AC 2009-731: ENGAGING FRESHMAN EXPERIENCE: THE KEY TO RETENTION?

Ronald Welch, University of Texas, Tyler

Ron Welch is Professor and Head, Department of Civil Engineering at The University of Texas at Tyler. He is a registered Professional Engineer in Virginia. Until 2 Jan 2007, Ron was an Academy Professor at the United States Military Academy (USMA). Ron received a BS degree in Engineering Mechanics from the USMA in 1982 and MS and Ph.D. degrees in Civil Engineering from the University of Illinois at Urbana-Champaign in 1990 and 1999, respectively. Ronald_Welch@uttyler.edu.

Engaging Freshman Experience – Key to Retention?

Abstract

Introducing freshmen to engineering is easy, right? Or is it? Current freshmen study while listening to an IPOD, texting or IMing their friends, etc. So methods used by faculty should be effective – measuring the tolerance of washers, building a circuit on a breadboard, etc. Those students not interested in these types of lab experiences should not be engineers, right? The University of Texas at Tyler chose to try something new while looking to improve retention of freshmen and provide valuable content like engineering constraints early in an engineer's academic career. First the history of engineering is introduced so that students better understand where current engineering has developed from while getting a feel for the type of people who have made contributions to society and who many times are just like them. Next toys were introduced – Lego, K'Nex, and strobe lights - to spark creativity and capture their attention while having fun during data collection. This paper will address the changes to the course and how it has improved retention.

Introduction

The freshman engineering course (ENGR 1200 Engineering Methods[1]) at The University of Texas at Tyler received a major overhaul during the summer of 2006. The original course outline is shown in Appendix 1. The new Chair of the Department of Civil Engineering who was to arrive in January 2007 was asked by the Dean to adjust the course to better engage and excite the students about engineering, and hopefully in the future, students about computer science if the course becomes a college wide freshman requirement, while not changing the objectives and major requirements currently in the course.

The author had been working unsuccessfully for some time to develop a freshman engineering experience at the United States Military Academy (USMA). Since the forty-seven month experience at USMA had to be generic for the first three semesters regardless of academic major, there was no room to insert a freshman engineering experience. Additionally, the large common core preparing future army officers severely limits the actual number of courses within the major that even individual majors can not afford a freshman (or sophomore) engineering experience. The desired content for the course would have been derived from an engineering course at Princeton University developed by Professor David Billington (CEE102 – Engineering and the Modern World[2]) and the Summer Leaders Seminar[3] for high school students at the United States Military Academy (USMA).

The focus of the engineering course by Professor Billington is to provide a historical foundation as to how society arrived at the present modern engineering capabilities based on the past history of engineers and their engineering machines and how these machines and surrounding events affected the politics of public works, the economics of private enterprise, the rise of industry that reshapes regions, and the conflict between public environment and private profit. The course is offered at Princeton University to engineering students as a history/social science course and to non-engineering students as a technical course that requires a lab component. The underlying thought being that engineering students will have numerous laboratory experiences within their engineering academic career and being able to get a course on the history of modern engineering which counts toward a core humanities requirement early in their career will provide them a unique insight into engineering. Additionally, the creative hands-on laboratory experiences with structures: Eiffel Tower and Menai Straits suspension bridge made out of K'Nex, machines: the prony brake, and networks: power at a distance and the bell telephone, and the associated data collection will encourage some of the non-engineering students to consider switching to engineering!

The focus of the summer leaders seminar at the USMA is to excite top students around the country to consider the academy as their college of choice while helping them to develop some leadership skills and learn a little about different academic disciplines and the Army. The USMA allows each academic program that desires the opportunity a two and one-half hour time slot to host an activity that introduces the participating high school students to their academic discipline. The high school students select choices from the available list of program activities to attend during their one week experience of the Army at the USMA which includes leadership and physical fitness activities. The civil and mechanical engineering programs use activities with K'nex and Legos to introduce their respective disciplines.

The UT Tyler freshman engineering course is two credit hours. The College of Engineering and Computer Science uses the two credit hours to provide one 50 minute lecture and one three hour laboratory exercise per week. Throughout the adjustments to ENGR 1200, the original objectives (Table 1, the parts not bolded) and focus for the course were to be maintained – familiarization of freshmen to engineering skills required throughout their academic careers such as laboratory data collection and report writing, team forming and experiences, improved (technical) writing skills, and design experiences.

Table 1. Course Objectives

1. Explain the engineering profession and engineering ethics.
2. Use technical communication skills to explain the results/analysis of introductory laboratory exercises in **Civil**, Mechanical, and Electrical Engineering and **Computer Science.**
3. Explain engineering analysis and design.
4. Analyze data collected during laboratory exercises.
5. Analyze the impact engineering has had on the modern world.
6. Design a simple engineering device, write a design report, and present the design as part of team.

The primary focus of the new course design is to provide a broad perspective on the history of engineering, engineering skills needed throughout their engineering academic program (i.e., lab report writing, etc.), an introduction to engineering design without needing to know all of the details of design, and an insight into all of the engineering disciplines within the college. Not every student has a thorough understanding of their initially selected engineering discipline nor do they have an understanding of others disciplines either. The initial selection is occasionally based on someone they know and the type of engineer they are.

The "something new" part of the course was not only to maintain the current content, but ensure fun open-ended laboratory experiences that introduced each discipline within the college as well as provide a historical introduction to modern engineering. Existing content was repackaged and condensed to increase efficiency and allow room for eleven hours covering engineering in the modern world. The laboratories were not only an introduction to each discipline, but provided the exercises to learn knowledge and skills used throughout their program of study. The modest adjustments to the course objectives are reflected in bold print in Table 1.

