

## **Tapping Indigenous Resources to Enhance the Decision Making Process in Senior Projects**

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### **Abstract**

Case studies are proven techniques to enhance the learning skills and the level of class participation in the project-oriented courses. Typical case study exercise involves reading the problem, forming student teams, research on the relevant technical and business aspects, preparing for the presentations, and finally the deliberations. Students have to make decisions at every stage of the case study. Several engineering case studies have been developed under the National Science Foundation (NSF) funded projects and are available for adaptation and implementation. One such case study based on electrical utility failure was implemented in the senior project course. Large percentage of students, who participated in the senior project course, have been working full time and thus had gained experience in decision-making. The success of the senior project was influenced by active participation from these students, who shared and applied their experience in the decision making for their team's role in the case study. Thus, these working students became a valuable resource to other students in the team and enriched the learning process as a whole. The participating students filled a questionnaire. Preliminary analysis of the students' response supported above conclusion.

### **Introduction**

In the US Accreditation Board for Engineering and Technology (ABET)<sup>1</sup> evaluates the quality, content, and success of the undergraduate engineering and engineering technology programs. Two commissions within ABET are called the Engineering Accreditation Commission (EAC) and the Technology Accreditation Commission (TAC) for Engineering programs and Technology programs respectively. As a coordinator of the Electrical Engineering Technology

program at the Prairie View A&M University (PVAMU), I had an opportunity to prepare and present our program for accreditation to the TAC-ABET evaluators last fall.

The program outcomes are described in the 'Criteria for Engineering Technology Programs'<sup>2</sup>. An Engineering Technology program must demonstrate that graduates have:

- (a) an appropriate mastery of the knowledge, techniques, skills and modern tools of their disciplines,
- (b) an ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering and technology,
- (c) an ability to conduct, analyze and interpret experiments and apply experimental results to improve processes,
- (d) an ability to apply creativity in the design of systems, components or processes appropriate to program objectives,
- (e) an ability to function effectively on teams,
- (f) an ability to identify, analyze and solve technical problems,
- (g) an ability to communicate effectively,
- (h) a recognition of the need for, and an ability to engage in lifelong learning,
- (i) an ability to understand professional, ethical and social responsibilities,
- (j) a respect for diversity and a knowledge of contemporary professional, social and global issues, and
- (k) a commitment to quality, timeliness, and continuous improvement.

For assessment, various data on students' work was collected from all the courses taken by each student during his/her four years.

## **Senior Projects**

Capstone courses in both the engineering technology programs at PVAMU are designed to implement the knowledge and skills gained by the students in various courses taken during three years. Items such as b, e, f, g, h, j, and k from 11 outcomes described in the TAC-ABET list above were identified as ones that can be achieved and measured in the senior project course.

The senior projects are always done in groups. This allows the students to acquire team-building skills. They have opportunity to work in teams with sharing, respect, and contribution towards one goal. A project is either selected by the team or assigned by the instructor. The scope of activities generally includes design, research, costing, building, testing, demonstration, and presentation. All teams must have meetings, consultations, proposal writing, project planning and management during the course duration. At each stage student have to make decisions regarding various aspects of their project. Most of these decisions come from their own deliberations.

At the University of Houston (UH) in the Engineering Technology program, senior project was offered within Micro-controller Interfacing course (ELET4308) for several years. This was one semester course with a laboratory consisting of few experiments and then the group project. Teams were formed and each team was assigned a different project. Recently the name of the course has been changed to 'senior project' and format has been slightly changed. This campus has a large percentage of commuter students with part time or even full time jobs. This situation led to consider this proposal of evaluating the indigenous resource.

At PVAMU senior project is a two-semester course (ELET4082 and ELET4092) and carries total 4 credit hours. Relative to the UH, Prairie View campus has smaller percentage of commuter students. Teams are formed and proposals are solicited. Instructor evaluates multiple proposals submitted by each team and assigns one selected. Students do research and prepare a detailed proposal and by mid semester each team knows which project they will be working on. First semester is devoted to mainly design, project management and collecting information about parts required. Second semester starts with building the project. Several weeks of testing and perfection brings the project at demonstration stage. Usual reports and presentations are required during both the semesters. In addition there are few assignments given to address ethics, global issues, and lifelong learning. Usually there is always a scope to introduce a case study.

## Case Studies

Case studies have been used in practically every branch of higher education. In engineering and engineering technology programs case studies of real problems are most effective if conducted in a slightly different manner. One approach proposed by the Laboratory for Innovative Teaching and Engineering Education (LITEE) of University of Auburn <sup>3</sup> consists of following steps: formation of teams, assigning different roles from the case for each team, studying the problem without knowing the actual solution adopted, conducting research using internet, and deliberation by each team for their role. Audience and/or instructor evaluate each team's presentation. Students are then told the actual approach taken by the industry to solve the problem. The grade usually depends on their presentations since the instructor has assigned roles. Analysis of a real problem always holds students' interest.

Many case studies have been developed by the LITEE of University of Auburn under NSF funded projects and are available for implementation and adaptation. Several workshops are also conducted for faculty from various universities for teaching how to implement case studies in their courses. These are real life industrial problems well documented for students study. The details of actual solution of the problem are not available to the students but are available to the instructor. Typically a case study will have multiple roles for students to play such as the design engineer, the maintenance engineer, the service provider, the manager, and the owner. Several technical or engineering, business, and financial aspects of the case need to be considered to resolve a problem.

