Using Student Engagement Projects in an Engineering Technology Program to Stimulate Regional Economic Development

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Abstract - Western Carolina University (WCU) is a comprehensive regional university in the Smokey Mountains of rural North Carolina. A significant element of the mission of the university is to support economic development in the region by promoting technology transfer and job creation. The university does this by linking faculty, students and employers in an engagement process. The faculty members are also encouraged to use live projects from regional companies for instructional purposes. In support of WCU's mission of engagement, students in an engineering technology logistics class were encouraged to develop team partnerships and work with regional companies to solve supply chain management issues. The project was very successful. Letters of acknowledgement were received from the participating companies acknowledging economic development in the form of projected savings.

Key words: Innovative Teaching Methods, Industrial Partnerships, Fostering Undergraduate Research

Introduction

Western Carolina University (WCU) is a comprehensive regional university of approximately 9000 students, 52 miles southwest of Asheville, in the Smokey Mountains of rural North Carolina. A significant element of the mission of the university is to support economic development in the region by promoting technology transfer and job creation. As a major public resource for western North Carolina, the university assists individuals and agencies in the region through the expertise of its faculty, its staff, and its students. The university also assures this interaction, or "engagement," by requiring faculty members to participate in engagement as one of the requirements for tenure. The Kimmel School at WCU has taken the lead in this endeavor. The Kimmel School houses the departments of Construction Management, the department of Engineering and Technology with programs in Electronics and Computer Engineering Technology and Engineering Technology and the Center for Rapid Product Realization. Engagement projects are a particularly good fit for these programs.

The mission for the Center for Rapid Product Realization is to match the Kimmel School's expertise and resources to needs in Western North Carolina's needs by forming effective partnerships to grow the region's economy, by assisting in generating value creating jobs and by improving the quality of life for its people. The vision for the Center is to be known and respected throughout the region as

an innovative, can-do partner and as the primary resource for technical assistance and technology transfer for government, business and industry officials with local economic growth and job creation responsibilities. The Center concentrates on two primary goals of economic development and engaged learning and supports a portfolio of strong and broadly-based engineering engagement projects taken on by faculty/staff/student teams to support the Center's goal for engaged learning goal.

WCU is accredited by the Southern Association of Colleges and Schools (SACS), and as part of the SACS review in 2007, the university developed a Quality Enhancement Plan (QEP) entitled *Synthesis: A Pathway to Intentional Learning.* The coherent model of the QEP is that learning at the college level must involve students in an active educational process that integrates theory, methodology, and subject matter with practice and reflection. The synthesis of these educational experiences will prepare students for life beyond college. Additional information with regard to the QEP plan may be found at http://www.wcu.edu/sacs/QEP/QEP-2-7-07-revised.pdf.

WCU's mission of engagement and the QEP fit well together. Integrating subject matter with practice has proven to be an effective educational technique. This is not a new concept. In the United States, a number of universities have used this concept for the twin purposes of improving learning and increased retention of students. Among these educational practices are cooperative education, collaborative learning, problem-based learning, supplemental instruction, and service learning [1]. Tinto [2] also notes that one of the keys to improved student retention is getting students involved in learning. Involved students tend to spend more time on task, are more likely to learn, and more likely to stay. In the United Kingdom, it is increasingly advocated by public policy that new relationships be established between higher education and the world of work. This policy reflects changes in the economy, society and higher education. [3] It is also a likely result of the increased competitiveness that comes with increasing levels of globalization in business.

Research has resulted in a better understanding of how learning takes place in the classroom and shown that lectures are relatively ineffective as a way to impart knowledge. As a result, class activities which reinforce learning have become increasingly important. Students retain 90% of what they say and do, as opposed to 20% of what they hear [4]. Interaction is critical. Instructors need to ask themselves if they could go into the classroom and do what they have planned each day if no students were present. If so, there is likely little or no student involvement in the class, and based upon the learning and retention factors and as previously noted, student learning and retention are likely to be poor. Active learning and cooperative learning may be used to facilitate this interaction and improve learning outcomes.

In many cases, we might think of active learning as eschewing the lecture for purely experiential instruction. However, experience suggests that a combination of lecture presentation of key concepts followed by a period of "learning by doing" can be very effective. For example a 15 minute lecture, followed by a group assignment to experiment, critique, troubleshoot, design, or flowchart, a case study allows students to integrate conceptual knowledge with practical application.