The underlying goal of the new course content (Appendix 2) is to develop a passion for engineering and hopefully a specific engineering discipline within the freshman and transfer students that will carry them through the many University Core (English, history, politics, social sciences, etc.), mathematics, basic science, and engineering science courses (statics, dynamics, etc.) during their freshman and sophomore years before they even start to take the majority of their discipline specific courses in their junior and senior years. Many times the passion for engineering is necessary to get the students just through the freshman year alone when they experience numerous life changes to include being away from home and the need to actually study to pass courses like calculus, physics, and chemistry – courses that they liked in high school and usually excelled in without much studying.

The fact that there are few discipline specific courses within the freshman and sophomore years highlight the need for students to make the correct decision on their major as soon as possible. Additionally, the State of Texas has added constraints on the number of drops and the number of grade replacements to force more students toward timely graduation; engineering programs need to help the students gain a passion for their engineering discipline and stay on the path to timely graduation. It appears that a student that discovers they are in the wrong engineering discipline sooner may change to another engineering discipline rather than another major at the university or leave school all together out of frustration. If a program places their worst teacher with the freshmen, the students will make quick comparisons with the teachers they have from the multiple colleges within the university and may decide to change majors based on the quality of the teaching alone.[4]

The UT-Tyler Freshman Engineering Course – ENGR 1200 Engineering Methods

Since the offering of the revamped course coincided with the completion of the new engineering and science building which has larger classrooms, the course was also team taught for the first time in the fall of 2006 with one large lecture for the entire course and multiple smaller laboratory sections of 32 students or less each week. Each instructor taught all labs covering a particular topic to ensure consistent content coverage. The table in Appendix 2 provides a glimpse into the content of each lesson or laboratory within the revamped course.

The course covers the administrative requirements of forming teams, team members getting to know each other, course requirements and the Dean Welcome within the first week. The college feels it is important to have the Dean welcome the students to the start of their engineering academic careers. It subtly lets the students know that they are so important that the Dean came to their course and welcomed them. Many students rarely meet the Dean during their time at a university nor do they get an introduction to engineering history by him/her during the process. Teams are formed using Soloman and Felder's learning style inventory[5], maintaining a mix of all disciplines in the college within each team, and maintaining a mix of male and female with two females in each team if a female is available to add to a team. Using this process, rarely are teams formed that are dysfunctional or have actual friends prior to the course on the team. By varying the learning styles, each team usually has balanced skill sets that appear based on five semesters of use to provide better performance within the teams – i.e., no dysfunctional teams, team work taking priority over individual assignments, and every member of the team showing up to laboratories when sometimes they are absent during the lectures.

The history of modern engineering starts with Telford and his bridges setting the stage for the establishment of the first engineering society in England and the introduction to civil engineering. This naturally sparks a discussion as to the importance of professional societies and when and how do they get involved. The coverage of steamboats and railroads leads to discussions about mechanical engineering, while the coverage of the telephone and electricity sets the stage for discussions about electrical engineering. The use of computers and research requirements on the web throughout the course and the introduction of sensors within the design project set the stage for the introduction of computer science. Even though the computer science majors do not currently take the course, the intent is to introduce the engineers to computer science while developing a course that can serve the same purpose for the computer science students once they begin to take the course in the next year or so.

Laboratories

The four discipline specific laboratory experiences are spread to allow for emersion into the content of that discipline while also considering the history of modern engineering and its impact.

The civil engineering laboratory starts with a general overview of civil engineering and a discussion of truss structures, tension and compression in two-force members, and a demonstration of the West Point Bridge Designer (WPBD) program. At the conclusion of the general overview of civil engineering, the students all work with the WPBD for about 15 minutes to try and design a working bridge that is cheaper than the instructor's design which was developed as part of the general overview. When the students are stopped and a winner declared, they are handed two new requirements: 1) a WPBD program homework assignment with a new tougher scenario, and 2) they are given the mission to build a bridge during that lab period to span a gap between two lab tables using K'Nex and the new knowledge on trusses they have just learned about through the general civil overview and designing a bridge in lab using the WPBD program. The students have one and a half hours to build a stable K'Nex bridge that can hold a load applied to the top chord of their bridge. The arbitrary load is four AISC Steel Construction Manuals (weights and order of placement are 3.25, 3.2, 2.6, and 2.6 pounds, respectively). Books are a stable load when placed on top of the bridges, except when the designed bridge is subject to twisting. The students are allowed to use these four manuals to test their bridges prior to the actual end-of-class competition just as a computer program would allow analysis of bridge designs. See the damage in Figure 1 to a bridge after testing with only 2 books. The bridges able to hold the four manuals can add up to three additional manuals (order of placement is 3.25, 3.05, 2.4 pounds, respectively) to compare with bridge costs to determine bragging rights. The students are provided arbitrary costs for each piece of K'Nex. The complete design to include procedures used, lessons learned, hand-drawn plans and material costs must be part of the lab report. Students are informed about the need to draw plans for their final design project using PC paint or something equivalent. Many teams choose to draw the plans of their bridges using a drawing package even in this first laboratory. Some students will take apart a working bridge if there is time left to go for a more efficient design that carries the full 7 books…passionate engineers, future civil engineers? Most student groups focus their lessons learned on the fact that triangular shapes are more stable and stronger, shorter members make the structure more stable, and connection design is critical (note: the purple connectors used in Figure 1 along the bottom chord easily slide apart in tension when the load is applied on the top chords of the truss).

