Using Student Attitudes to Inform the Design of a First-Year Civil Engineering Course

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Abstract

The Civil and Environmental Engineering (CEE) Department at The Citadel is engaged in ongoing efforts to improve their Introduction to Civil Engineering course. The freshman class has been completely redesigned to accomplish three major goals: (1) introduce students to the sub-disciplines of civil engineering, (2) equip students with the study skills needed to succeed in engineering, and (3) build a civil engineering student community. To assess the effectiveness of this new course, student attitudes towards engineering were measured using the Pittsburg Freshmen Engineering Survey. Results indicated that students were significantly more confident in their knowledge of the engineering profession after participation in the course. Students were only marginally confident in their study skills and habits. When reflecting on group study, students recognized the advantages of working with peers, although they still preferred to work alone at the end of the semester. Future course implementations will include additional activities to help students sharpen their general and group study skills.

Keywords

First year engineering, civil engineering, Pittsburg Freshmen Engineering Attitudes Survey

Introduction

A skilled engineering workforce is essential for ensuring a prosperous future for the United States (US). For instance, engineers are essential for developing innovative strategies for solving emerging problems, such as climate change and dwindling petroleum reserves. However, data supports that the number of engineering graduates has been declining. Among the reasons cited for dwindling enrollment and persistence include a lack of engineering experiences during students' freshmen year. Typically, the first year in engineering is laden with mathematics and science courses. Although the knowledge and skills acquired through these courses is essential, such experiences are often abstract and do not reflect "what engineers do" or the nature of upper-level engineering courses. Consequently, designing first year experience courses that expose students to engineering may improve retention[1-3].

Beyond strengthening students' knowledge of and commitment to engineering, there is a need for first year courses to guide freshmen in "becoming college students[4]." This includes helping students master time management[4], as well as academic success skills[5]. For instance, students often need help adapting their study skills to the college environment. In addition, they may not recognize the benefits of working with peers or interacting with professors outside of the classroom. Many of these *soft* skills are quite important for freshmen development into successful engineering students[5].

The goal of this project was to redesign an existing first-year engineering course ("Introduction to Civil Engineering") to expose students to engineering early in the curriculum, as well as equip them with other essential skills needed for success. The course was modeled after Ray Landis's "Introduction to Engineering" course, which has been implemented across the country. The Pittsburg Freshman Engineering Student Attitudes Survey was administered to students before and after completion of the modified course to detect important changes in student habits and opinions. Using this data, the following research questions were addressed:

1. How do students' first year experiences impact their knowledge of the engineering profession?
2. How do students' study skills evolve over their first semester in engineering?
3. How effective is the first year course in encouraging formation of a civil engineering student community?

Background Information

Ray Landis's Introduction to Engineering Course

It should not be assumed that students will learn about engineering through the regular engineering curriculum. The first year engineering curriculum focuses almost entirely on mathematics, physics, chemistry, and English. If there are engineering courses in the first year, they are likely to be content-focused in areas such as: computing, design, graphics, or problem solving[6].

For decades, the policy of sink or swim has determined the success or failure of America's first-year engineering students[7]. The general paradigm has been to "weed out" those students that don't measure up. Fortunately, engineering education in the United States is undergoing a revolution that includes a shift from the "sink or swim" model to one of "student development." Engineering colleges all across the nation are revising their freshman year curricula with the primary goal of enhancing student success[7].

To support freshmen student development, Ray Landis has introduced a model "Introduction to Engineering" course. Ray Landis is widely known for his expertise in developing minority engineering programs, as well as freshmen curriculum development[8]. In fact, his text *Studying Engineering: A Road Map to a Rewarding Career*[7] has been used by over 100,000 students at more than 300 institutions[8]. Through this course, students gain a clear picture of what success in engineering study will bring to their lives[5, 6]. They learn about the various sub-disciplines of civil engineering, how to study in engineering, and the engineering design process. Through this knowledge, they become articulate in telling others about civil engineering[5-7]. They can also learn about opportunities for pre-professional employment in engineering and the benefits of such employment. Finally, participation in student organizations (e.g. the American Society of Civil Engineers) is emphasized as a strategy for gaining a sense of community and belonging. To assess the effectiveness of the "Introduction to Engineering" course, student attitudes toward engineering can be measured through use of the Pittsburg Freshman Engineering Attitude Survey (PFEAS).

