An Update: The Engagement and Retention of Electrical Engineering Students with a First Semester Freshman Experience Course

Dr. Hector A. Ochoa, The University of Texas at Tyler

Dr. Ochoa received his Ph.D. in electrical and computer engineering from the University of Texas at El Paso (UTEP) in 2007, his M.S. degree in physics from UTEP in 2003, and his B.S. in physics from the University of Guadalajara (U de G), Mexico in 2001. He is a member of the IEEE, the International Society for Optics and Photonics (SPIE), the American Society for Engineering Education (ASEE), and the order of the engineer. He also serves as the faculty advisor to the IEEE student chapter and the Society of Hispanic Professional Engineers (SHPE) at the University of Texas at Tyler. Dr. Ochoa is an electrical engineer with roughly seven years of experience spanning subjects as diverse as analysis of radar signals using Fourier and relativistic approaches; application of compressive sensing in chaotic radars; analysis of induced currents on a perfect electric conductor using the current tensor; and the analysis of large time-bandwidth product radar signals when high-velocity targets are considered. Dr. Ochoa has published a total of four conference papers in the field of engineering education. Two of the papers discussed the development of a freshmen course in electrical engineering to improve retention. Another paper is related to the development of an online graduate course in Random Process. And the last paper focuses on the development of an online course in Linear Circuit Analysis for Electrical Engineering Student.

Dr. Mukul Shirvaikar, University of Texas at Tyler

Dr. Mukul Shirvaikar is the Chair and Professor of Electrical Engineering at the University of Texas at Tyler, where he develops curriculum and laboratories in computer engineering. Prior to this he worked at Texas Instruments specializing in real time imaging systems. Dr. Shirvaikar graduated with his doctorate from the University of Tennessee, a M.S. degree from the University of Maine, and a Bachelor's degree from Banaras Hindu University, India. His current research interests include real time imaging and engineering education.

An Update: The Engagement and Retention of Electrical Engineering Students with a First Semester Freshman Experience Course

Abstract

Freshman retention has been a critical issue for engineering programs over the last decade. Universities have implemented many different approaches to improve freshman retention including: creating general freshman courses to give early hands-on experience to the students, utilizing student feedback to design courses, and moving the ownership and maintenance of laboratory equipment from the university to the students. In the fall semester of 2009, the Electrical Engineering program at The University of Texas at Tyler took the initiative of creating and offering a first semester freshman experience course aimed at improving freshman retention. The rationale for creating this course was based on student and faculty feedback, and comments provided by graduating seniors during their senior exit interview. A number of students also expressed their concern about how late the electrical engineering laboratory experience is in the curriculum. Since then significant changes have been made to this course in order to make it more enjoyable and effective in retaining students. Some of these changes include the establishment of a departmental template used to prepare the materials that are distributed to the students, the inclusion of virtual instruments such as the NI myDAQ and Labview, and the replacement of PSpice with NI Multisim and Ultiboard. The last two software utilities have made the fabrication of PCBs easier for the students and faculty. Furthermore, the students are required to use the NI myDAQ in some of their laboratories and in the final project which some of them also include the use of Labview. This paper will present the data collected as a part of the course offering over four academic years, specifically split into two analysis categories. The first part of the data analysis will focus on the effect of the course on student retention, extracted from the freshman cohorts. The second part of the data analysis will focus on student surveys performed at the end of the semester. This survey was designed to measure vital components of overall course effectiveness with finer granularity, including students understanding of topics such as the role of electrical engineers and their impact on society. Finally, the first cohort of students that took this course are graduating this year, by analyzing the numbers it can be seen that the retention rates have been increased from 54.8% in 2008 to 80%.

Introduction

Retention is a major concern in most engineering programs over the last decade. Many students decide to pursue a career in electrical engineering based on counselor advice, performance in math, while others may like to work with electrical gadgets and decide that electrical engineering is the right path to pursue. However, most of these students are not exposed to the electrical engineering profession and practice thereof. Some of the students enter the program expecting to start building circuits and programming microprocessors at the very beginning of their education.

However, in most programs they face a tough time working through theoretical courses like physics and calculus. This usually results in bored and disappointed students, adversely affecting retention. The Department of Electrical Engineering at The University of Texas at Tyler, in an effort to increase the retention of their freshman students has created a new freshman electrical engineering course first offered in the fall of 2009. This course is titled "EENG 1301 – Engineering the Future," and does not have any prerequisites. The objective of the course is to introduce freshman students to the world of electrical engineering by exposing them to different areas of specialization and give them the opportunity to work on introductory laboratory projects related to the topics covered in this course.

The University of Texas at Tyler was established in late 1996 and taught its first classes in summer of 1997. The College of Engineering initially offered two Bachelor of Science degrees (electrical and mechanical engineering) and one graduate degree (Master of Engineering), which was intended principally as a service of continuing education to practicing engineers. All students in that first cohort were transfer students; at that time, the University was an upper-division school, enrolling only juniors and seniors. The University was authorized in summer of 1997 to expand to a 4-year institution and began enrolling freshmen and sophomores in fall of 1998. This necessitated the development of appropriate freshman and sophomore courses in the BSEE and BSME programs including which had previously not been offered by the University. The BSEE program has been ABET accredited for the last two cycles.