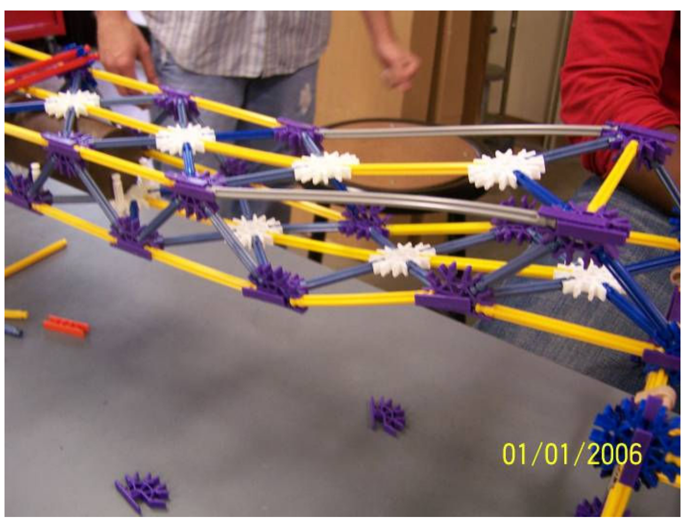

Figure 1. Damaged K'Nex Bridge after testing with Steel Manuals

The mechanical lab experience starts with a general overview of mechanical engineering and transitions to a similar challenge as the civil engineering laboratory. The challenge is to build a mechanical device with Lego's to lift at least 2.45 pounds to successfully complete the laboratory exercise (Figure 2). The 2.45 pound load is an arbitrary load comprised of weights from a weight set based on a reasonable mid-range load for the Lego rods and gears and the time available to build a successful lifting machine. Of course, most teams go for the brass ring and the challenge to lift up to 6.6 pounds (a reasonable upper bound limit based on rod and gear material strengths). The cost of the individual Lego pieces (again arbitrarily assigned) is also part of the determination of the best design and bragging rights. The plans must be included and can be hand drawn, but most teams are using a drawing package of some type. Many teams begin to discover the power of taking digital photos throughout the process to capture successive designs and what worked and did not work to highlight lessons learned within their laboratory report. Once a team is successful lifting the 2.45 or 6.6. pound weight, they always look for ways to decrease the lift time which is a built in part of the overall assessment of the design. A few students stay after class to design a gear ratio that can lift 13.2 pounds (lifting two of the 6.6 pounds metal cylinders). They quickly learn that the rods will begin to twist at about 12 pounds depending on how the support structure supports the rods. Another lesson learned is the importance of the gear alignment to ensure complete seating of the teeth to limit the amount of load being transferred at only the tips of the gear teeth. These students have developed a real passion for mechanical (automotive) engineering.

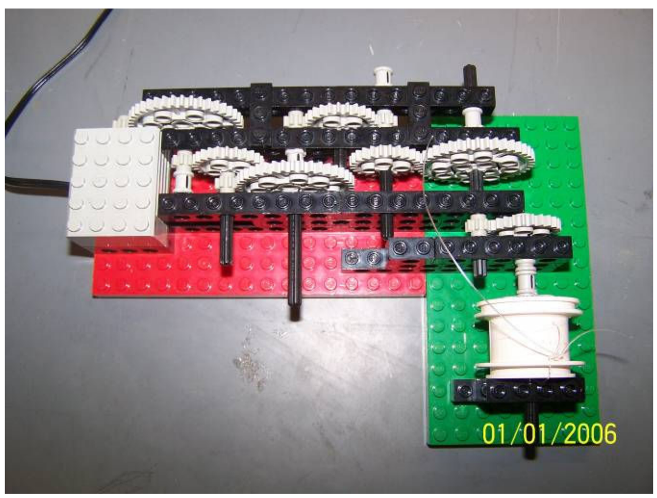

Figure 2. Lego Gear System Used in Mechanical Lab

The electrical lab experience begins with a general overview of electrical engineering and transitions to a challenge to build a strobe light that they get to keep while designing a creative cover for bonus points (Figure 3). However, instead of just jumping into the construction of the strobe light on its pre-stamped breadboard, the team must first develop the strobe light using a breadboard similar to the one in Figure 4. The instructor provides parts of a basic wiring diagram and allows the students to investigate how they are connected. As the lab progresses, the entire wiring diagram is provided to ensure the students have a working strobe light. Before each student begins to build and solder their own strobe light, the students are shown how the smaller stamped breadboard they are provided in the kit is the same as the one they have just built as a team. Each student must solder all of the components themselves. Attention to detail and trouble shooting the soldering using a multi-meter allows the real electrical engineering students to shine. Those students now have the opportunity to assist their classmates in trouble-shooting their strobe lights. Generally, the main lessons learned center around attention to detail: which components go where and sometimes in which direction, proper soldering does not require big blobs of material, and a steady hand is a plus!