Pittsburg Freshmen Engineering Attitudes Survey (PFEAS)

Research has shown that attitudes of freshman engineering students change over the course of their first academic year[9, 10]. It is believed that these changes can be affected by the type and quality of educational program that the students experience. Consequently, an accurate assessment of both the attitudes that students bring to the university and the attitudinal changes that occur over the course of the year can provide an effective means to evaluate freshman engineering programs. First-year engineering student's opinions about engineering and the reasons that they chose to study civil engineering can be measured through use of The PFEAS. The PFEAS is a closed-form questionnaire developed and tested at the University of Pittsburgh to gather information about incoming engineering students' initial attitudes and their changes as they experience their first year[9]. This survey also rates the students' self-assessed confidence in their background (preparatory) knowledge and skills and their perceived ability to succeed in engineering. Students also rate their study skills and their interest in working in groups. In total, the pre-survey contains 50 items that are rated on either five-point Likert scales or ordinal-based self-assessed confidence scales.

The PFEAS has been effectively used by other institutions to help evaluate their freshman engineering programs[11]. In addition, it is being used in a national cross-institutional study of freshman engineering attitudes[12]. Historically, the PFEAS has been used to make many comparisons among freshman engineering students, such as those across gender and ethnicity[10], institutional differences[11], and causes of student attrition in engineering programs[12]. As both the reliability and validity of this survey has been well documented[10], it has been determined to be the best model on which to base this comparison survey.

Case Study: First Year Civil Engineering Course at The Citadel

The first year civil engineering course at The Citadel was recently modeled after Ray Landis's "Introduction to Engineering" course[5, 7]. The three major goals of the course were to: (1) introduce students to the sub-disciplines of civil engineering, (2) equip students with the study skills needed to succeed in engineering, and (3) build a civil engineering student community. The course syllabus is provided in Appendix A.

Introduce Students to Engineering and the Civil Engineering Sub-Disciplines

Throughout the course of the semester, students worked collaboratively in small groups (3 – 4 students) on mini-projects to explore the five specialties of civil engineering (Table 1). As an introduction to environmental engineering, students designed, constructed, and tested water filters using basic materials such as sand, gravel, charcoal, and coffee filters. Related to transportation engineering, students developed a scaled design of a parking lot to meet several criteria, including number of spaces, accommodations for expectant mothers and disabled drivers, as well as area of green space. For water resources engineering, students learned about dams and spillways, and they conducted a related experiment to analyze a hydraulic jump. To illustrate key concepts in geotechnical engineering, students learned about the relationship between soil moisture and strength by conducting a compaction test. Finally, the principles of tension and compression in structural engineering were emphasized by guiding students in designing bridge models using West Point Designer, a free software program. Afterwards, students actually constructed and tested bridges using KNEX. Overall, small projects throughout the semester were used to inform and excite students about civil engineering.

Table 1. Summary of mini-projects used to illustrate the five major civil engineering sub-disciplines[1].

Sub-Discipline	Mini-Project
Environmental Engineering	Creating a water filtration system
Transportation Engineering	Designing a parking lot
Water Resources Engineering	Analyzing a hydraulic jump
Geotechnical Engineering	Completing a compaction study
Structural Engineering	Designing and testing a K'NEX bridge

[1]Resources for the environmental engineering mini-project is provided in Appendix B. Additional activities are available upon request.

Equip Students with Essential Study Skills

An additional goal of the freshmen civil engineering class was to equip students with the attitude and study skills needed to succeed in engineering (Figure 1). The concept of a growth (as opposed to a fixed) mindset[7] was introduced as the central theme of the course. In fact, upperclassmen visited classrooms to share the importance of embracing challenges, seeing failure as an opportunity for learning, and accepting criticism for evolving as an engineering student. Time management was also presented as a key skill for engineering students, especially at a military college where cadets constantly struggle with balancing academics and military life. As the semester progressed, the need for good study skills was emphasized. Topics included group study, preparing for lectures, and preparing for exams. While many non-engineering, introductory classes address study skills, it was essential that students discuss these strategies in the context of engineering. It was clear from classroom activities, that students enjoyed sharing strategies and experiences with each other.

