

How the Capstone Class Students Perceive Their Knowledge Base?

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Abstract

The Capstone Course is a 5-credit Research and Development course covering all aspects of project development and implementation, entrepreneurship, innovation, creativity, team-work, and communication. The philosophy behind the course is to provide training and real-world, small-scale project experience for the students. This is where students work in teams and apply the culmination of their knowledge in the program. The paper presents how students in the capstone class perceive their knowledge base. This self-assessment is conducted in the first day of the class and the second one is conducted after the final examination. In addition, instructors ask knowledge-base questions, questions regarding the work experience, hours worked, credit hours taken currently, membership in professional organizations, expected date of graduation, and expectations from the course. Additional comments on strengths and weaknesses of the course represent the qualitative questions. The analysis of the information gathered at the beginning of the semester helps the management team to understand the composition of each team, their strengths and weaknesses, how much each team member can contribute to their team, whether the combination of hours worked and credit hours taken are in line with the UH guidelines, etc. During the first week of the semester, once the results are tallied, one-on-one meetings were held with the students that were identified as having potential conflicts and who realized to have time constraints. Timely advice is given to these students so that they are successful to complete the course. Once the results of the self-knowledge at the end of the semester are tallied, they are compared to the results at the beginning of the semester, conclusions are drawn, and action items are identified that can help the curriculum remain current and in focus.

Introduction

The Capstone class in its present format can accommodate a maximum of 48 students. It is presently a one full semester long course. The students work in teams of four or else a team of three students (due to enrollment issues). Students are provided the freedom to choose their team members. Two student surveys are conducted during the start of the

session – a self-assessment survey and a time block survey. The first survey is a self-assessment of the student's knowledge in this field and also gives information about their work schedule. The second is a time block survey for deciding the open lab hours (hours outside the normal class and lab hours). As a result, students can make a proper schedule for their work and utilize better time management. The work schedule is necessary to avoid employment conflicts since most of the students work either part time or full time. The lab presently has five graduate students, who are hired through an intensive interview process and are provided training and orientation for their jobs.

The Resources for Students to Perceive Knowledge

The capstone class provides various resources which aid the students to perceive knowledge. These resources are very well standardized and distributed over the entire semester which ensures the complete and continuous learning of the students. These resources are

Senior Project Course Components [1-4]

Books- Two books are assigned in the course. One on engineering design and the other covers creativity. Reading assignments are given routinely.

Lectures- Nine lessons are presented in the class. The lectures are synchronized with the two books and are supplemented with additional information. The lectures are presented in the form of discussions rather than the traditional lectures. The first lesson is an overview of the entire course. Students have access to the lecture notes through the course web portal, discussed later.

Homework- Each semester, there are four to five homework assignments. The homework has five to six questions and students work on the homework individually. Each homework is design to address specific knowledge requirements and often are open ended. Most assignments require a degree of research and they are drawn from the author's years in the industries and consulting for the high-tech companies.

Exams- Closed book and notes midterm exam and final exam is given. Most questions are from the two books, lessons, guest speaker presentations and workshops which ensures and tests their grasp on the contents.

Workshops- Three workshops are given at the beginning of the semester. The first workshop is a three-hour hands-on training to use the Microsoft Project. The Microsoft Project is used for Gantt chart to track teams' progress and is conducted by the Information Technology trainer at the University of Houston. In the second workshop, students are introduced to the UH policies regarding intellectual property and patent. The workshop is conducted by the office of Research and Intellectual Property Management. The third workshop is on research in technical and science libraries and is presented by the College of Technology Librarian.

Guest Speakers-The guest speaker series is designed to introduce students to the real world challenges. The speakers are engaged in the cutting edge of their industry. They often bring in a new perspective to the senior project. A few of the speakers are members of the ET industrial advisory board and are familiar with the curriculum and provide valuable feedback for the improvement of the senior project course. Others are entrepreneurs and CEOs and enlighten the students by discussing the success of their companies. These guest speakers influence the students a lot as they not only learn about the various phases of project cycle but are also exposed to the latest trends in the technical fields.

ET Faculty Speakers- Volunteer faculty members who are interested in mentoring students present their research and expertise. A separate policy governs the ET faculty mentorship.

Laboratory Assistants Presentations- All assistants assigned to the course are formally introduced to the students. Each assistant makes a short presentation and students will get to know them and understand the areas of their expertise. These presentations often give an idea to the students regarding their project topic and help them to learn from their experiences.