Figure 3. Strobe Light Under Construction

The computer science laboratory experience begins with an overview of computer science and transitions to the students using Boolean algebra to express decisions. This lab has had the most growth since the course began. It started off as an Excel spreadsheet exercise to mathematically express the decisions made through Boolean algebra. However, based on the excitement and action developed in the first three labs, this lab fell flat in both excitement and a desire to learn. The end-of-course assessments had numerous comments calling for a change. Over the last two semesters the lab has been adjusted to now present Boolean expressions as a stepping stone to developing a sensor to stop a Lego engine at a pre-determined location (Figure 4). The sensor is built on a breadboard and used to stop the Lego engine which is designed and built as part of the semester design project. Examples are stopping a lift bridge, elevator, or crane at a desired height or floor. Since the students have not built their semester projects yet, the instruction team has developed a lift bridge to allow the students to use their sensor to control its movement (Figure 5). The excitement builds as each team tries to successfully stop the bridge in a desired location since no matter what the instructor does, the competition is on to be the team that is successful. The ensuring discussions in the lab naturally tie the activities such as megatronics that ultimately ties the computer science, mechanical, electrical, and civil engineering fields together to accomplish most projects.

The civil and mechanical laboratory experiences of a K'Nex bridge to span a gap and a Lego device to lift a required weight are slightly modified from the USMA summer experiences for the civil and mechanical engineering programs.[3] The electrical engineering laboratory experience is a modification of the USMA experience in that the students build a strobe light instead of a digital temperature gage. The University of Texas at Tyler computer science program developed the initial computer science experience for the course. In fact, each program has one of its professors teach and grade the laboratory experience as part of developing a connection with the students during their freshman year. As an addition, the civil engineering program brings all instructors into the lab to be a resource for student questions during the lab as well as to use the lab as an opportunity to introduce the civil engineering team to the freshman early in their academic programs. These are the same faculty that will become their advisors at the end of the freshman year when the department chair transitions from being the advisor for all freshmen and transfer students. There is an effort to get the other departments to do the same.

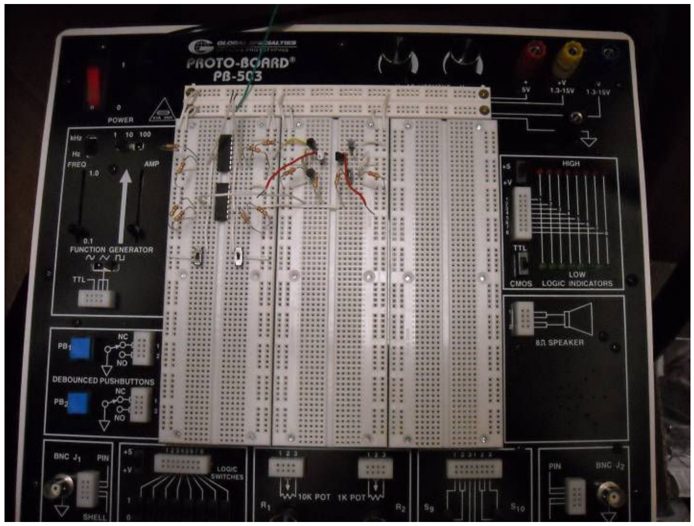

Figure 4. Sensor Under Construction

Figure 5. Lift Bridge

Writing Requirements

The insertion of writing and laboratory assignments throughout the course allows for the building of confidence and skill within each student while they write about their chosen profession – engineering. The writing assignments begin with individual journals worth 20-30 points out of 2000 points in the course and group laboratory reports worth 100 points. This method allows for not only learning the requirements within the course with few points on the line, but improvement of skills through very tough, detailed assessment of their writing skills. The journals are based on topics being discussed within the context of engineering in the modern world. As an added layer, the students must select five to eight engineering constraints based on the assignment to focus their analysis of the individual and associated engineering feat. The first journal assignment requires each student to define the engineering constraints before selecting the five to use within their further analysis: political, social, economic, sustainability, manufacturability (constructability for civil), public health and safety, and ethics.

The focus of the journals, essays, laboratory reports and the technical/research report is to not only to introduce the students to technical writing, but to improve their overall writing skills. The use of a grading rubric that is provided to the students with the grade broken out into three areas: content, organization, and writing, allows the students to see where they need to focus their efforts for improvement. With the introduction of this grading scheme in the high challenge, low risk journal format (20-30 points out of 2000 course points), the students receive feedback early and begin to make improvements immediately. The students do not catch in the syllabus that the journals are assigned a very small portion of the grade and they naturally work harder on the second journal and really show marked improvement. The small number of points assigned to the journals is pointed out by the instructor after the second journal to ease some of the stress for those students who have a low course grade after those two assignments. The students are informed that the method is to help them improve their skills before later assignments with greater point totals.

The laboratory reports also change in format throughout the semester. The first assignment is a full laboratory report. Each student is provided a simple lab report format during the civil engineering lab and asked to arrive with as much of the report completed as possible in the next lab period where that lab is mostly devoted to the format, content, and completion of the report. Their initial effort to complete the lab report sets the stage for a detailed lab report format to be issued and how it applies specifically to the lab report that they are completing for the next lesson. The discussion of tables, figures, and results is particularly eye opening for most, if they have spent some time already working on the lab report. Many students do not initially recognize that the process they used to determine a successful bridge to span a gap was an experiment that included trial and error learning. The fact that they are required to record all they do in a lab notebook provides the material they need to successfully complete their lab report. The second graded lab is a business letter with the full lab report attached. The third graded lab is an internal memorandum with appropriate appendices based on the content of a full lab report. The fourth graded lab is an individual lab report to ensure every student has had the opportunity to compete a lab report after they have wrestled with the different parts of the report for three group lab assignments.