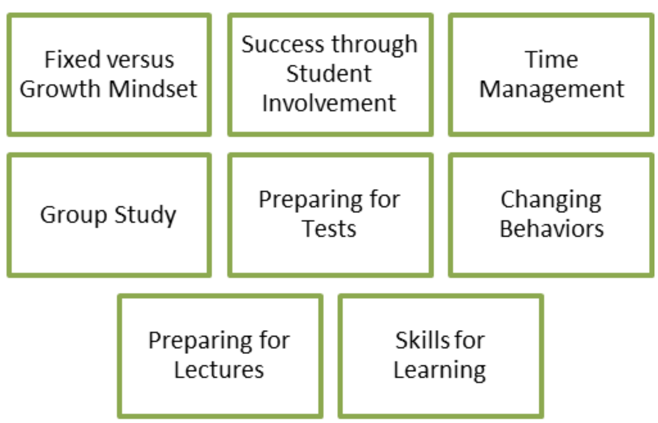

Figure 1. Summary of study skills discussed in introductory civil engineering course.

Building a Civil Engineering Student Community

Perhaps the most important goal of the course was to facilitate development of a student community. In fact, each class began with "The Name Game," an exercise where students learn the first and last names of all students in the class. Each student, before the end of the semester, earned 10% of their course grade by reciting their classmates' names. Furthermore, formal sessions on the importance of student involvement and group study were used to emphasize that the rigor of engineering courses is somewhat mitigated by creating a reliable study group. In completing course mini-projects, students also worked in small groups, which changed in composition throughout the course of the semester. The series of active, collaborative activities clearly served to excite students about civil engineering, as well as allow them to build relationships with classmates.

Study Methods

The refined "Introduction to Civil Engineering" course, as presented above, was disseminated during the Fall 2013 semester at The Citadel (Appendix A). At the beginning and end of the course, students were administered the previously-developed Pittsburg Freshmen Engineering Attitudes Survey (PFEAS)[9-12]. This instrument was used to gage student attitudes and perceptions (on a five-point scale) in 13 different categories[13]:

- General Impressions of Engineering
- Perception of the Work Engineers do and the Engineering Profession
- Financial Influences of Studying Engineering
- Perception of How Engineers Contribute to Society
- Enjoyment of Math and Science Courses
- Engineering Perceived as Being an Exact Science
- Family Influences to Studying Engineering
- Working in Groups
- Confidence in Communication and Computer Skills
- Problem Solving Abilities
- Confidence in Basic Engineering Knowledge and Skills
- Engineering Compatibility
- Adequate Study Habits

Data analysis was conducted on all completed surveys to detect any changes in students' attitudes over the course of the semester. Quantitative comparison of pre- and post-survey scores was completed using Welch's *t*-test, which is robust against unequal variances[14]. Significant shifts in scores were identified for $p \leq 0.05$. Since student responses were anonymous, it was not possible to compare scores based on demographics.

Results and Discussion

Introduce Students to Engineering and the Civil Engineering Sub-Disciplines

Results of the PFEAS suggest that students' *general impressions of engineering and the engineering profession* were overwhelmingly positive, both before and after participation in the course. For instance, students agreed that "engineers are innovative" ($M_{pre/post} = 4.57$) and "have contributed greatly to fixing problems in the world" ($M_{pre/post} = 4.55$). In addition, many students indicated that they [were] "studying engineering because [they] enjoy[ed] figuring out how things work" ($M_{pre/post}$ = 4.54). Consequently, students "[expected] engineering [to be] a rewarding career" (M = 4.76) and felt that "the advantages of studying engineering outweigh the disadvantages" (M= 4.62). Overall, students entered their freshmen year with a positive outlook on their future career path.