One of the major observations from the senior survey, which is a part of the ABET Continuous Quality Improvement process, was that the BSEE curriculum needed early and frequent hands-on experiences, where the students actually feel that they are building something that worked. Four years have passed since this course was implemented and some significant adjustments have been made since 2009. The data collected during these four years will help to show that the course has satisfied its mission, and is working as expected. It is the opinion of the faculty that the implementation of the course was one of the best curricular changes in departmental history.

Learning from Others Experience

The addition of a first year course, trying to address retention issues is not something new or particular about any university. Several programs have implemented freshman courses in which a broad introduction to engineering and some hands on experience is offered[1-4]. Some programs utilize student feedback and program outcomes to design introductory courses[5,6], some have decided to move the ownership and maintenance of laboratory equipment from the university to the students, thereby giving them the feeling of being vested in the program[7]. Even some programs have studied how the retention is affected when an introductory course is not offered at the right time in the curriculum[8]. Retention of freshman students has been something happening from a long time and a perfect solution has not been found for this problem. Many universities have tried different approaches trying to improve the retention and performance of their freshman students. The main problem with the high school students entering college is that most

of them are not prepared to start a life as a college student. In the following paragraphs, some of the approaches used to improve the retention of freshman students are summarized.

The most common approach is the introduction of a first year freshman course[1-4, 9-13]. The question behind this approach is: "What should be the content of this course"? Some universities address this question by teaching problem solving skills, complex numbers and matrix operations, PSpice and MATLAB, Communications Skills, Group Work, and by illustrating the different areas of electrical engineering. Other universities decide to have inside and outside classroom activities, teaching engineering problem solving, and have project designs.

Another approach followed by other universities is the creation of seminars that will provide the students with useful skills and knowledge about engineering[14-15]. For example, students are taught the basic survival skills: How to study, how to take notes and how to manage time between school obligations and social obligations. This approach has proven successful to quickly adapt the students to the college life.

The creation of mentoring programs[16-17] seems to be another option to these problems. The main drawback from this approach is the amount of time that needs to be invested and that it also requires a lot of resources, because either a faculty will be highly involved or students need to be hired for these mentoring positions. However, this option has proven to work at some extent and improved the performance of student.

Finally, there have been non conventional approaches trying to address retention. Some examples of these are the inclusion of freshman students to capstone design project[18], and the use of science of "science fiction films" and literature to help illustrate many common engineering concepts[19].

EENG 1301 - Engineering the Future

Previous Structure

Four years have passed since "EENG 1301 – Engineering the Future" was introduced in the fall of 2009. All freshmen electrical engineering students were signed up for the course. The course was composed by two lecture hours and three hours of laboratory. A single professor was not assigned to the course; instead, the lectures and laboratories were divided between the faculty members of the department to make it more dynamic for the students. Each professor was assigned to give lectures and laboratories related to his area of expertise or to advanced courses taught by the professor. This creates the perfect opportunity for each of the professors to interact with the student and encourage them to stay on the program by talking about advanced courses and the different areas in which they could specialize[20].

The lectures were taught assuming that the mathematical background of the students was at the level of high school algebra. As a result, some of the concepts presented to the students were

lowered in terms of the math required and the level of abstraction, but the general concepts and applications were still presented to the students. Furthermore, to increase the exposure to the profession of electrical engineering, speakers were invited to talk with the students about their experiences and the importance of electrical engineering outside the school. The students were given a final project based on a simple circuit that could be applied to real life to wrap up the semester. By this point in the semester, the students have acquired enough knowledge to understand the basic functionality of the circuit. Also, a basic description of how the circuit works is provided to them. The students were asked to create a working prototype on a breadboard. Once their prototype is working, they were asked to design the layout of a PCB and by using a LPKF milling machine create their own PCB for their final design.

The course lectures were divided into the following eleven main topics:

1. History, Dimensions and Units
2. Electrical Concepts and Components
3. Digital Systems
4. Electrical Engineering Tools and Communication Systems
5. Fiber Optics
6. Electronics
7. Power Systems
8. National Electrical Code
9. Data Analysis
10. Computer Engineering
11. Ethical Issues in Engineering

A main consideration while preparing these topics was that the focus of the course was not to make the students understand all the details from each topic. Instead, the objective was to expose them to these topics by keeping in mind that most of them do not possess the necessary knowledge on calculus and differential equations. Based on the amount of exposure that the student will receive on each of the topics, either two or three weeks were allocated for each topic. In addition to the two hours of lectures per week a three-hour laboratory was preformed once a week. This laboratory was directly related to the topic covered during the same week; in essence, the purpose of the laboratory was to apply the knowledge provided during the lecture and at the same time give them the opportunity to get some hands on experience related to the topic, so they can realize how those concepts are applied outside the lecture. The semester was concluded by creating teams of no more than four students; each group could select one project from a pool projects previously reviewed by the faculty members. The list of projects selected for the fall of 2011 is shown below:

- Audio Mixer
- Battery Powered USB Charger
- Electrocardiograph Amplifier
- Sine, Square, Triangle Generator

- Electronic Stethoscope
- Model Sports Car Lighting System
- Telephone Bug
- AM Radio
- Random Number Generator
- Siren Generator
- Spying Microphone
- Voice Changer

The teams were asked to build a prototype of the circuit on a breadboard. This gave the student the opportunity to apply the knowledge acquired during the semester about how to use the equipment and how to build a circuit. Once the prototype was fully functional and ready for production, they were asked to create a PCB layout based on their prototype. Using their layout and the LPKF milling machine available at the department, the students were able to create their own PCB in which they placed the components to obtain a final working product.