Progress Reports- Each team submits a weekly progress report. Specific guidelines and requirements are provided to the students. The format of these reports follows strict industry standards which enhance their technical writing skills

Project Proposal- The project proposal consists of a presentation and report. Each team must clearly address the following items in their presentation and report:

- Benefits of the product or process to the end customer
- Project objectives tied to the project specifications
- Strategy for achieving project objectives
- Detail plan of action divided into a number of tasks to be performed by individual member of the project team to achieve the project objectives
- Time schedule depicting weekly progress and individual/team assignments
- Cost analysis
- Design verification procedures
- Procedures to quantify prototype performance

Final Project- The final project consists of a presentation, report and prototype demonstration. This is the most exciting event for the students and the department. UH Faculty, industry guests, staff and other students are present during the presentation and demonstration. The report consists of an Executive Summary, Newsletter, Product Requirements, Design Specifications & Description, Construction Details, Cost Analysis, User Instructions, etc. Multiple assessment forms are used during this event.

The above components were used as an essential component in the senior project lab for Fall 2007 semester and we have noticed marginal increases in various inter-personal,

technical as well as management skills of the students. The data is categorized in the following areas

- Real Project Experience
- Customer Interaction
- Research Skills
- Writing Skills
- Presentation Skills
- Hardware Skills
- Leadership Skills
- Team Player Skills
- Professional Ethics

The following data is taken in form for a carefully designed **Beginning of the Semester Survey** [See Appendix 1] and **End of the Semester Survey** [See Appendix 2]. These surveys provide the data and metrics to measure the growth of the students in the above mentioned skill areas and gives a direct estimate of the knowledge perceived by the students.

Real Project Experience

This class provides them an environment similar to real industrial environment. They do apply the theoretical concepts learned by them to real hardware and software designing of the products. This lab demands the students to be very professional, and helps them in making a transition from student life to professional life. The real project experience clearly shows a growth from the Figure 1. Almost for all the teams there is an increase in the experience for the project.

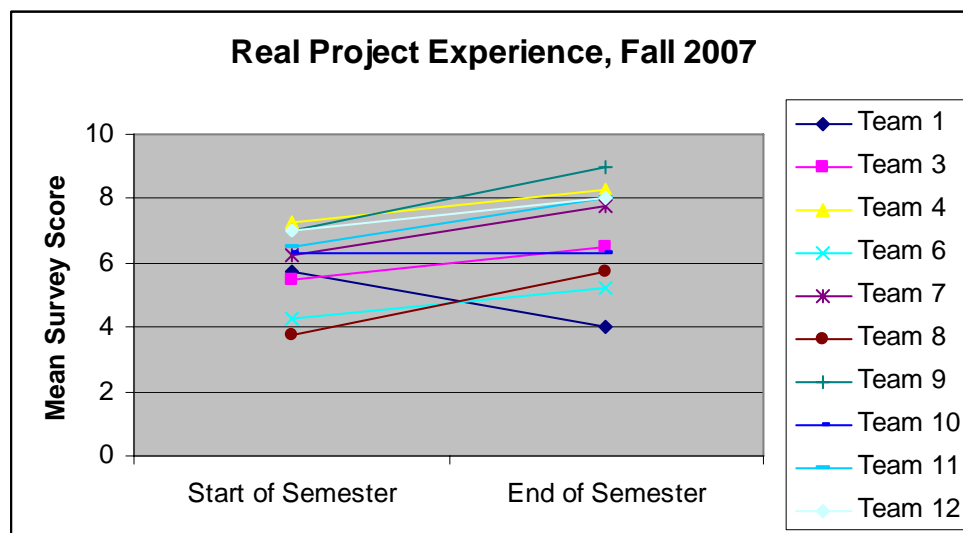


Figure 1: Real project experience. [See Appendix 3]

Customer Interaction

It is very necessary to have interaction with the customer, to know if the product is feasible, is there a real need for the product and what the customers actually want, will the product sell in the market and what is the probability of making it a success. The customer feedback forms the initiating force for the formation/making/designing of a product. The students are suggested to look for customers for their products. The statistics are depicted in Figure 2.