Perhaps the greatest changes in students' perceptions were related to their *engineering compatibility* and *perception of how engineers contribute to society*. At the end of the semester, students were more confident in their knowledge of "what an engineer does" (M_{post} = 4.31), as compared to the beginning of the course (M_{pre} = 3.88) ($p \leq 0.001$). Similarly, students felt more "technically inclined" at the end of the course (M_{post} = 4.06) than when first beginning college (M_{pre} = 3.88) ($p \leq 0.05$). Finally, students' more strongly agreed by the end of the term that "engineering is more concerned with improving the welfare of society than most other professions" (M_{pre} = 3.89, M_{post} = 4.24, $p \leq 0.05$). As a result, students participating in the revised course were more aware of the professional role of engineers, especially their ability to positively impact society.

Equip Students with Essential Study Skills

Students perceived few changes in their study habits over the course of the semester. In fact, students' confidence in their "current study habits or routine" was only marginal ($M_{pre/post}$ = 3.38), regardless of their participation in the course's study skills sessions. When evaluating their own *confidence in basic engineering knowledge and skills*, students were more confident in their engineering competencies at the end (M_{post} = 4.37), as compared to the beginning (M_{pre} = 4.08) of the course ($p \leq 0.05$). Conversely, students were significantly ($p \leq 0.05$) less confident in their chemistry knowledge between the beginning and end of the term (M_{post} = 3.27, M_{pre} = 3.64, $p \leq 0.05$). Chemistry is known to be a significant challenge for students at The Citadel, given the "sink or swim" mentality of the introductory courses. Given these results, additional activities and initiatives may be needed in the future to more significantly impact students' academic development skills.

Building a Civil Engineering Student Community

Student responses to questions related to *working in groups* were somewhat ambiguous. Students' desire to "study/work alone" generally increased during their first semester of college (M_{pre} = 3.09, M_{post} = 3.44, $p \leq 0.05$). However, they recognized that "studying in a group is better than studying by [themselves]" (M_{pre} = 3.70, M_{post} = 4.02, $p \leq 0.05$). Thus, although students are more comfortable working alone, they at least value the benefit of group work. Similarly, students were more likely to indicate that "most of [their] friends that [they] hang-out with are studying engineering" at the end of the course, as compared to the beginning (M_{pre} = 2.83, M_{post} = 3.34, $p \leq 0.05$). Future implementations of the course will incorporate additional community-building activities and assignments.

Table 1. Student attitudes before and after completion of CIVL 103: Introduction to Civil Engineering at The Citadel.

	Pre (n = 66)		Post (n = 68)		Welch's t-test*	
	Mean	StDev	Mean	StDev	F (1, 132)	p
General Impressions of Engineering						
• Engineers are innovative	4.50	0.56	4.63	0.54	1.919	0.168
• Engineers have contributed greatly to fixing problems in the world.	4.56	0.61	4.54	0.66	0.023	0.881
• Engineers are creative.	4.38	0.70	4.40	0.69	0.023	0.879
• Technology plays an important role in solving society's problems.	4.52	0.56	4.46	0.66	0.316	0.575
• Engineering is an occupation that is respected by other people.	4.44	0.56	4.46	0.61	0.027	0.870
• I like the professionalism that goes with being an engineer.	4.36	0.72	4.37	0.88	0.001	0.977
• I am studying engineering because I enjoy figuring out how things work.	4.64	0.48	4.43	0.74	3.798	0.054
Perception of the Work Engineers Do and The Engineering Profession						
• I expect that engineering will be a rewarding career.	4.74	0.47	4.78	0.42	0.229	0.633
• I expect that studying engineering will be rewarding.	4.64	0.54	4.72	0.48	0.894	0.346
• I don't care for this career.	1.35	0.57	1.38	0.65	0.104	0.748
• The advantages of studying engineering outweigh the disadvantages.	4.58	0.63	4.65	0.59	0.452	0.503
• I have no desire to change to another major (ex. Biology, English, chemistry, art, history, etc).	4.06	1.11	3.77	1.42	1.822	0.179
• The rewards of getting an engineering degree are not worth the effort.	1.42	0.77	1.57	0.82	1.193	0.277
• The future benefits of studying engineering are worth the effort.	4.71	0.46	4.63	0.57	0.801	0.372
• From what I know, engineering is boring.	1.67	0.77	1.56	0.84	0.603	0.439
• I can think of several other majors that would be more rewarding than engineering.	2.23	0.87	2.24	0.92	0.003	0.959
Financial Influences of Studying Engineering						
• An engineering degree will guarantee me a job when I graduate.	4.32	0.73	4.27	0.75	0.177	0.675
• I will have no problem finding a job when I have obtained an engineering degree.	4.38	0.67	4.44	0.74	0.260	0.611
• I am studying engineering because it will provide me with a lot of money, and I cannot do this in other professions.	2.96	0.95	3.18	0.98	1.775	0.185
• Engineers are well paid.	4.32	0.59	4.41	0.63	0.795	0.374