The technical/research report requires each student to investigate and analyze an engineer/scientist and/or their engineering feat/machine/process or an industry using all eight engineering constraints. Improvement of engineering student writing skills occurs through visits to the university writing center at least three times: 1) the paper outline, 2) the rough draft before the paper receives focused content grading from the course instructor, and 3) the final paper before turning in for a grade. Fifteen percent of the paper grade is assigned to the draft paper to force students to present at least a ninety percent solution for the rough draft submission. The purpose is to show each student how much improved their papers can be if they develop an outline, develop a complete rough draft, have someone review it, and rework the final paper after it has had time to sit for awhile. Waiting to do a paper the night before it is due will not normally result in a high quality paper. A different perspective on improving writing skills from an organization like the writing center is always helpful for all engineers.

Design Project

The design project uses both K'Nex, Lego's, and a sensor to build a structure that performs a function such as a crane, lift bridge, rotating bridge, or elevator (Figure 6). What the students do not know until they start the project is that they have already gained significant knowledge as they completed the civil, mechanical, electrical, and computer science labs. Those trial and error experiences form the basis for developing the structure with K'Nex, the lift device with Lego's, and the sensor to stop the movement at a desired point. The students are still using trial and error, but the process is streamlined by their previous experiences. Each team must present their design concept not only within a written report, but also as an oral presentation to the entire class after the actual competition day. The students must build and take apart their structure and lift device each day since other students must use the same kits to build their design the next lab day. UT Tyler currently has three lab periods for the course, but is expecting to grow to four or five labs periods in the very near future. This process of building and taking the project apart each day improves the team's ability to efficiently build the structure on the competition day and their understanding of their design as they articulate it in the design report.

The freshmen are introduced to engineering constraints on the first day of the course and they must demonstrate their understanding through defining each and using five within their first journal assignment. The desired goal is early use of the constraints in the course leads to better understanding and use within the design project. Of course, the ultimate goal of introducing the freshman to the engineering constraints is to improve their consideration of engineering constraints during their senior design experience. Currently, seniors are not very familiar with what the engineering constraints are and how they affect or are affected by engineers in real world design. Any time students wait until the senior year to consider engineering constraints within their design, the analysis generally lacks any real depth. The civil engineering program has taken the process one step further and developed a matrix of courses during the sophomore and junior years that will require the students to continue to wrestle with the engineering constraints that are reasonable for their course: examples are social issues – introduction to environmental engineering and public health and safety – construction management. The ability to consider and adjust designs due to engineering constraints is required in all engineering design and is also required to be part of the design process expected by ABET.

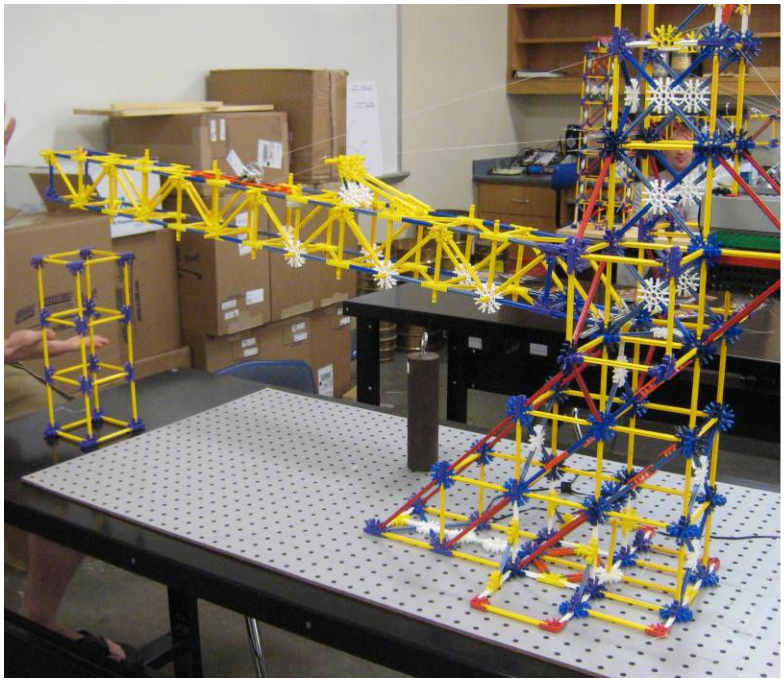

Figure 6. Design Project Construction (Lift Bridge)

Portfolio

All students are required to maintain a portfolio of all graded requirements to include group assignments. They must assess their performance on each assignment and determine what they should have done to attain a better grade. Until students learn to assess their own learning ability and skills, they will never truly be self-motivated life-long learners.

Results

The course in its current format with a few minor modifications after the first semester (Fall 2006) has been taught for five semesters. The student comments within end-of-course assessments state that they would like to have even more fun hands-on learning experiences such as the ones described above. Outgoing seniors during their recent senior exit interviews noted how they wished they had the same type of freshman experience (observed when walking by and seeing the freshmen working on their design project). In fact, a few seniors have noted that they may have chosen a different engineering discipline if the freshman experience on each type of discipline had been more exciting. Their lab experiments were measuring the tolerance of washers and current produced in different electrical configurations.

Student assessment of the course and the instructors has been very positive, even during the fall semesters when the course is team taught and lab experiences for all sections are split between instructors. Figures 5-7 present how the course in recent years has done against the other courses in the Civil Engineering program (as an example) and previous offerings of the current formatted course against the fall semester (081S) when it is team taught. The results are rather good considering most responses are above 4 on a Likert scale of 1-5. These results are tremendous given comparison with Civil Engineering courses where the students are majors in their junior and senior years and most of the faculty have attended the ExCEEd Teaching Workshop[6] which has greatly improved their teaching abilities. Additionally, many freshman are still not sure they want to be an engineer as well as many are not quite ready to be students at four-year programs. The College of Engineering and Computer Science at UT Tyler also uses the University admittance as criteria for students to gain admittance to the engineering programs. Combine all of these factors and the redesign of ENGR 1200 has clearly been able to gain the respect of the freshmen as to the quality of the course being offered.