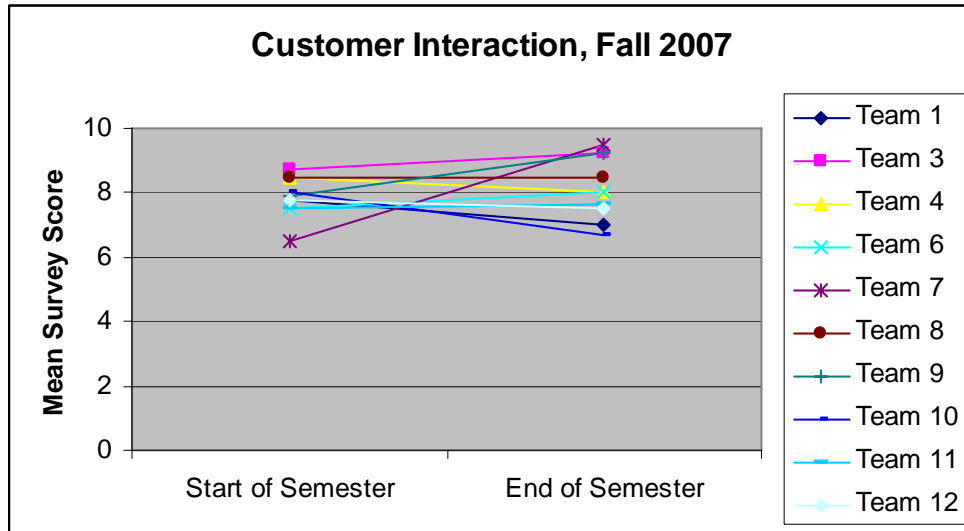


Figure 2: Customer Interaction. [See Appendix 3]

Research Skills

Research is the backbone for making a new product. Research is required at every stage of product cycle from the initial brainstorming to making the final product and even to market it. The students are given a library session to help them in researching ideas for their projects through databases, patents, books, online articles. As is evident from Figure 3 there is enrichment in their research skills.

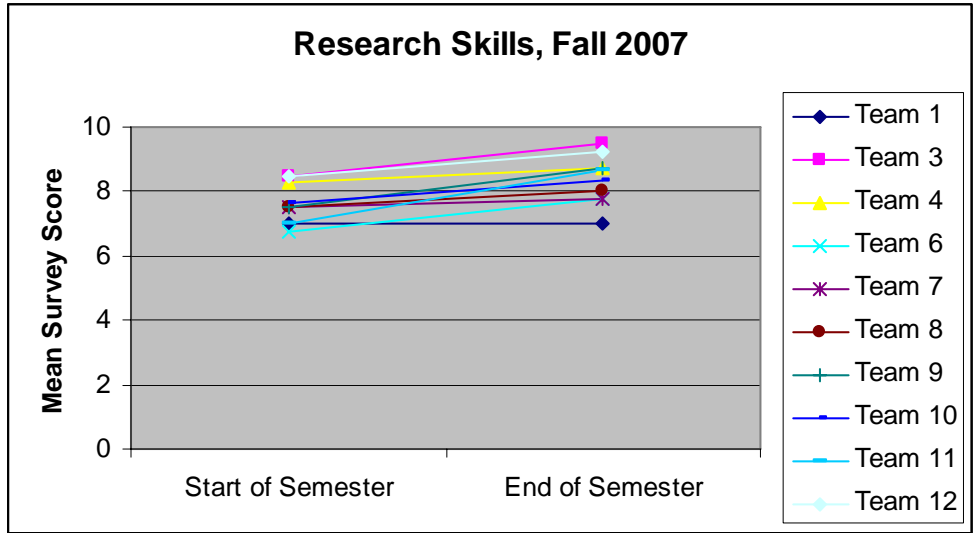


Figure 3: Research Skills. [See Appendix 3]

Writing Skills

If you are able to convey what you want to say to the readers then your work is almost done. The writing skills play an important role in professional life. The students are made to write Weekly Progress Reports, including what they accomplished last week, what is their plan for the next week, what problems they are facing in the project. Figure 4 depicts the improvement in writing skills of the students from start to end of the semester. The students also write the proposal reports and the final project reports (which is an in-depth description of their whole project).

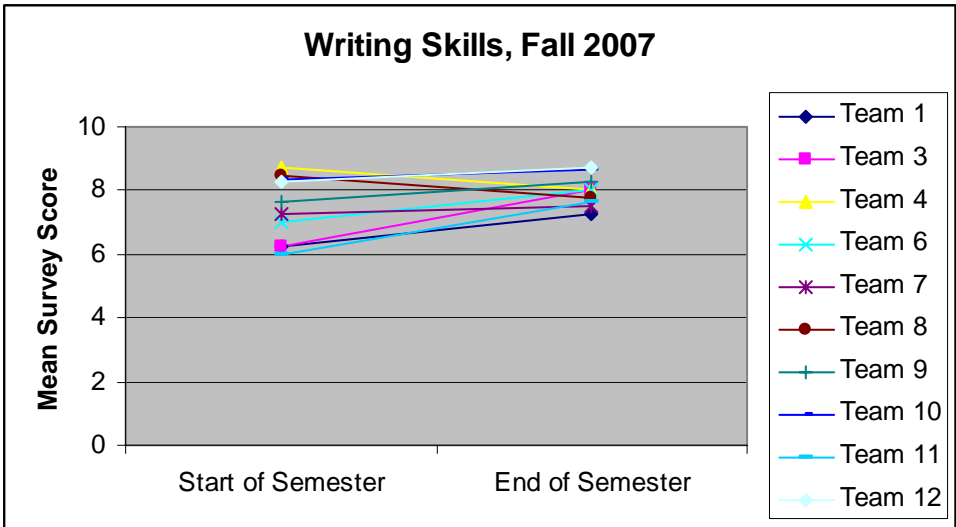


Figure 4: Writing Skills. [See Appendix 3]

Presentation Skills

Presentation skills are the gateway to communicate with others. This is the way you make others understand what your project actually is, how does it work, what are its features and what will be its applications? The students give a proposal presentation once they have come up with a final idea and they also give a final presentation after the completion of their project. They also present a demonstration of their final prototypes. The increase in this area of skill set is shown in Figure 5.