*Robust test for unequal variances.

Table 1 (cont). Student attitudes before and after completion of CIVL 103: Introduction to Civil Engineering at The Citadel.

	Pre (n = 66)		Post (n = 68)		Welch's t-test*	
	Mean	StDev	Mean	StDev	F (1, 132)	p
Perception of How Engineers Contribute to Society						
• Engineering is more concerned with improving the welfare of society than most other professions.	3.89	0.91	4.24	0.77	5.425	0.021*
• Engineers contribute more to making the world a better place than people in most other occupations.	4.11	0.84	4.29	0.88	1.591	0.209
Enjoyment of Math and Science Courses						
• I enjoy taking liberal arts courses more than math and science courses.	1.71	0.80	2.09	1.09	5.215	0.024*
• I enjoy the subjects of science and mathematics the most.	4.38	0.65	4.18	0.83	2.483	0.118
Engineering Perceived as Being an Exact Science						
• Engineering is an exact science.	3.65	0.98	3.68	1.03	0.021	0.886
• Engineering involves finding precise answers to problems.	4.46	0.66	4.35	0.71	0.739	0.392
Family Influences to Studying Engineering						
• My parent(s) want me to be an engineer.	3.47	0.93	3.63	0.98	0.974	0.325
• My parent(s) are making me study engineering.	1.55	0.77	1.79	1.03	2.518	0.115
Confidence in Basic Engineering Knowledge and Skills						
• Physics	3.62	0.94	3.71	0.77	0.323	0.571
• Engineering	4.08	0.77	4.37	0.64	5.640	0.019*
• Calculus	3.68	0.86	3.94	0.86	3.032	0.084
• Chemistry	3.64	0.87	3.27	1.13	4.575	0.034*
Confidence in Communication and Computer Skills						
• Writing	3.26	1.00	3.71	0.99	6.795	0.010*
• Speaking	3.83	0.94	4.06	0.94	1.923	0.168
• Computer Skills	3.82	0.91	4.02	0.86	1.658	0.200
Problem Solving Abilities						
• I enjoy problems that can be solved in different ways.	4.12	0.87	4.12	0.78	0.001	0.980
• I enjoy solving open-ended problems.	3.89	0.83	4.02	0.84	0.707	0.402
• Creative thinking is one of my strengths.	3.88	0.95	4.19	0.82	4.147	0.044*
• I feel confident in my ability to succeed in engineering.	4.39	0.68	4.35	0.73	0.114	0.736
• I have strong problem solving skills.	4.05	0.71	4.15	0.87	0.551	0.459

*Robust test for unequal variances.

Table 1 (cont). Student attitudes before and after completion of CIVL 103: Introduction to Civil Engineering at The Citadel.