## **Tapping the Indigenous resource**

Typically the instructor provides the problem or a case and discusses possible approaches. Students generally have to analyze the case and find solutions that may include making various decisions individually or as a group. Many times there is more than one approach to solve the problem. Students make decisions based on the information and any experience of similar situations they have. If some members have earlier work experience especially with decision-making responsibility, they themselves can become additional resource to other members. This will help improve and mature other students' decision-making process. A case study developed by the LITEE based on the failure of an electrical utility was selected to investigate utilization of this indigenous resource. This case study had various aspects such as technical, managerial, and financial implications. Several decisions were required to be made by each member to come to final recommendations.

### **Formation of Teams**

To determine the effectiveness of the proposal, groups are formed with at least one member with work experience. All the team members are informed about intention of the team formation. Out of the total 43 students in the class, four teams with 5 students in each team were formed for the case study. The student groups were briefed about the case and given two weeks for their team's research and preparation for the final presentation. Deliberations were performed in the presence of the whole class.

### **Evaluation of the Effectiveness**

#### Survey questionnaires

For assessment of the success of this approach three questioners were developed using the guidelines from the NSF handbooks for evaluations<sup>4,5</sup>. The first questionnaire was designed for those students participating in the case study with little or no decision making experience, the second was for those students having work experience, and the third for peer-evaluation by the whole class. Whole class was asked to evaluate the performance of each presenter team. The answers were asked on a scale of 1 - 5 with answers from strongly disagree to strongly agree respectively.

The questionnaire for participating students with less or no decision making experience consisted of following five questions:

1. Were you informed of one or more members in your team having work experience?
2. Did you notice his/her/their contribution in your case study was different and helpful?
3. Do you think that their sharing benefited you?
4. Will you recommend forming teams in this manner for case studies?

5. Will you recommend forming teams in this manner for the senior projects?

For the students who had work previous experience, following questions were asked:

1. Did you make use of your decision making experience you gained at your job?
2. Did your team accept any decisions or strategies you proposed?
3. Were there any instances where final decision was not the one you suggested?
4. Do you think you were benefited in your role?
5. Will you recommend forming teams in this manner for case studies and senior projects?

#### Peer-evaluation

Following questions were asked to every participant in the class to evaluate presenter teams after all the deliberations were done. Case study participating students evaluated all other teams.

1. Do you think this team did a good professional job?
2. Did the team use enough resources for preparing for their role?
3. Was the argument convincing?
4. Are you convinced that this team's approach must have been the actual path followed?
5. Are you convinced that this team's deliberations were better due enhanced decision-making process?

Each student is asked to do a peer-evaluation before declaring the actual approach taken by the industry to solve the problem.

### **Preliminary Analysis**

#### Student Participation

Students were very enthusiastic about the case study. Those participated as team members were excited and spent lot of time in research and preparation for deliberation. During the actual deliberations many students who were not selected to participate were very curious to see how this case study is presented. Some of them indicated their willingness to participate if there was any more case studies that semester. Only one case study was used for the sparing enough time needed for their project.

#### Numerical results

The data collected from the first questionnaire is displayed in Table 1. Only averages were calculated. Any statistical analysis was not performed due to small number of samples.

The data collected from the second questionnaire is displayed in Table 2. Only averages were calculated. Any statistical analysis was not performed due to small number of samples.

Question Number	Question	Average
1	Were you informed of one or more members in your team having work experience?	4.1
2	Did you notice his/her/their contribution in your case study was different and helpful?	3.5
3	Do you think you were benefited by their sharing?	3.7
4	Will you recommend forming teams in this manner for case studies?	4.5
5	Will you recommend forming teams in this manner for the senior projects?	4.5

Table 1 Averages of student response who participated in the case study

Question Number	Question	Average
1	Did you make use your decision making experience gained at your job?	4.3
2	Did your team accept any decisions or strategies you proposed?	3.6
3	Were there any instances where final decision was not the one you suggested?	3.9
4	Do you think you were benefited in your role?	3.8
5	Will you recommend forming teams in this manner for case studies and senior projects?	4.1

Table 2 Averages of student response who participated in the case study and had decision-making experience

#### Students Comments

Students were informed about the proposed study of finding effectiveness of the decision-making based on the demography. Students were encouraged to write their comments about this approach of conducting case study. Several students had interesting comments as listed below:

- It turned out more interesting than I thought
- We had too long discussions while preparing for our presentation
- There was not enough time for research
- We have not taken courses related to the case
- It was too large group
- I enjoyed participating with other experienced members

- It was difficult to play role which I did not believe was correct one
- Bottom line is money
- Interesting to see implications of the decision you make on the society

### Peer-Evaluation Analysis

Students were asked to do peer-evaluation basically to address some of the program outcomes listed in the TAC-ABET criteria. It was emphasized that in real life, on the job one will have to evaluate several colleagues with professional judgment. No specific relationship was intended to relate this to the effectiveness of the decision making in the case study.

## Summary and Conclusions

Large percentage of students participated in the senior project course worked full time and thus had gained experience in decision-making. The success of the case study and senior projects was influenced by active participation by these students, who shared and applied their experience in decision making for their team's role in the case study. Complexities of decision making for an actual problem caused students decision-making skills to improve and mature. Thus, these working students became a valuable resource to the other students in the team and enriched the learning process to the class as a whole.

## References

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