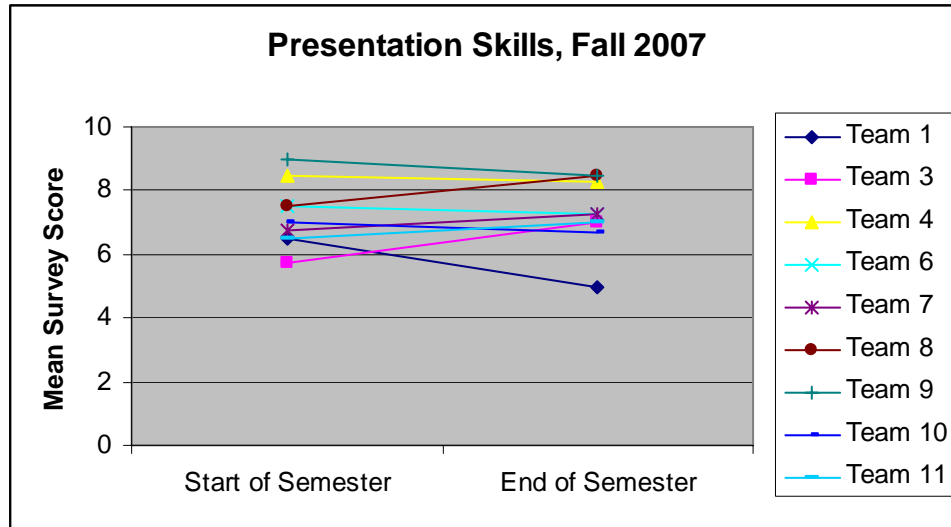


Figure 5: Presentation Skills. [See Appendix 3]

Software Skills

The software skill is an integral part of the project in this lab. The various skills learned by students are applied by them to a real project in this lab. Their skills are enhanced as the semester progresses, as can be seen from Figure 6 They are provided with hands on training on MS Project.

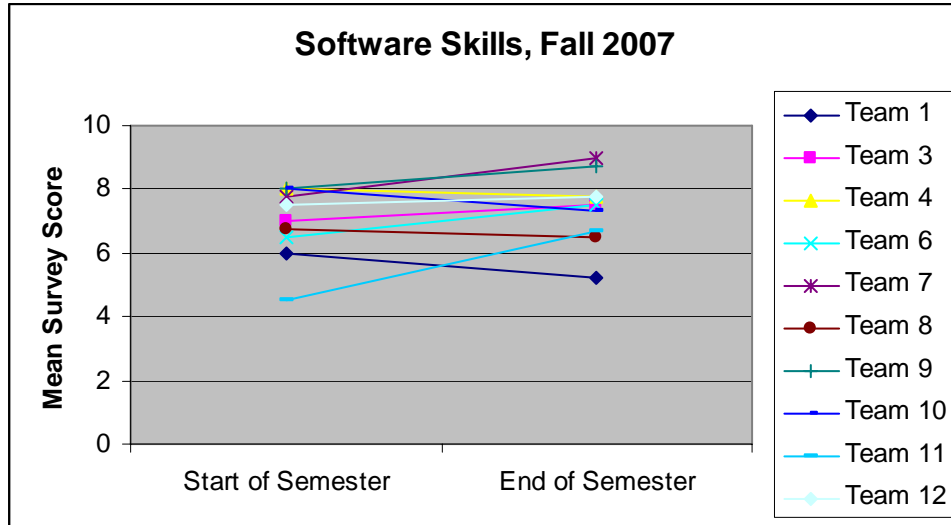


Figure 6: Software Skills. [See Appendix 3]

Hardware Skills

The hardware skill is an indispensable component of the senior project lab. The students need to integrate the hardware and software for successful completion of their project. As is clear from Figure 7 they show remarkable progress in their hardware skills.