	Pre (*n* = 66)		Post (*n* = 68)		Welch's *t*-test*	
	Mean	StDev	Mean	Mean	StDev	Mean
<u>Engineering Compatibility</u>						
• I consider myself mechanically inclined.	3.89	0.84	4.09	0.82	1.818	0.180
• I consider myself technically inclined.	3.76	0.82	4.06	0.83	4.464	0.037*
• I feel I know what an engineer does.	3.88	0.75	4.31	0.63	12.797	0.000***
• I am good at designing things.	4.15	0.75	4.19	0.80	0.088	0.767
<u>Working in Groups</u>						
• Most of my friends that I 'hang-out' with are studying engineering.	2.83	1.21	3.34	1.22	5.799	0.017*
• I prefer studying/working alone.	3.09	1.00	3.44	1.03	3.985	0.048*
• Studying in a group is better than studying by myself.	3.70	0.88	4.02	0.95	4.034	0.047*
• In the past, I have not enjoyed working in assigned groups.	3.11	1.04	3.00	0.96	0.375	0.541
<u>Adequate Study Habits</u>						
• I am confident about my current study habits or routine.	3.27	0.85	3.49	1.03	1.692	0.196
• I need to spend more time studying than I currently do.	4.17	0.83	3.99	0.98	1.327	0.251

*Robust test for unequal variances.

Conclusions

A study was conducted to evaluate the effectiveness of a new first-year engineering course in Civil and Environmental Engineering at The Citadel. The course was modeled after Ray Landis's "Introduction to Engineering" course. Through a variety of active learning strategies, the goals of this course were to introduce students to civil engineering, equip students with important study skills, and build a student community. A previously-validated survey was used to examine changes in freshmen students' attitudes before and after participation in the course. The following conclusions were made based on the results:

1. Participation in hands-on activities demonstrating the major civil engineering sub-disciplines positively impacted students' knowledge of the profession.

2. Additional strategies for improving students' study skills are needed, since student confidence in study habits remained marginal after participation in course activities.

3. Emphasis on group learning positively impact students' perceptions of collaborative learning, although they still preferred to work alone after completion of the first-year course.

Overall, the revised "Introduction to Civil Engineering" course achieved most of its intended goals. Students became extremely confident in their knowledge of engineering, and remained excited about a future career in engineering. However, additional work is needed to encourage students to improve their study habits. Class activities included requiring students to attend group study sessions and write reflections, as well as attend tutoring for calculus and/or chemistry. Future course implementations will likely include more frequent group study activities, as well as recruiting upper classmen to mentor freshmen on collaborative learning. Given the demand for engineering graduates, it is essential to improve recruitment and retention efforts at the undergraduate level. Enhancement of first year engineering courses, as was completed in this study, represents one promising strategy for better retention of students already interested in engineering.

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Dr. Mary Katherine Watson is currently an Assistant Professor of Civil and Environmental Engineering at The Citadel. Prior to joining the faculty at The Citadel, Dr. Watson earned her PhD in Civil and Environmental Engineering from The Georgia Institute of Technology. She also has BS and MS degrees in Biosystems Engineering from Clemson University. Dr. Watson's research interests are in the areas of engineering education and biological waste treatment.

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Dimitra Michalaka, PhD

Dr. Dimitra Michalaka is an Assistant Professor at the department of civil and environmental engineering at The Citadel. Dr. Michalaka received her undergraduate diploma in civil engineering from the National Technical University of Athens (NTUA), after which she entered into the transportation engineering graduate program at UF. She graduated with a Master's of Science in May 2009 and with a Ph.D. in August 2012. Her research is primarily focused on traffic operations, congestion pricing, traffic simulation, and engineering education.

Kaitlin Marley

Kaitlin Marley is a PhD student in Civil Engineering at the University of California at San Diego. She earned her Bachelor of Science degree in Civil Engineering from North Carolina State University in 2008, and she received her Master of Science degree in Geotechnical Engineering from the University of California at Berkley in 2009. Previously, she was an instructor at The Citadel and also helped to develop textbooks and courseware for mathematics courses.

APPENDIX A:

CIVL 103 Course Syllabus and Schedule

Instructor

Name
Office:
Email:
Office Hours:

Course Description

The engineering design process is demonstrated through use of practical problem-solving methods for public infrastructure and built environment projects. Course subjects include civil engineering career paths, ethical canons of the engineering profession, and requirements for professional licensure. Course assignments, conducted within a collaborative learning environment, focus on creative engineering solutions through technical analysis, teamwork, communication skills, and professionalism. As a foundation for sustained success in civil engineering, additional course topics include: lifelong learning, time management, community and professional service, and career development.