Finding an adequate textbook for the course was a great challenge. The faculty considered several textbooks for this course. The main problem that was encountered from all the books reviewed was that any of these books could cover all the required topics for the course. Some of the books covered the topics using math that was too advanced for a freshman. Some other books were not at the desired level. In summary, there was no book available that will satisfy all the objectives of this course.

After discussing by days about the best book for the course it was decided to try creating a custom textbook from Pearson[21]. The major advantage of the approach was the flexibility provided by including only the necessary topics and limiting the cost of the book. The custom book created for this course consisted of the following chapters:

Table 1. Chapter break-down of the custom book used for EENG 1301

Author	Title/Chapter
Fleddermann/Bradshaw	Electrical and Computer Engineering Specializations
Hagen	Dimensions and Units
Fleddermann/Bradshaw	Electrical Concepts and Components
Hagen	Electrical Circuits
Fleddermann/Bradshaw	Active Components and Integrated Circuits
Fleddermann/Bradshaw	Engineering Tools for Electrical and Computer Engineers

A second textbook on the National Electric Code (NEC) was added as a reference to inculcate a sense of belonging to the profession and the electrical engineering major. To evaluate the success of the course, the students were asked to fill out a survey at the end of the semester in which they

evaluate the effectiveness of the course to increase their understanding about electrical engineering and the profession.

New Course Structure

By the end of fall of 2011, some significant comments and observations about the course were given by the faculty and the students. The most significant comments are the following.

- The students felt that the course was not organized
- The students felt that the projects where not well prepared and a considerable amount of details were missing

After analyzing the comments it was concluded that they were based on small problems that were not previously observed by the faculty. Therefore, a series of changes were made to the course in order to fix the problems and allow the students to have a more enjoyable experience.

Course Outline

The course outline was revamped to show in detail the days and topics of the laboratory and lectures. The outline also showed when the tests are going to be applied and when the laboratory reports were due. This allowed the students to plan in advance how they organize their time. The aim was to create a feeling of organization and structure. The course outline and the assignment grid are shown in Tables 3 and 4 respectively.

Central Assignment Repository

One important change that was made to the course is the establishment of a specific location in which the students turned in their assignments. This location was the Electrical Engineering Office, in which a hanging-file-folder-box was placed with folders labeled for each assignment. In a similar way, the students were asked to pick up their assignments from the office once the announcement was placed in Blackboard. This will prevent the problem of students turning assignments to other professors or searching for the professor who assigned the work.

Establishment of a Departmental Template

In previous years, the faculty were allowed to use their own template to format their PowerPoint presentations and their exams. It was realized that this creates a feeling of a non-organized course, in which each professor is doing whatever he wants. Therefore, the department decided to establish a template used to develop the presentations and the exams. The professors were required to submit their final PowerPoint presentation and exams at least three days in advance in order to verify that they were using the template and upload all the necessary documents to blackboard. At the very beginning there was some struggle from the faculty to use the template, but eventually they accepted and kept everything in the same format.

Attendance

Many college professors, including myself believe that when a high-school student enters college magically their mentality switches into the one of a responsible college student. However, this is not what really happens. Most of these kids learn the hard way how college works and how to organize their time. The problem comes when they are given too much freedom, they will start missing lectures and laboratories, and soon enough they will be struggling and trying to catch up with the materials. For that reason, it was decided to take attendance. Some of the faculty opposed to this measure at the very beginning, but now they realized that by doing this most of the students stayed in track and were able to detect any problems with the students early in the semester. Also, the students get the feeling that the professors care about their well-being, and they are paying attention to their education.

Multisim, Ultiboard, Labview and myDAQ

One of the most significant changes to the course was the introduction of National Instruments software and hardware. Multisim was used to teach the students about circuit simulation and how to predict results from real circuits. It was seen that the students were able to catch up with this software quicker compared to PSpice. Also, the students were required to use the software in their final project. Ultiboard was used to develop Printed Circuit Boards (PCBs). The students learned how to use this software by first building a simple PCB circuit for a 555-Timer. Later, they used Ultiboard to design the PCB for their final project. LabView was introduced for the first time in the fall of 2012. With LabView, the students learned about virtual instruments, and the use of computers and data-acquisition cards to perform experiments. The implementation of the myDAQ is something that has been made all across the curriculum. Every student is required to buy a myDAQ, the idea is to allow students to learn about virtual instruments and perform laboratory experiments at home. In this course, the students learned how to use the myDAQ to perform measurements in simple circuits, and later they use it to build a prototype for their final project.

Final Project

In order to provide a good experience with the project it was decided to cut back in the amount of projects given to the students. Instead of giving them an option of 11 projects, a total of 5 projects were assigned. These projects were built and tested by the faculty and the teaching assistant to debug any potential problems that the students may face. Also, these projects were intended to make use of the myDAQ and LabView. The following projects were extracted from "Tinker, Learn, and Do Engineering With NI myDAQ." This reference contains a selection of projects designed to work with LabView and the myDAQ[22].

- Photogate Fun
- Music Synthesis
- Soda Bottle Symphony

- Karaoke Circuit
- Optical Theremin

The students were required to present a working prototype two weeks before the end of the semester. Once their prototype was approved, they were given green light to start working in designing the PCB using Ultiboard. The design of the PCB was submitted to the department for fabrication and returned to the students, so they can solder the components and start testing the final product. Lastly, the day of the final exam the students were asked to make a poster presentation to the faculty regarding their projects and their functionality. They were assessed base on the functionality of the PCB, the soldering of the components, and their level of understanding.