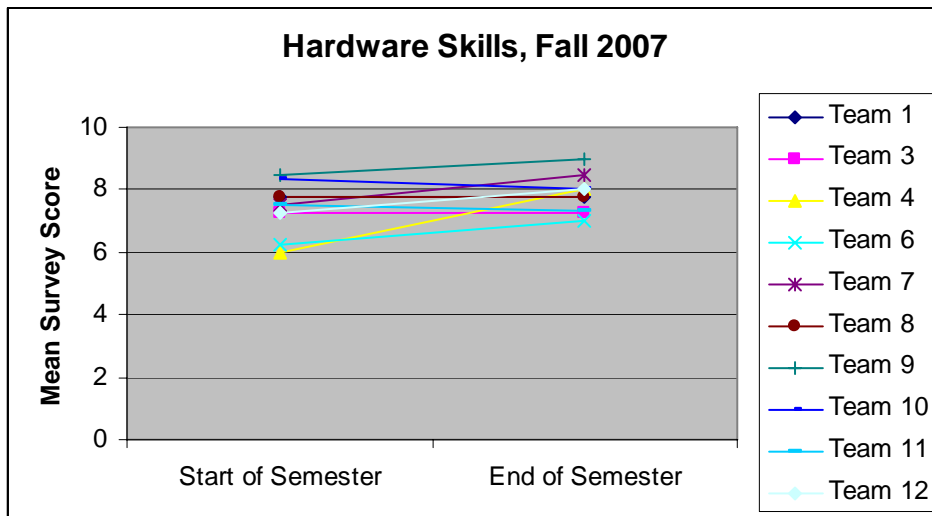


Figure 7: Hardware Skills. [See Appendix 3]

Leadership Skills

Every group has to choose a group leader among them. The leader decides the line of action for the group with suggestion from other members. The capstone course induces some good and prominent leadership skills in everybody. This can be seen in the statistics of Figure 8.

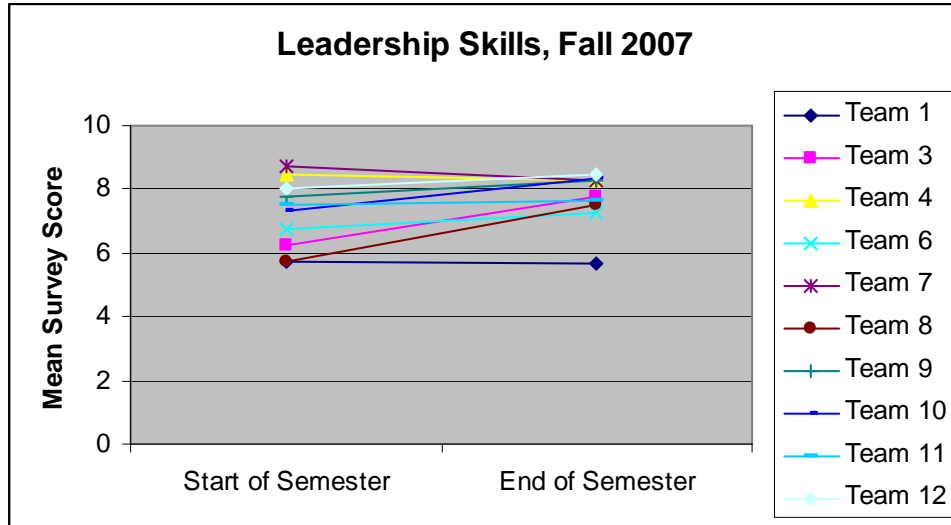


Figure 8: Leadership Skills. [See Appendix 3]

Team Player

A team is a group of people who come together to achieve a common goal. Students form a team of four for their project work and then they have to work together as one team to achieve their goal. All members need to be good team players for better coordination among themselves and success of their work. If there is a rift amongst them then they can lag behind the desired schedule. As apparent from Figure 9 there is a consistent rise in team work.

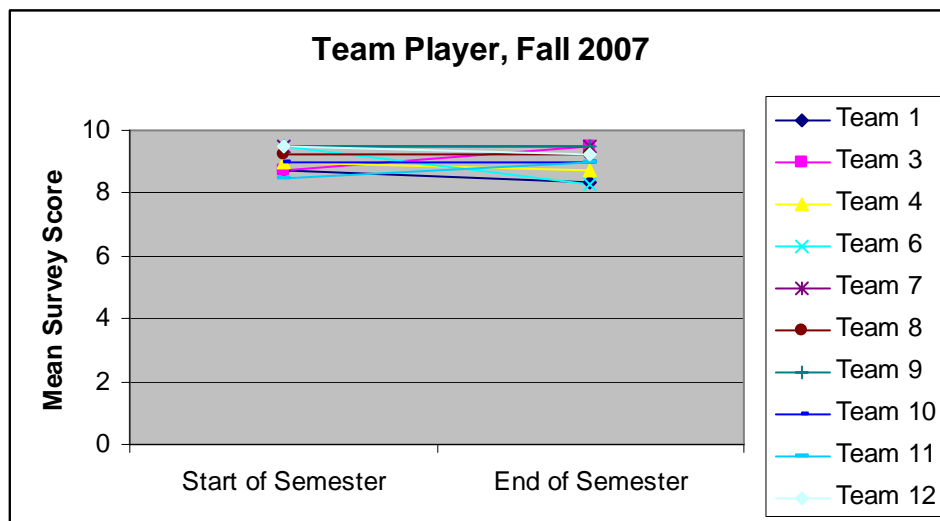


Figure 9: Team Player. [See Appendix 3]