Course Goals

1. Knowledge of the civil engineering profession, specialty areas, and career opportunities.
2. Knowledge of ethical cannons of the engineering profession, requirements for professional licensure, and what is expected in a civil engineering degree program.
3. Knowledge of lifelong learning and how it is important to civil engineers.
4. Knowledge of engineering problem-solving techniques.
5. Knowledge of team dynamics through engineering projects and class assignments.
6. Practical knowledge of sustainable engineering solutions for public infrastructure and built environment projects.
7. Knowledge of the engineering design process.

Materials

Textbook
Studying Engineering, A Road Map to a Rewarding Career, 4th edition – By Raymond B. Landis
The textbook is available at the student store. Electronic versions are available through Amazon.

Notebook
You should keep a 1.5” to 2” 3-ring binder for the course to keep all notes, assignments, and course materials.

Calculator
Often, you will need a calculator to participate in projects. You may use the calculator of your choosing.

Grading

Grades will be determined as follows:

Naming All Classmates	10%
Reading Quizzes	15%
Homework	15%
Graded Projects	10%
Participation	10%
Midterm	15%
Final Exam	25%

A	90 – 100
B	80 – 89
C	70 – 79
D	60 – 69
F	< 60

Naming All Classmates
Before the semester ends, you must recite the first and last name of all of your classmates at least one time in front of the class.

Projects and Participation
Projects will be assigned during the semester. These projects will focus on various aspects of civil engineering. Some of these projects will be graded, and those projects will be averaged to account for 10% of your grade. Some of the projects will not be graded. Your participation in those projects will be reflected in the 10% of your participation grade.

Reading Quizzes
Frequently, reading will be assigned to the class. These reading assignments will be the basis for a reading quiz at the beginning of the next class. Your performance on these quizzes will account for 15% of your grade.

Midterm Exam
A midterm examination is tentatively scheduled as shown on the tentative schedule. The midterm exam will cover all topics discussed in the class, including information on the projects.

Final Exam
A final examination is tentatively scheduled as shown on the tentative schedule. The midterm exam will cover all topics discussed in the class, including information on the projects.

Policies

Attendance
You are reminded of the college attendance policy published in the catalog. Absence, excused or unexcused, from 20% or more of the class meetings can, at the discretion of the professor, result in a grade of F for the course. Attendance is normally taken at the beginning of the class period. If a student is late for class, it is the responsibility of the student to inform the professor of his or her presence.
All tests and the final examination must be taken on the assigned day. Any exceptions to this policy must be approved by the professor in advance. Exceptions will be granted only for reasons beyond the control of the student. Cadets are reminded that Guard Duty is not grounds for missing an assigned test.

Grading Policy

While the instructor strives to make grading as consistent and fair as possible, grading is inherently a somewhat subjective process. The instructor does, however, strive to grade all submissions using the same standards. As a result, changes to one student's grade could be unfair to others.

If a student feels that his or her assignment has been graded in error, he or she should submit a request for a re-grade in writing within one class period after the submission is returned. A request for re-grade requires re-submission of the original work with a short statement that: (1) states which problems should be re-graded, and (2) clearly outlines why the student believes that his or her answer is correct. The instructor reserves the right to re-grade your entire assignment, so note that it is possible your grade may go down after the re-grade.

Academic Integrity

The Cadet Honor Code states that a cadet does not lie, cheat, or steal, nor tolerate those that do. The honor system is not limited to cadets but is equally applicable to students in the evening sections. Engineers have a trust placed on them by society to ensure that the public safety is held paramount. As such, it is not difficult to extrapolate the cadet honor code to the engineer's code of ethics. People constantly depend on engineers to provide safe bridges, buildings, drinking water, etc. This trust must not be violated. For this reason, cheating on any activities, assignments, or exams will not be tolerated. While collaboration on in-class and homework assignments is encouraged, simply copying the work of other students is prohibited. Any evidence of cheating will result in a grade of a "zero" on the assignment. Consult the Honor Manual for additional details.