Transferability of the Course

Even though this course is team taught, because of the standardization of the course contents and materials. Transferring the course from one faculty member to another should be an easy task. Currently, all the materials including PowerPoint presentations, Quizzes, Laboratories, and Projects are stored at a central location in the department. This facilitates the distribution of the materials between the faculty.

Looking into the Future

Even when the content is taught at an algebra level, it is always mentioned that the material covered in this course is just an introduction, and the question about "Why it works the way it does?" will be eventually answered at each of the advanced courses. It is expected that this creates an interests in the students to continue learning about engineering and mathematics.

EENG 1301 as a recruiting tool

The University of Texas at Tyler is an open public institution with no admission requirements to the Electrical Engineering program. It is completely possible that if a student is interested in electrical engineering he/she can take this course without been enrolled in the program. However, at this point in time, the department has not considered the possibility of using this course as a recruiting tool.

Results

The inter-year retention rate for the BSEE program for the 2008-2009 academic years, based on data before the introduction of the freshman electrical engineering course was 54.8%. In the last offering of the course, a total of 30 students started in EENG 1301. From those, two students withdrew in the middle of the semester, and one student didn't pass the class. From the 27 students who passed 5 are not enrolled for the spring semester. This represents an 81% retention. Clearly, this course is having a huge impact on the retention of students compared to the retention rates from years before this course.

The course has been offered for four years, and enough data has been collected to analyze the impact of the course through a student survey with questions outlined in Tables 5 and 6. The figures in this section represent survey histograms with overlaying Gaussian distributions corresponding to the survey responses. The mean rating for each question is measured on the horizontal axis, while the amplitude of the normal distribution is represented on the vertical axis.

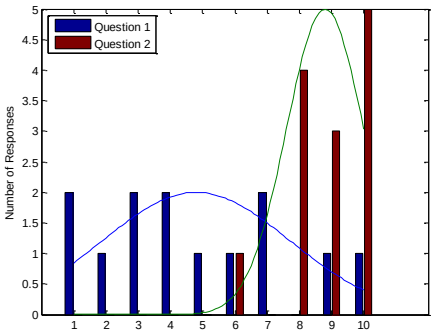
The students were given a survey composed of sixteen questions to evaluate the success of the course. The survey is given to the students the last week of the semester during class. The professor is required to leave the classroom while the students fill out the survey. Since some of the questions are reflective in nature, in the following years the authors will seriously consider modifying the survey methodology to include two surveys: one at the beginning of the class and one later. One of the major difficulties with this approach is to quantify and measure items like "knowledge of the area of electrical engineering" at the beginning of the course. The first six questions of the survey are committed to obtaining information about the amount of knowledge that the student possessed about electrical engineering before taking the course, how sure they were about becoming electrical engineers and how this course has improved that knowledge and their thoughts about becoming an electrical engineer. The survey questions represented by the graphs are listed below with a complete listing in Tables 5 and 6:

1. Your knowledge about the electrical engineering profession before taking the course
2. Your knowledge about the electrical engineering profession after taking the course?
3. Your confidence about becoming an electrical engineer before taking the course
4. Your confidence about becoming an electrical engineer after taking the course
5. Your knowledge about the areas within electrical engineering before taking the course
6. Your knowledge about the areas within electrical engineering after taking the course

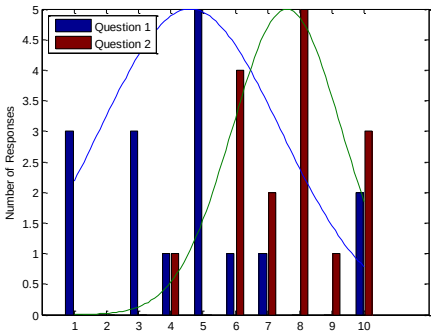
The summary of the data obtained from fall of 2009, 2010, and 2012 can be observed in Tables 5 and 6. (Unfortunately, the data from fall 2011 was lost, and no hard copies were found)

Figure1 represents the data obtained from questions one and two from the surveys of 2009, 2010, and 2012 respectively. It can be clearly seen that the knowledge about the electrical engineering profession has been highly increased thanks to the course.

Fall 2009



Fall 2010



Fall 2012

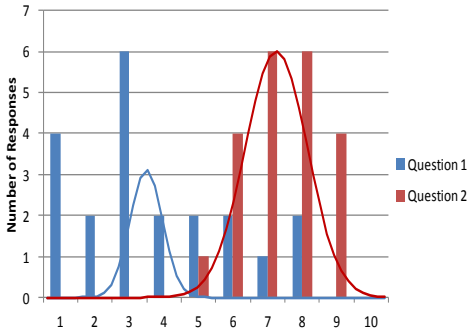


Figure 1. Rating of the knowledge (horizontal axis) about the profession of electrical engineering before and after the course. The dark line represent their knowledge before the course and the light line represents their knowledge after the course.

Figure 2 represents the data obtained from question 3 and 4. The objective of these questions is to assess the confidence of the students to become electrical engineers before and after this course. It can be clearly seen from these figures that the students feel more confident about their decision of becoming electrical engineers.