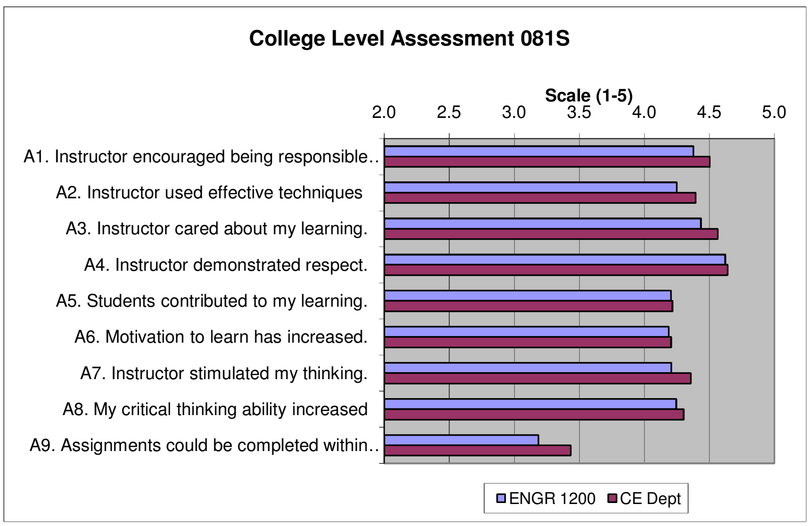

Figure 5. End-of-Course Assessment

One other truly amazing fact is that the end-of-course assessment statements state most students spent more time on this two credit course than two or more of their other freshman three credit courses combined. This might naturally point to course overload, but the instructors collect time spent between lessons to ensure there is no course overload. The students spent on average 92 minutes preparing for each course meeting (one lecture and one lab per week). The student handbook states that students should be prepared to provide up to 180 minutes out of class preparing for each class period. Therefore, the results are really good. Reliable assessment results are not available prior to 2006 on the previous course design due to a very small number of students responding to a home grown web-based system within the college. The current results are collected in class using paper surveys to ensure that input from almost every student is captured.

So what about retention? Table 2 presents the retention of engineering freshmen since the college was formed and began tracking the data. The data shows that our retention is about the same as across the nation when considering aggregate college numbers. A gradual improvement in retention between the freshman and sophomore years has

