feature of ENGR 160 is the opportunity to demonstrate mastery by Week Twelve via attendance, Blackboard assignments, classroom exercises and the first of the two Reflection Papers. The first Reflection is assigned during Week 10 and encourages students to consider their original motivations to choose engineering and to reflect on their experiences and gains. These are generally very revealing and extremely helpful to the students--based on course evaluation data[12,13] and anecdotal responses from students in subsequent years. The first Reflection enables students to see their success or to describe steps needed to be successful. Students in Group I typically complete the course after attending Week Twelve; the remainder of Group I and the bulk of Group II complete the course before Week Thirteen with or without attendance points that week (Figure 3). Groups III and IV continue to attend and complete exercises to reinforce community, content, and confidence.

The second Reflection occurs during Week Thirteen after the majority of the students have passed. It seeks answers to more probing questions about self-perception and personal growth and serves to complete the course for Group III. Students completing during Week Fourteen represent the now motivated Group IV. Completion at this stage represents success for C^3; students were underperforming and now have the motivation and skills to succeed. Students who never complete are statistically likely to leave engineering (60%) or leave the institution (30%) with the remaining 10% successfully remediating the course during the subsequent spring semester

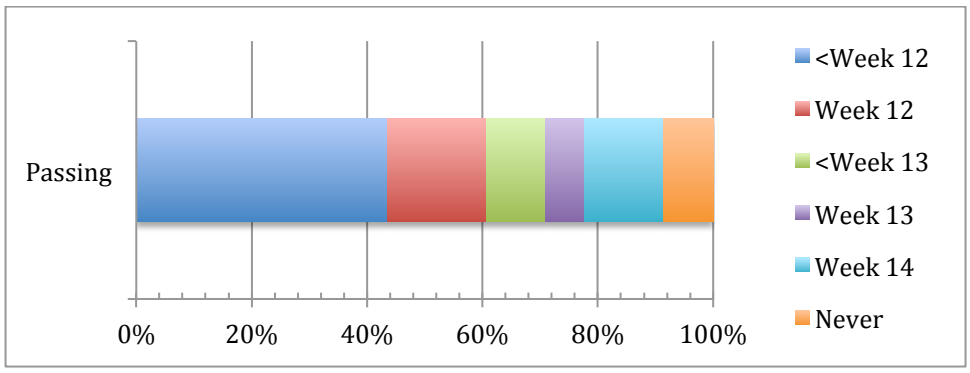

Figure 3. Time needed to accrue sufficient points to pass ENGR 160 (Fall 2013).

Summary

Since creation of ENGR 160, fourth semester sophomore student reports of satisfaction have improved and a number of undesirable high-school behaviors have diminished in subsequent courses. Overall, the zero-credit C^3 approach has reduced the disparity in skillsets and motivations amongst a very diverse incoming student cohort. It has successfully balanced the needs of Groups III and IV without distressing the more skilled students in Groups I and II. Likert feedback underscores the importance and effectiveness of the C^3 approach of ENGR 160 (Table 1). These perception scores are especially noteworthy since the course is *zero* credits and has an enrollment twice that of any other first-semester course for the students, i.e., the course is "worth nothing" and lacks the individualized attention that students expect from a small university like Alfred University. Given the latter consideration, the C^3 approach should be replicable at nearly any size institution for first semester students.

Table 1. Extract of three questions from the ENGR 160 concluding course evaluation (~90% of students responding on a 0-5 Likert scale)[12].

	2013	2012	2011
17: The out-of-classroom time required to complete this class was reasonable..	4.27	4.23	3.98
21: ENGR 160 exposed me to useful information and/or documentation, e.g., majors, course advising, groups, places on campus.	4.33	4.35	n/a
22: Participation in ENGR 160 was an overall useful experience.	3.94	3.80	n/a

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