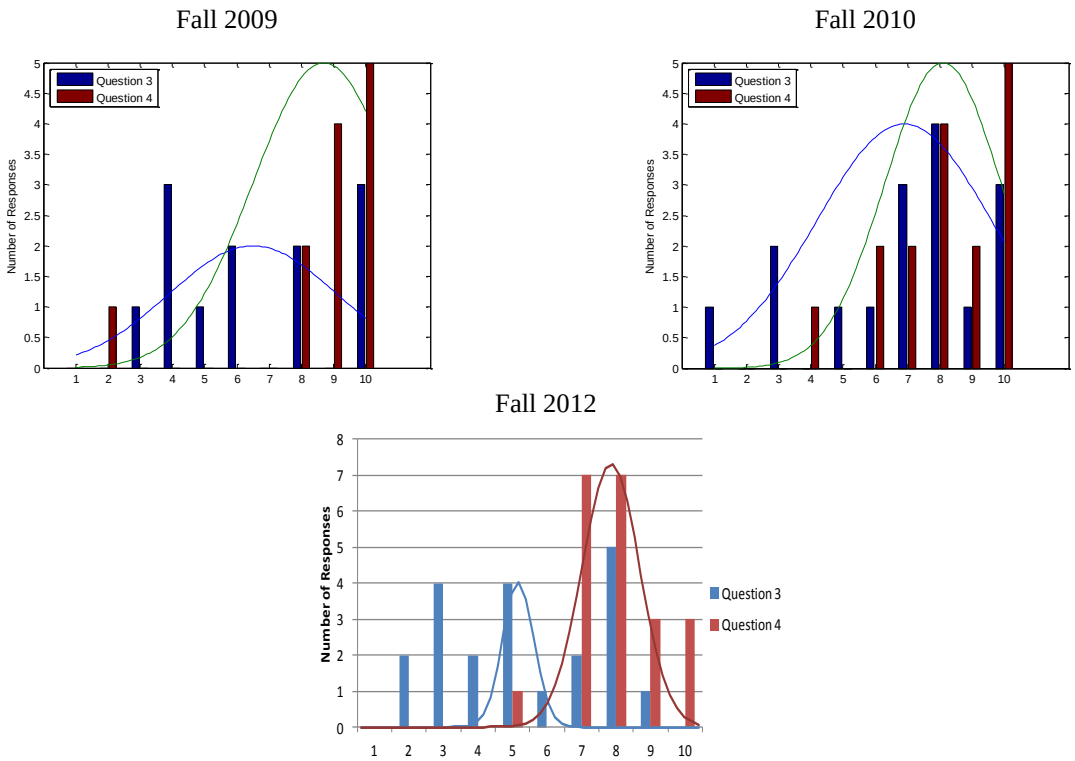


Figure 2. Rating of their confidence (horizontal axis) about becoming electrical engineering before and after. The dark line represent their confidence before the course and the light line represents their confidence after the course.

Finally, figure 3 represents the data obtained from questions 5 and 6. The objective of these questions is to assess how much knowledge the students acquired from the different areas of

electrical engineering. It is evident that the course is helping the students to understand more about the different areas of electrical engineering, helping them to realize a more informed decision about what they want to do once they graduate.

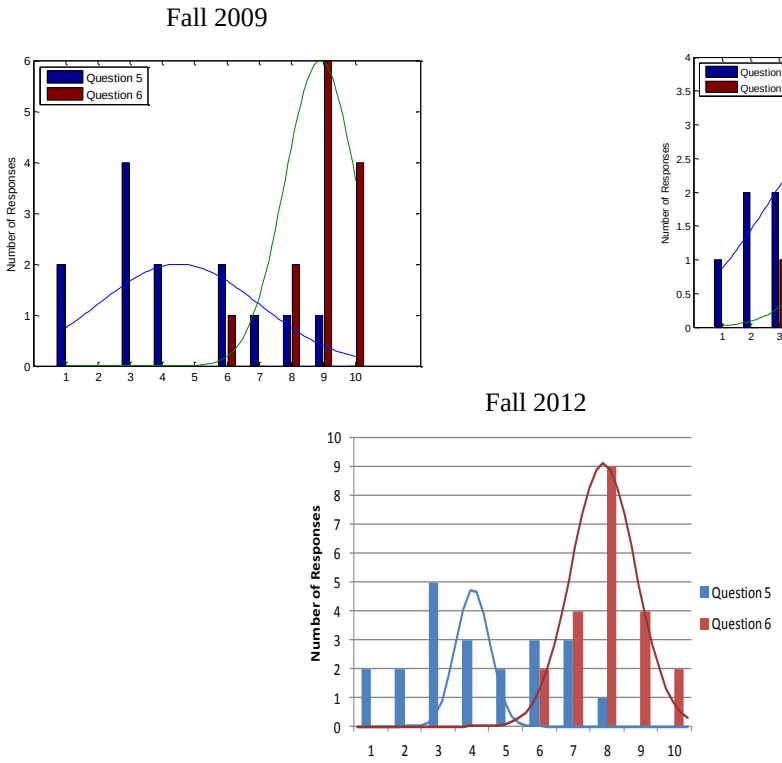


Figure 3. Rating of the knowledge (horizontal axis) about the areas within electrical engineering before and after. The dark line represent their knowledge before the course and the light line respresents their knowledge after the course.