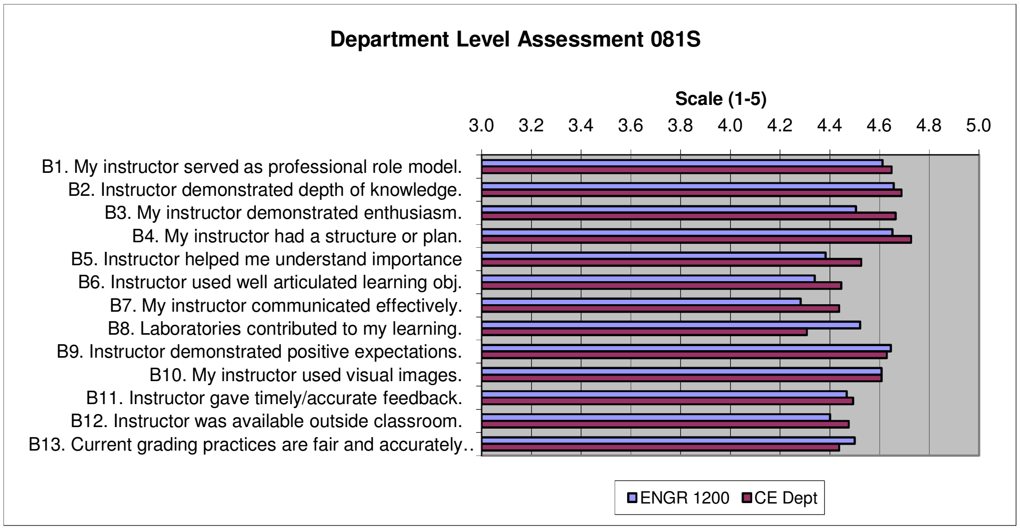

Figure 6. End-of-Course Assessment

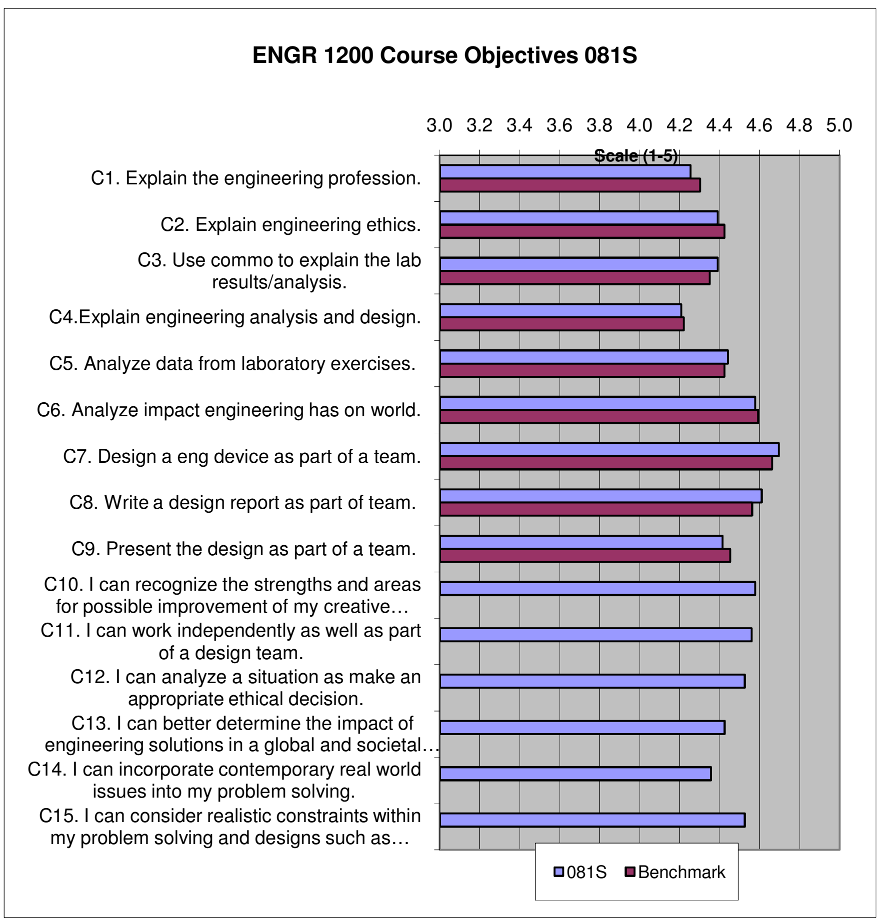

Figure 7. Course Objectives End-of-Course Assessment

occurred since the first year (2006) the new format of ENGR 1200 was offered (Row 4, in red, Table 2). Additionally, the increase in retention is not tied to the increase in the number of freshman entering the college as engineers (Row 2, Table 2). Upon further analysis, not every freshman takes ENGR 1200. Therefore, the impact of the course is not as clear. The next step in the analysis was to look at whether the student actually took ENGR 1200 during the freshman year and compare that to those retained and to those that departed the engineering programs. The data shows that if the student took ENGR 1200 they are more likely to stay with engineering (Row 6, Table 2). Given the fact that some students need to take other leveling courses to improve their chances of graduating within five or fewer years (e.g., Algebra or Trig), the resulting schedule does not always support taking ENGR 1200 within the sometime critical first semester. However, the data (Row 9, Table 2) supports the need to get more (all) students into ENGR 1200 within the first semester to stoke a passionate fire for engineering that carries them through the non-engineering courses into the sophomore year and beyond. The fall 2009 schedule was developed to ensure no obvious freshman or leveling courses might conflict with ENGR 1200. As with most engineering programs, the discussions with students leaving engineering even after taking ENGR 1200 is their inability to be successful in the math and science courses. However, most were still passionate about the activities they did in ENGR 1200.

Table 2. Freshman Retention vs. Number Taking ENGR 1200

	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Total Engineering Freshmen	**28**	**29**	**18**	**27**	**21**	**28**	**51**	**47**	**61**	**55**
Total Engineering Freshmen Retained	***10***	***16***	***8***	***11***	***5***	***12***	***23***	***20***	***30***	***29***
Percentage Retained	**36**	**55**	**44**	**41**	**24**	**43**	**45**	**43**	**49**	**53**
# Retained Who Took ENGR 1200	9	11	8	10	5	12	22	17	30	29
Percentage Retained Who Took ENGR 1200	90	69	100	91	100	100	96	85	**100**	**100**
Total Engineering Freshman Departing	***18***	***13***	***10***	***16***	***16***	***16***	***28***	***27***	***30***	***26***
# Departing Who Took ENGR 1200	16	11	9	12	16	15	26	25	23	10
Percentage Departing Who Took ENGR 1200	89	85	90	75	100	94	93	93	**76**	**38**

Recommendations

Students need to be actively engaged in their chosen professions as soon as possible. The experiences and data at UT Tyler indicate that students who are in exciting active freshman engineering experiences tend to return sophomore year as engineers and those that do not take the course are more likely to gravitate to other majors when struggling in the math and science courses (based on interviews with each student changing their major away from engineering). The activities should be open-ended play-type experiences that help a student grow their creativity while at the same time require them to develop necessary engineering skills such as technical writing, lab report writing, and data collection. The ability to get into design experiences (K'Nex, Lego, and WPBD) without needing to wait until completing the content of junior and senior year adds to the students desire to make it to the junior and senior year and sometimes slog through the freshman and sophomore humanities core, math, science, and engineering science courses.

Conclusions

The college will continue to monitor the statistics to ensure this exciting, fun, challenging freshman engineering course continues to have a truly dramatic impact on the retention of engineering freshmen as well as increasing numbers retained through graduation. The students want to have fun while learning about engineering to include the history of engineering, the design processes, and a little about the engineering disciplines within the college. Even though there are only two years of data based on the changes to the course, the course appears to solidly connect the students to the engineering profession sooner than normal based on the improved retention numbers and the number retained who actually took the course during the freshman year. Helping students to connect to their profession is critical since the majority of the engineering courses are taught during the last two undergraduate years. The students do not ask for the course to be easy when their future will have lots of hard, challenging engineering courses. They know that to become an engineer is not going to be easy and the pay and benefits of being an engineer do not always motivate a student to stay the course to graduation. What everyone wants is to be excited each day about going to class through fun and challenging experiences that prepares them for their future – that experience is the UT Tyler ENGR 1200 Engineering Methods course.