Professional Ethics

This lab is like an industry run by professionals for making professionals. Professional ethics is embedded in the working environment of this lab. The students become more professional as they the semester moves on as can be seen from Figure 10.

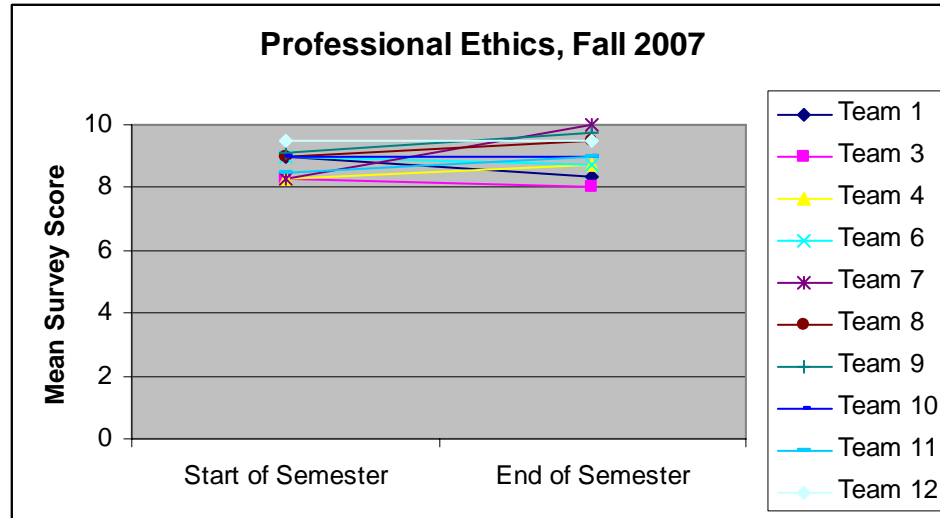


Figure 10: Professional Ethics. [See Appendix 3]

Conclusion

This paper presented the results of how students perceive their knowledge at the beginning and at the end of the semester in the capstone course at their senior level. The surveys were developed by the course instructor and the teaching assistants collected and compiled the data into spreadsheets, and finally the director of assessment and accreditation analyzed the data. The pattern obtained through the analysis seemed to be consistent with some minor glitches but overall revealed where the strengths and weaknesses of the students were and take corrective actions in the prerequisite courses. This is part of the departmental goals to continuously monitor the curriculum and use the capstone class as the final stage of students' educational experience.

References

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4. Attarzadeh, Farrokh, Gurkan, Deniz and Benhaddou Driss, "Innovative Improvements to Engineering Technology Laboratory Education to Engage, Retain and Challenge Students of the 21st Century," *Proc. of the 2006 ASEE Gulf-Southwest Annual Conference*, Southern University and A&M College, Baton Rouge, LA.

Biographies

FARROKH ATTARZADEH

Dr. Attarzadeh is an associate professor in the Engineering Technology Department, College of Technology at the University of Houston. He teaches software programming, operating systems, digital logic, and is in charge of the senior project course in the Computer Engineering Technology Program. He has developed a concept referred to as EMFA (Electromechanical Folk Art) as a vehicle to attract young students to the STEM fields. He is the Associated Editor for student papers at *the Technology Interface* (<http://engr.nmsu.edu/~etti/>), Manuscript Editor for the *International Journal of Modern Engineering* (IJME, <http://www.ijme.us/>), and Conference Associate Chair for the *IJME-NAIT Joint International Conference* (http://www.ijme.us/IJME_Conference_2008/index.htm). He is a member of ASEE and has been with the University of Houston since 1983.

ENRIQUE BARBIERI

He received a Ph.D. in Electrical Engineering from The Ohio State University in 1988. He joined Tulane University where he served on the faculty of the Electrical Engineering Department (1988-96) and was a tenured Associate Professor and Chair of the Electrical Engineering & Computer Science Department (1996-98). In 2002 he joined the University of Houston as Professor & Chair of the Department of Engineering Technology. His research interests are in control systems and applications to electromechanical systems. He is a member of IEEE and ASEE and Chairs the Executive Council of the Texas Manufacturing Assistance Center.