In order to observe the significance of this data a T-Test was performed with a confidence level of 0.05. Table 2 presents the results from this analysis.

Table 2. T-Test analysis of the data from the 2009, 2010 and 2011 surveys.

Questions	T-Test	Confidence level	Degrees of freedom	Data from significance table	Conclusion
2009					
Q1 and Q2	4.69	0.05	24	1.711	Significant
Q3 and Q4	2.19	0.05	22	1.717	Significant
Q5 and Q6	5.80	0.05	24	1.711	Significant
2010					
Q1 and Q2	3.62	0.05	30	1.697	Significant
Q3 and Q4	1.55	0.05	30	1.697	Not Significant
Q5 and Q6	2.78	0.05	30	1.697	Significant
2012					
Q1 and Q2	6.59	0.05	40	1.697	Significant
Q3 and Q4	4.55	0.05	40	1.697	Significant
Q5 and Q6	7.25	0.05	40	1.697	Significant

The survey data clearly shows that the students are more engaged and enthusiastic about their profession as a result of the introduction to electrical engineering course. It can also be clearly seen by looking at the T-Test that the data is significant, except for one set of questions from 2010.

Furthermore, students have the opportunity to write comments regarding the course. The following is a list of some of the comments given by the students regarding the course and the faculty.

- I enjoyed getting to interact with the different faculty members. It's good to have exposure to the different teaching styles we will see in our course.
- The labs were the best part of the course because actually doing things with your hands teaches me more than sitting in lecture
- Using equipment and materials, hands-on applications make the things we learn tangible to us
- Getting in the lab and actually doing work I thought it was fun and a great way to get experience in the field
- Learning the technical aspect of the core parts of the EE professors

Graduation

This spring semester the first group of students that took this course is schedule for graduation. By looking at the seven students that passed EENG 1301only two of them dropped from the program. That means that 71% of the students that took this course as a freshman are receiving their degree in electrical engineering. It needs to be noted that in 2009 the EENG 1301 group was composed of 22 students. However, at UT Tyler approximately 40-50% of the students in the program are transfer students. By performing a similar analysis for the 2008 cohort that took EENG 1201 – Electrical Engineering I, from the four freshman students that started in the electrical engineering program none of them has graduated, two are schedule for graduation this spring semester and two drop out of the program. That represents a retention rate of 50% and a graduation rate of 0%.

Conclusions

The Department of Electrical Engineering at The University of Texas at Tyler, in an effort to increase student retention, created an introductory electrical engineering experience course that is offered during the first semester of the freshman year. The course has no prerequisite other than high school algebra and covers the following topics: History, Dimensions and Units; Electrical Concepts and Components; Electrical Engineering Tools; Introduction to Digital Systems, Communication Systems, Fiber Optics; Electronics, Power Systems and Computer Engineering; National Electrical Code; Data Analysis and Ethical Issues in Engineering. After surveying the available textbooks, the faculty designed their own custom textbook for this course. They have

also designed appropriate laboratory projects to meet course learning objectives. In addition, the students attend IEEE meetings and invited lectures from practicing engineers.

Four years have passed since "EENG 1301 – Engineering the Future" was introduced into the BSEE degree plan. Preliminary data shows that the retention rate has improved from 54.8% to 80%. The survey data also clearly indicate that the retained students are more engaged and enthusiastic about the profession. It can be safely concluded that the impact of this course is very positive. Also, by talking with the students and reading their comments it can be realized that the changes to the course had a positive effect improving the way in which the students feel about the course. In the following years data concerning graduation rates and retention rates directly affected by this course will be compiled and analyzed. It is expected that another update regarding this project will be presented in the years to follow.

References

1. H. Knickle, "Foundations of Engineering a First Year Course", Proceedings of the ASEE Annual Conference, Washington, DC 1996.
2. J. W. Pierre, F. K. Tuffner, "A One-Credit Hands-On Introductory Course In Electrical and Computer Engineering Using a Variety of Topics Modules", IEEE Transactions on Education, vol. 52, No. 2, May 2009.
3. Ronald Roth, "Improving Freshman Retention Through an Introduction to Engineering Design Course", Proceedings of the ASEE Annual, 2001, Albuquerque, NM 2001
4. Ruben Rojas-Oviedo, Dr. X. Cathy Qian, "Improving Retention of Undergraduate Students in Engineering through Freshman Courses", Proceedings of the ASEE Annual, Montréal, Quebec, Canada 2002
5. M. R. Anderson-Rowland, "Understanding Freshman Engineering Students Retention through a Survey", Proceedings of the ASEE Annual Conference, Milwaukee, WI, 1997
6. Ronald E. Barr, Thomas J. Krueger, Theodore A. Aanstoos, "Using Program Outcomes as a Curriculum Theme for an Introduction to Engineering Course", 35th ASEE/IEEE Frontiers in Education Conference, Indianapolis, IN 2005
7. D. Hall, H. Hegab, and J. Nelson, "Living with the Lab – Freshman Curriculum to Boost Hands-on Learning, Student Confidence and Innovation", 38th ASEE/IEEE Frontiers in Education Conference, Saratoga Springs, NY, 2008.
8. Mary R. Anderson-Rowland," The Effect of Course Sequence on the Retention or Freshmen Engineering Students: When Should the Intro Engineering Course be Offered?", 28th Annual Frontiers in Education, Vol. 1, 1998.
9. D. F. Mix, J. C. Balda, "ELEG 1003 – Introduction to Electrical Engineering: An Approach to Motivate and Teach EE Freshmen," 27th ASEE/IEEE Frontiers in Education Conference, Vol. 3, 1997.
10. C. Pomalaza-Ráez, B. H. Groff, "Retention 101: Where Robots Go…Students Follow," Journal of Engineering Education, January 2003
11. R. Sash, H. Detloff, B. Chen, N. Grandgenett, D. Duran, "Work in Progress: Retention of Freshmen Computer and Electronics Engineering Students," 36th ASEE/IEEE Frontiers in Education Conference, San Diego, CA, 2006
12. J. Y. Z. Wang, M. Saifi, "Teaching and Learning in Engineering Freshman Year," Proceedings of the 2001 ASEE Annual Conference and Exposition, 2001.
13. J. R. Parsons, J. E. Seat, R. M. Bennett, J. H. Forrester, F. T. Gilliam, P. G. Klukken, C. D. Pionke, D. R. Raman, T. H. Scott, W. R. Schleter, F. E. Weber, D. C. Yoder, "The Engage program: implementing an assessing a new first year experience at the university of Tennessee," Journal of Engineering Education, October 2002.
14. R. Montgomery, D. Follman, H. Diefes-Dux, "Relative Effectiveness of Different First-Year Engineering Seminars," 33rd ASEE/IEEE Frontiers in Education Conference, Boulder, Co, November, 2003.
15. R. Morsi, P. C. Smith, S. J. DeLoatch, " Student Success Seminars: A School Level Freshman Intervention Program," 37th ASEE/IEEE Frontiers in Education Conference, Milwaukee, WI, October 2007.