In addition to active learning, team learning had also become an important part of the instructional environment. Cooperative learning is a teaching technique that utilizes student teamwork to achieve a common goal. As suggested by Johnson, et al., [5] students must be taught a scientific approach to teamwork which includes the following:

- Reliance on one another to achieve the goal
- Individual accountability
- Appropriate use of collaborative skills
- Group processing, including setting goals and assessment

In support of engagement, students in an engineering technology logistics class were encouraged to develop team partnerships and work with regional companies to solve supply chain management issues. Student teams traveled to regional companies, consulted with stakeholders, and developed proposals which were delivered as formal papers and presentations to the client. Students gained experience in applying theoretical classroom instruction in a real-world setting. They also gained experience in teamwork, project planning, engineering proposal presentations, and working in an environment where their work made an impact on the economic well-being of people in the region.

Organization of the Course

The engineering logistics course is at the junior level and in advance of the senior capstone course, where students are expected synthesize knowledge from all the engineering technology courses to plan and execute a senior project. The text chosen for the course was "Fundamentals of Logistics Management" (Lambert, Stock and Ellram, 1998). The organization of course topics closely mirrored the coverage of logistics topics as presented by the text. Hypothetical case studies created by the instructor to suit local topics of interest were used to supplement the text and help to shape patterns of problem solving that could then be honed in solving problems for local businesses.

Class activities

Students were introduced to team activities which evaluated case studies. These teams used the material presented in the class to propose solutions to problems presented in the cases. Students were also required to evaluate the effectiveness of the team in addressing the problems posed in the cases. Assessment of these team

activities indicated that students lacked skills appropriate to effectively working in teams, and further, that many students lacked motivation to contribute to team effectiveness.

Students were introduced to team activities which evaluated case studies. These teams used the material presented in the class to propose solutions to problems presented in the case studies. They also evaluated the actions taken to solve the problems in the case studies. It was found that students did not have the skills or desire to perform effectively in teams. Although students had participated in team activities in the past, they had been provided little teamwork training. As a result of this lack of exposure, students experienced poor organization and a lack of ability to get everyone on the team to perform equally. The attitude was, "Just give me the work and let me do it myself."

Based upon these findings, the faculty introduced the cooperative learning approach as a topic in the course, and discussed the process of team building with the students. A film on working in teams helped to emphasize the process. Among the critical topics covered in introducing the cooperative learning approach to students were the purpose and advantages of the team process. Students were also introduced to information about leadership styles and their effectiveness as part of class discussion.

As the class progressed, assignments were made that required students to synthesize information in the preceding chapters in the text book into a team reports and formal presentations (Appendix A). Students chose their own teams, developed the topic, and made formal presentations. The results were evaluated by the instructor and suggestions for improving the process were discussed with each group. This team exercise was repeated three times during the semester prior to starting the final team project.

For evening students who were employed while pursuing their education, a distinct advantage was observed in that they could pursue active learning activities at their places of employment. This option provided the opportunity for students to learning logistics as part of their daily job duties. One applied example was an assignment that required evening students to chart the customer order cycle in their companies, determine the variability in such orders and suggest improvements.

As the semester progressed, students were generally found to be deficient in presentation skills. Most had taken a course in oral communications, but the skills involved had not been adequately rehearsed through repetition for the students to develop proficiency. For example, students tended to read the screen during video presentations. In response, instruction was provided in oral presentation skills and the development of handouts for training purposes. Following the first course presentation, students were found to be much more receptive to presentation skills training.

In addition to the other course activities, course requirements included a final team project (Appendix B). Students were allowed to form teams of three or four members to do a research paper on an approved topic, analyze an engineering logistics process in a business, or do an engagement project with a local business to improve some aspect of engineering logistics and profitability. Among these categories of potential projects, students were strongly encouraged to do an engagement project. The instructor provided a list of potential projects, but a preference was expressed that students should find their own projects.

Three things were required for a good grade on an engagement project:

- A paper of at least 10 pages plus references and illustrations. This paper was required to provide a clear statement of problem and solution, as well as describing the linkage to concepts learned in the class which were applicable and how they were used to solve the problem. The paper also had to detail each team member's contribution and analyze the interaction between both the team members and all company contacts.
- A formal presentation. The companies that were involved in the case study were invited to the presentation. When told that the clients would be invited to the presentations, one student commented "That certainly changes the whole tone of this class!"
- A letter of acknowledgement from the company acknowledging the contribution of the students.

Conclusion

In the Spring 2006 class, seven groups did logistics projects for businesses. Six of them were excellent and resulted in letters of thanks from the participating companies. The letters indicated the nature of the project and the contribution of the teams. A list of engagement projects done by three classes of student teams is listed below.