MIGUEL A. RAMOS

Miguel A. Ramos is the Director of Assessment and Accreditation Services for the College of Technology at the University of Houston. He earned a Ph.D. in Educational Research, Measurement and Evaluation from Boston College in 2004. Dr. Ramos has worked as Program Evaluator for Boston Connects, a school-community-university partnership designed to address non-academic barriers to school success via a web of coordinated health and social service resources in ten public elementary schools. He has also worked as a federal education researcher for the Southwest Educational Development Laboratory evaluating the effectiveness of reform models developed to improve student academic performance by enhancing systemic coordination of academic resources. In addition, Dr. Ramos has served as a consultant in a variety of contexts investigating a range of issues including program effectiveness, organizational communication, assessment and public policy, and research methodology.

ANKUR SHUKLA

Ankur Shukla is currently pursuing his Masters in Computer Science (Majoring in Software Engineering) from the College of Natural Sciences & Mathematics, University of Houston and plans to graduate in Summer 2008. He is interested in the field of Software Engineering and IT Project Management and Enterprise Application Development. He is a Teaching Assistant in the department of Engineering Technology.

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Mayuri Mahajan is currently pursuing her Masters in Electrical Engineering (Majoring in Signal Processing) from the Cullen College of Engineering, University of Houston and plans to graduate in Summer 2009. She is interested in the field of Sound and Image processing, Internetworking, Digital design and Telecommunications. She is a Teaching Assistant in the department of Engineering Technology.

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Aditya Gupta is currently pursuing his Masters in Electrical Engineering from the Cullen College of Engineering, University of Houston. He plans to graduate in summer 2009. He is interested in VLSI Circuit Design, Layout, Verification and Testing. He is a Teaching Assistant in the Department of Engineering Technology.

Appendix 1

ELET 4308/ELET 4208 Senior Project Class Self-Knowledge Survey Fall 2007 – At the Beginning

Name: _____ E-mail: _____
Major: _____ Minor: _____
Daytime Phone: _____ Employer: _____

1. The senior project class tracks student performances over several years. Please state if you have taken any of the courses listed below as a *pilot* or *full deployment* through the CLABS initiative. Please check appropriate boxes below if it applies to you

- | | | | | | | | |
|--------------------------|-------------------------|--------------------------|-------|--------------------------|-----------------|--------------------------|------|
| <input type="checkbox"/> | ELET 1100 (DC lab) | <input type="checkbox"/> | Pilot | <input type="checkbox"/> | Full deployment | <input type="checkbox"/> | None |
| <input type="checkbox"/> | ELET 1101 (AC lab) | <input type="checkbox"/> | Pilot | <input type="checkbox"/> | Full deployment | <input type="checkbox"/> | None |
| <input type="checkbox"/> | ELET 2103 (Digital lab) | <input type="checkbox"/> | Pilot | <input type="checkbox"/> | Full deployment | <input type="checkbox"/> | None |

2.

- Working fulltime
- Working part-time
- Not working

If working, provide a brief job description.

Hours worked per week? _____ On Campus or off campus? _____
Credit hours enrolled this semester? _____
Expected date of graduation? _____
Plan to go to a graduate school? _____
If yes, when, where, and what field (please explain)? _____

3. In this class, all students are resources. What are some of your abilities/strengths as they might relate to this class?

4. What are some of your weaknesses or areas you would like to improve?

5. What are you most interested in learning from this class?

6. Are you currently working on a project or have you recently completed one? Please describe the project below.

7. For the senior design project, team members will need skills in several areas. Please rank yourself on a scale of 1 to 10 (10 being best) on each of the skills listed below.

	Scale (1-10)
<input type="checkbox"/> Real project experience	_____
<input type="checkbox"/> Customer interaction	_____
<input type="checkbox"/> Research skills	_____
<input type="checkbox"/> Writing skills	_____
<input type="checkbox"/> Presentation skills	_____
<input type="checkbox"/> Software skills (project management software & programming software(C/C++, Assembler)	_____
<input type="checkbox"/> Hardware skills	_____
<input type="checkbox"/> Web site creation	_____
<input type="checkbox"/> Leadership	_____
<input type="checkbox"/> Team player	_____
<input type="checkbox"/> Your understanding of professional ethics	_____
<input type="checkbox"/> Your training skills	_____
<input type="checkbox"/> Your mentoring skills	_____
<input type="checkbox"/> Knowledge working with K9 or under students	_____
<input type="checkbox"/> Knowledge working with K10-K12 students	_____
<input type="checkbox"/> Knowledge of robotics	_____
<input type="checkbox"/> Knowledge of sensors	_____
<input type="checkbox"/> Interest in working with 9-16 years old	_____

8. Are you a member of IEEE? Yes No

9. Expected graduation date _____.

10. List your questions, concerns, or comments about this course here.

ACADEMIC HONESTY:

I have read and understand the policies regarding academic honesty. I understand how they apply to the senior project class (ELET 4308/ELET 4208), and I pledge myself to abide by the policies and work to create an atmosphere of academic integrity on the campus.