16. M. Shuman, J. Akerlund, D. Heer, T. Fiez, “Work in Progress – Implementing a Freshman Mentor Program,” 38th ASEE/IEEE Frontiers in Education Conference, Saratoga Springs, NY, October, 2008.
17. D. D. Budny, C. A. Delaney, “Working With Students and Parents to Improve the Freshman Retention,” 31st ASEE/IEEE Frontiers in Education Conference, Reno, NV, October, 2001.
18. W. S. Janna, J. I. Hochstein, M. Racer, A. Phillips, H. H. Lin, “Freshman-Senior Collaboration in a Capstone Design Course,” Proceedings of the ASEE Annual Conference and Exposition, 2002.
19. A. E. Segall, “Science Fiction in the Engineering Classroom to Help Teach Basic Concepts and Promote the Profession,” Journal of Engineering Education, October, 2002.
20. H. A. Ochoa and M. V. Shirvaikar, " The Engagement and Retention of Electrical Engineering Students with a First Semester Freshman Experience Course," Proceedings of the ASEE Annual Conference and Exposition, 2011.
21. http://www.pearsoncustom.com/
22. Tinker, Learn, and Do Engineering With NI myDAQ, Barry Paton, http://www.ni.com/white-paper/13639/en

Table 3. Semester schedule for the freshman electrical engineering course

WEEK	TOPICS COVERED	LECTURE (T)	LABORATORY	LECTURE (R)
1	Introduction, History, Dimensions and Units	Introduction - EE Areas	History of EE/Activity	Dimensions and Units, Greek Alphabet
2	Electrical Concepts and Components	Electrical Concepts and Components	Circuits - Breadboard, Resistor codes, Power Supply	Electrical Concepts and Components - Applications
3	Electrical Concepts and Components, Lab Reports	Report Writing	EE Lab Instruments - Multimeter, Scope, Function generator	EE Tools - Multisim
4	EE Tools, IEEE Meeting	EE Tools - Multisim	EE Tools - Multisim	IEEE Meeting, **Test 1**
5	Applications to Real Life	Resistor Problems	EE Tools - myDAQ	Applications to Real Life
6	Data Analysis	Data Analysis - Graphing	Introduction to Matlab/Simulink	Data Analysis - Statistics
7	Electronics	Electronics	Basic Electronics Lab - Soldering and Project	Electronics - Applications
8	EE Tools, Communication Systems	History of Communication Systems	EE Tools - Labview	Communication Systems Applications, **Test 2**
9	Digital Systems	Digital Systems	Basic Gates	Digital Systems Applications
10	Group Project, Complex Variables	**Group Project Kickoff**	Group Project Meeting	Introduction to Complex Variables
11	Power Systems	Power Systems	Basic Power Systems Lab - Motors, Generators	Power Systems - Applications
12	National Electrical Code	NEC	Group Project Meeting	**Invited Talk, Test 3**
13	Computer Engineering	History of Computer Engineering	PCB Layout Software - UltiBoard	Computer Engineering Principles
14	Computer Engineering	Computer Engineering Applications	Group Project - myDAQ Prototype Deadline, PCB Production	**Thanksgiving Holiday**
15	Ethics	Ethical Issues in Engineering	Group Project Meeting	IEEE Meeting, **Test 4**
16	Engineering Your Career	Engineering Your Career	Group Project Meeting	Project Demonstration

Table 4. Semester assignments grid for the freshman electrical engineering course