References:

1. http://ce.uttyler.edu/Documents/ENGR1200ABETsyl2008Jun.pdf Accessed 30 Jan 2009.
2. http://www.princeton.edu/cee/undergraduate/courses/course_details.xml?courseid=008721&term=1092 Accessed 30 Jan 2009.
3. http://admissions.usma.edu/moreinfo/SLSCourseDescriptions2008.pdf, Seminar O. Accessed 30 Jan 2009.

4. Seymour, E. and Hewitt, N. 1997. *Talking about Leaving: Why Undergraduates Leave the Sciences*. Boulder, Colorado: Westview Press.
5. Solomon, B.A. and Felder, R.M. http://www.engr.ncsu.edu/learningstyles/ilsweb.html Accessed 30 Jan 2009.
6. ExCEEd Teaching Workshop. http://www.asce.org/exceed Accessed 11 Mar 2009.

Appendix 1 Course Outline Prior to Summer of 2006

Lsn	**Class topic**	**Deliverable(s)**
1	Introduction to engineering profession	Undergraduate information sheet, e-mail addresses
1L	Laboratory: introduction to computer laboratory	
2	Course outline; laboratory notebooks; laboratory report example	
2L	Continuation of computer laboratory	
3	Engineering ethics; discuss Ohm's Law laboratory; HW 1 assigned	Laboratory report example
3L	Laboratory: Ohm's Law	
4	Laboratory reports and design reports (visit by writing center)	HW 1 (the engineering profession and engineering ethics)
4L	Laboratory: Teaming skills; design assignment; form project teams	
5	Discuss ethics exercise and heat conduction laboratory	
5L	Laboratory: heat conduction	Ohm's Law report
6	Engineering problem solving; introduction to engineering design; HW 2 (engineering problem solving) assigned	
6L	Team design day: develop WBS, GANTT, responsibility matrix	
7	Engineering design; discuss linear circuits laboratory exercise	HW 2 (engineering problem solving)
7L	Laboratory: Linear circuits	Heat conduction report
8	Presentation by the Counseling Center	
8L	Laboratory: Visit Library	
9	Systematic Design	WBS, GANTT, LRC due; Technical Paper topic due
9L	Laboratory: Team design day	Linear circuit laboratory report
10	Systematic Design	
10L	Laboratory: Library research or team design day	
11	Discuss Vibrations laboratory	First draft of technical paper
11L	Laboratory: Vibrations	Preliminary design report due
12	Business Letters and Memoranda	Final version of technical paper
12L	Laboratory: Team design day	Vibrations Laboratory report
13	Resumes and cover letter	Business letter and memorandum
13L	Laboratory: Team design day	
14	Team Design day	
14L	Laboratory: Team Design Day	
15	Professional Presentations	Resumes and cover letters
15L	Evaluation of projects; begin project presentations	Project reports
Final	Finish presentations; course evaluations	Course portfolios and course evaluations

Appendix 2 Current Course Outline

Lsn	Notes	Lesson Title	Graded Requirements Due Dates
1	LEC	Introduction to Course	
1L	LAB	Dean Welome, Lab Admin	Civil Engineering Lab Out
2	LEC	Introduction to Eng in the Modern World	Journal #1 Out
2L	LAB	Intro into Civil Engineering	Homework #1 Out
3	LEC	Steamboat/Textiles	Journal #1 Due, Design Requirement Out, Essay #1 Out
3L	LAB	Lab Report Writing	Mechanical Eng Lab Requirements Out, Homework #1 Due
4	LEC	Railroads/Telegraph	Journal # 2 Out
4L	LAB	Intro into Mechanical Engineering	Civil Engineering Lab Requirement Due, Engineering Ethics Out
5	LEC	Power/Telephone	Journal #2 Due
5L	LAB	Engineering Problem Solving	Homework #2 Out, Essay #2 Out, Electrical Eng Requirement Out
6	LEC	Oil Refinery/Automobiles	
6L	LAB	Intro into Electrical Engineering	Mechanical Engineering Lab Requirement Due
7	LEC	Wright Brothers/Airplaine	Essay #1 Due
7L	LAB	Study Skills Seminar	Homework #2 Due, Research/Technical Paper Out
8	LEC	Systematic Design	Essay # 3 Out, Essay 2 Due
8L	LAB	Engineering Problem Solving	WBS, Gantt, LRC Out
9	LEC	Steel Industry/Bridges	Technical Research Paper Topic Due, Journal # 3 Out, Intermediate Portfolio Due
9L	LAB	Library Research Day	Computer Science Lab Req Out, Electrical Engineering Lab Due
10	LEC	Counseling Center Guest Lecture	Journal 3 due
10L	LAB	Intro to Computer Science	WBS, Gnatt, LRC Due
11	LEC	Major Power Sources	Draft Research/Technical Paper Due (Writing Center)
11L	LAB	Design day	
12	LEC	Nuclear Power/Aircraft Milestones	Essay # 3 Due
12L	LAB	Design Day	Computer Science Lab Req Due
13	LEC	Power & Water/Wireless Communication	Research/Technical Paper Due
13L	LAB	Design/Fabrication Day	
14	LEC	Presentations	Final Portfolios Due
14L	LAB	Fabrication Day/competition	Final Design Report Due
15	LEC	Information/Infrastructure	
15L	LAB	Professional Presentations	Presentation delivery