Signature: _____ Date: _____

Appendix 2

ELET 4308/ELET 4208 Senior Project Class Self-Knowledge Survey Fall 2007-End of the Semester

Name: _____ E-mail: _____
Major: _____ Minor: _____
Daytime Phone: _____ Employer: _____

Are you a Transfer Student? _____, If yes, where from and when? _____

1.

- Working fulltime
- Working part-time
- Not working

If working, provide a brief job description.

Hours worked per week? _____ On Campus or off campus? _____

2. Answer each of the following questions

Credit hours enrolled this semester? _____
Expected date of graduation? _____
Plan to go to a graduate school? _____
If yes, when, where, and what field (please explain)?

3. In this class, all students are resources. What was some of your abilities/strengths as they related to this class?
4. What were some of your weaknesses at the beginning of the semester and areas you had improved?

5. What were the most interesting concept, subject, and experience that you learned and gained in this class?

6. Are you currently working on a project (besides the senior project) or have you recently completed one? Please describe the project below and explain your role on this project.

7. For the senior design project, team members were required to have certain skills and knowledge in several areas. Please rank yourself on a scale of 1 to 10 (10 being best) on each of the knowledge and skills listed below.

	Scale (1-10)
<input type="checkbox"/> Real project experience	_____
<input type="checkbox"/> Customer interaction	_____
<input type="checkbox"/> Research skills	_____
<input type="checkbox"/> Writing skills	_____
<input type="checkbox"/> Presentation skills	_____
<input type="checkbox"/> Software skills (project management software & programming software)	_____
<input type="checkbox"/> Hardware skills	_____
<input type="checkbox"/> Web site creation	_____
<input type="checkbox"/> Leadership	_____
<input type="checkbox"/> Team player	_____
<input type="checkbox"/> Your understanding of professional ethics	_____

8. Are you a member of IEEE? Yes No
If yes, please state what you did this semester for IEEE.

9. Are you a member of any other organizations? If yes, please list them below and explain what you did for each organization this semester.

10. List any questions, concerns, or comments here.

Appendix 3

- **Real Project Experience:** Refer Excel Sheet “ELET 4308 Beginning and End Semester Survey Fall 2007”, Sheet 5, Figure 1 & Figure 2 extracted from column B112-B121 and C112-C121 respectively.
- **Customer Interaction:** Refer Excel Sheet “ELET 4308 Beginning and End Semester Survey Fall 2007”, Sheet 5, Figure 3 & Figure 4 extracted from column E112-E121 and F112-F121 respectively.
- **Research Skills:** Refer Excel Sheet “ELET 4308 Beginning and End Semester Survey Fall 2007”, Sheet 5, Figure 5 & Figure 6 extracted from column H112-H121 and I112-I121 respectively.
- **Writing Skills:** Refer Excel Sheet “ELET 4308 Beginning and End Semester Survey Fall 2007”, Sheet 5, Figure 7 & Figure 8 extracted from column K112-K121 and L112-L121 respectively.
- **Presentation Skills:** Refer Excel Sheet “ELET 4308 Beginning and End Semester Survey Fall 2007”, Sheet 5, Figure 9 & Figure 10 extracted from column N112-N121 and O112-O121 respectively.
- **Software Skills:** Refer Excel Sheet “ELET 4308 Beginning and End Semester Survey Fall 2007”, Sheet 5, Figure 11 & Figure 12 extracted from column Q112-Q121 and R112-R121 respectively.
- **Hardware Skills:** Refer Excel Sheet “ELET 4308 Beginning and End Semester Survey Fall 2007”, Sheet 5, Figure 13 & Figure 14 extracted from column T112-T121 and U112-U121 respectively.
- **Leadership Skills:** Refer Excel Sheet “ELET 4308 Beginning and End Semester Survey Fall 2007”, Sheet 5, Figure 15 & Figure 16 extracted from column Z112-Z121 and AA112-AA121 respectively.
- **Team Player:** Refer Excel Sheet “ELET 4308 Beginning and End Semester Survey Fall 2007”, Sheet 5, Figure 17 & Figure 18 extracted from column AC112-AC121 and AD112-AD121 respectively.
- **Professional Ethics:** Refer Excel Sheet “ELET 4308 Beginning and End Semester Survey Fall 2007”, Sheet 5, Figure 19 & Figure 20 extracted from column AF112-AF121 and AG112-AG121 respectively.

The contents of the above references will be provided upon request.