WEEK	START DATE	READING ASSIGNMENT	TEST SCHEDULE WITH TOPICS	LABORATORY REPORTS
1	20-Aug-2012	Chapters 1, 2, 13,14,15	**Test 1 – Thursday, September 13, 2012** Introduction, History, Dimensions and Units, Greek Alphabet, Electrical Concepts and Components	**Lab Report 1 - Circuits Laboratory** Due **Tuesday,** **September 11, 2012**
2	27-Aug-2012	Chapter 3		
3	3-Sep-2012	Chapter 4, 12		
4	10-Sep-2012	Chapter 6		
5	17-Sep-2012	Handouts	**Test 2 – Thursday, October 11, 2012** EE Tools, IEEE, Applications to Real Life, Data Analysis	**Lab Report 2 – EE Tools** Due **Tuesday,** **September 25, 2012**
6	24-Sep-2012	Chapters 7, 8, 9, 17		
7	1-Oct-2012	Chapter 5		**Lab Report 3 – Matlab/Simulink** Due **Tuesday,** **October 2, 2012**
8	8-Oct-2012	Handouts		**Lab Report 4 – Electronics Lab** Due **Tuesday,** **October 16, 2012**
9	15-Oct-2012	Chapter 5	**Test 3 – Thursday, November 8, 2012** Electronics, Communication Systems, Digital Systems, Complex Variables	
10	22-Oct-2012	Handouts		**Lab Report 5 – Digital Systems Lab** Due **Tuesday,** **October 23, 2012**
11	29-Oct-2012	Handouts		**Lab Report 6 – Power Systems Lab** Due **Tuesday,** **November 6, 2012**
12	5-Nov-2012	Handouts		
13	12-Nov-2012	Handouts	**Test 4 – Thursday, November 29, 2012** Power Systems, National Electrical Code Computer Engineering Computer Engineering Ethics	**Lab Report 7 – Computer Engineering Lab** Due **Tuesday,** **November 27, 2012**
14	19-Nov-2012	Handouts		
15	26-Nov-2012	Chapter 18		
16	3-Dec-2012	Chapter 10	**Group Project Presentation** **Thursday, December 6, 2012**	

Table 5. Summary of the student survey responses Fall 2009 and Fall 2010

Rate the following from Low to High	Fall 2009			Fall 2010		
	High	**Low**	**Avg.**	**High**	**Low**	**Avg.**
1. Your **knowledge** about the electrical engineering profession **before** taking the course	10	1	4.8	10	1	4.6
2. Your **knowledge** about the electrical engineering profession **after** taking the course?	10	6	8.8	10	4	7.6
3. Your c**onfidence** about becoming an electrical engineer **before** taking the course	10	3	6.5	10	1	6.9
4. Your c**onfidence** about becoming an electrical engineer **after** taking the course	10	2	8.7	10	4	8.1
5. Your knowledge about the **areas within electrical** engineering **before** taking the course	9	1	4.5	10	1	5.4
6. Your knowledge about the **areas within electrical** engineering **after** taking the course	10	6	8.9	10	3	7.8
7. How much has EENG 1301 helped you decide upon an area of specialization within electrical engineering?	10	2	7.5	10	5	8.3
8. How much has EENG 1301 helped you understand the fundamental principles of electrical engineering?	10	7	8.9	10	4	8.1
9. How much has EENG 1301 helped you understand the tools used in electrical engineering?	10	6	8.6	10	4	7.9
10. How much has EENG 1301 helped you during the current semester?	10	7	8.8	10	3	7.1
11. How much will EENG 1301 help you in the future?	10	5	8.9	10	4	8.4
12. How much has EENG 1301 helped you get in touch with the faculty members of the department of electrical engineering?	10	7	9.5	10	3	8.5
13. Rate the lectures in the course	10	8	9.5	10	5	8.1
14. Rate your laboratory experience in the course	10	8	9.5	10	5	8.4
15. Rate the exposure to professional societies like IEEE in the course and the invited talks by practicing engineers in the course	10	5	8.8	10	4	8.0
16. Would a three-hour lab only course (no lecture) be a preferable format for this course?	10	1	5.0	10	1	7.3

Table 6. Summary of the student survey responses Fall 2012

Rate the following from Low to High	Fall 2012		
	High	**Low**	**Avg.**
1. Your **knowledge** about the electrical engineering profession **before** taking the course	8	1	3.8
2. Your **knowledge** about the electrical engineering profession **after** taking the course?	9	5	7.4
3. Your c**onfidence** about becoming an electrical engineer **before** taking the course	9	2	5.4
4. Your c**onfidence** about becoming an electrical engineer **after** taking the course	10	5	8.0
5. Your knowledge about the **areas within electrical** engineering **before** taking the course	8	1	4.3
6. Your knowledge about the **areas within electrical** engineering **after** taking the course	10	6	8.0
7. How much has EENG 1301 helped you decide upon an area of specialization within electrical engineering?	10	2	7.0
8. How much has EENG 1301 helped you understand the fundamental principles of electrical engineering?	10	5	7.5
9. How much has EENG 1301 helped you understand the tools used in electrical engineering?	10	5	8.2
10. How much has EENG 1301 helped you during the current semester?	10	3	7.3
11. How much will EENG 1301 help you in the future?	10	1	7.2
12. How much has EENG 1301 helped you get in touch with the faculty members of the department of electrical engineering?	10	6	8.9
13. Rate the lectures in the course	10	5	7.9
14. Rate your laboratory experience in the course	10	6	8.5
15. Rate the exposure to professional societies like IEEE in the course and the invited talks by practicing engineers in the course	10	3	7.8
16. Would a three-hour lab only course (no lecture) be a preferable format for this course?	10	1	6.1