Academic Support

If you need accommodations because of a disability, please inform me immediately. Please see me privately after class, or at my office.

To request academic accommodations (for example, a note taker), students must also register with OASIS/Special Services, 105 Thompson Hall, 953-1820. It is the campus office responsible for reviewing documentation provided by students requesting academic accommodations, and for accommodations planning in cooperation with students and instructors, as needed and consistent with course requirements.

E-mail

The departmental policy on e-mail is that all students must have a CIT account and check for e-mail messages from the Department Head or faculty at least twice a week (and more often than this is advisable). Course information may be distributed occasionally via e-mail. If you use an e-mail service other than the Citadel, it is recommended that you forward messages from your CIT account.

APPENDIX B:

Environmental Engineering Mini-Project

Lesson 5

10 minutes
Warm-Up Activity: Allow students to fill out the warm-up activity worksheet. Question 1 asks students to describe sustainability. Question 2 prompts students to respond to the New Environmental Paradigm Scale (NEP).

5 minutes
Sustainability: Ask students what they think the term sustainability means. Next, discuss the Brundtland definition which states that "sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs."

5 minutes
Sustainability and Environmental Engineering: Discuss ways that environmental engineers can contribute to sustainability. Focus specifically on the role that environmental engineers play in providing clean drinking water.

5 minutes
Engineers for a Sustainable World: Show the video available on http://www.discoverengineering.org. Note that this video is quite long, so may want to just show the first 5 minutes.

5 minutes
Laboratory Preparation: Explain to students that the first step in cleaning water is figuring out how dirty the water is. This can be done using an instrument called a spectrophotometer. When you put a water sample into this instrument, it measures the amount of light that passes through it ("optical density."). Higher optical densities correspond to more contamination in the water. Explain that students should divide into groups of 4-5.

20 minutes
Laboratory Exercise: Class travels to the environmental laboratory. Each group is given a water sample. Students answer questions on laboratory handout. Each group determines the optical density of their water sample using the spectrophotometer.

Class Vision – students strengthen their commitment to CEE through a deeper understanding of environmental engineering.

Homework

Students should submit their completed laboratory worksheet at the beginning of the next class.

Lesson 5:
Environmental Engineering Laboratory Exercise

Questions to answer in lab:

1. Describe what your water sample looks like (e.g color, particle sizes, etc.)?

2. Using the spectrophotometer, what is the optical density of your water sample?

3. Describe the relationship between optical density and amount of water contamination.

4. Would you drink your water sample? Why or why not?

Questions to answer after lab:

1. What is the meaning of the term "sustainability?"

2. How can environmental engineers contribute to a sustainable future?

Lesson 6

Before class
Make dirty water (e.g. add food coloring, dirt, and other materials to water). Obtain materials for students to make water filtration system: sand, gravel, charcoal, rubber bands, paper towels, coffee filters, mesh screen. Each group will also need one 2-L bottle with the bottom half removed.

5 minutes
Name Game: Put students in groups of 5 (different from last class) & play the name game

2 minutes
Recap: Review environmental engineering with students.

8 minutes
Project: Describe the environmental engineering project to students. Students should divide up into five groups. Remind them that last class we learned how to measure how clean water is. This class we will come up with ways to clean the water.

20 minutes
Group time: Allow groups time to construct their water filtration system. They should also fill out the project worksheet.

15 minutes
Testing: Instructor should pass the same volume of water through each of the filtration systems designed by the groups. Make sure and collect the filtrate in a clear container. Have students visually compare and rank the turbidity of the filtrate. If there is time, you can have students use the spectrophotometer.

Resource
http://www.discoverengineering.org/
Engineers for a Sustainable World – Filtration Activity

Class Vision – students strengthen their commitment to CEE through a deeper understanding of environmental engineering.

Homework

Read p143 from "Learn to Manage Your Time" to page 151 "Test-Taking Strategies"

Lesson 6:
Environmental Engineering Project

1. List the materials that you used to make your drinking water filtration system.

2. Describe how your group constructed your drinking water filtration system. Include a diagram.

3. If you could re-make your system, how would you design it differently?