- **Eaton/Cutler-Hammer** – Development of testing equipment and pre-delivery test procedure to solve logistical issues, Skyland, NC

- **Volvo Construction Equipment** – Developed a more efficient way of packing goods for inter-continental shipping, Skyland, NC

- **Lowes Home Improvement** – Developed and administered a survey to determine employee solutions for issues with "top-stock" inventory. This was sent to corporate from the manager of the local store with recommendations to implement on a wider scale. Sylva, NC

- **MC Logistics** – Logistics planning support for an international import management company, Gastonia, NC

- **Eaton Cutler Hammer** – Did a study and made recommendations to determine durability of carbide tools and possible cost benefits of different products. Fletcher, NC

- **Price Equipment Company** – Did a study of communications logistics and determined that a new telephone system would save the company money. Researched different systems and made recommendations. Monroe, NC

- **Moog Inc** – Determined the need for a video conferencing system, did a cost analysis and made a recommendation based on the latest technology and the companies needs. Murphy, NC

- **Pro Tool** – Space utilization study for a small machining company to determine feasibility for expansion. Canton, NC

- **Body Works** – Organized a method for inventory and tracking of customer vehicles. Charlotte, NC

- **Wix Filters** - Reduction of waste by scrap analysis at Gastonia. NC

- **Global Logistics Recovery** - Analysis of future locations for an electronics recycling company. Tampa Fl.

- **Con-Met** - Logistics improvement of material flow through production area. Bryson City. NC

- **BorgWarner Inc** - Flowchart order cycle time to seek areas for improvement. Fletcher, NC

- **Continental-Teves** - Project to flowchart order cycle time to seek areas for improvement. Morganton, NC

- **BorgWarner Inc** - Recommendations for changing the logistics design process. Fletcher, NC

Student evaluation of teaching on the end-of-class surveys indicated that they enjoyed the course format and felt that they had learned the material. Students commented that the class was much more fun and interesting than they had expected. Students felt that their presentation skills were improving and appreciated the fact that everyone was contributing equally to classroom discussion. Students also became more comfortable participating in the team process.

From a faculty perspective, students were perceived through the synthesis of learning and application to have gained greater integration of knowledge and increased student learning compared to the traditional lecture methodology. The

use of applied course assignments yielded superior class engagement without students lost to dropping the course.

References

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Appendix A

ET 362
Group Activity 2

Logistics activity using material presented in:

- Chapter 2 - Develop a customer service strategy.
- Chapter 3 - Use technology to support the customer order cycle.
- Chapter 4 – Inventory concepts
- Chapter 5 – Inventory management
- Chapter 6 – Managing materials flow

General Education Goals

- Explore the practical application of the concepts presented in chapters 2-6.
- Practice the team approach to problem solving.
- Develop oral presentation skills.

Case study

You are a graduate in engineering technology who has been working in local companies in the areas of chemical and food processing. You have now decided that it is time to use your technical expertise to strike out on your own and form a new business.

After hearing a local presentation concerning the biodiversity of western North Carolina, you think that there must be some way to leverage this into a new product. You have developed a new product and need investors.

You have been contacted by a potential investor interested who wants to meet and hear your proposal. This investor's primary concern is both engineering logistics and supply chain problems that you may be faced with due to the nature of the business and it's location in the mountains.

You have set up a meeting to discuss your proposal. Without knowing the exact nature of his concerns, you will form a group of experts to brainstorm what his possible objections may be and come up with solutions. You should refer to the activity goals for logistics activities that must be addressed.

Directions

1. Form a group of four.
2. Assign roles to each member of the group. (Leader, Note taker, Timekeeper, Reporter)
3. Go through the four stages of team dynamics that we discussed in class to decide on a product and do logistics planning. What was your observation of these stages?
4. Prepare for your presentation and address the following issues:
    a. What is the need for the product and its projected demand?
    b. What are logistics and supply chain issues and how will your company address them?
5. You may use any presentation format that is appropriate and effective.
6. You have the remainder of today's class, as well as the next Tuesday class to work on the problem. Your report is due on Thursday.

Appendix B

Team Project
ET 362
Spring 2008

There are two options for team projects.

Option 1 – Research paper

Paper:

The paper will be the product of some analytical thinking concerning a specific topic in engineering logistics. A sample topic is noted as follows:

> The analysis of the material or information flow through an actual business. Flow diagrams, suggestions for improvement, and a cost/savings analysis for improvement are required.

I will require a short, one page, preliminary, proposal from the team for a topic subject by February 1, 2008. The paper will conform to APA guideline for construction and references. It will be from 10 –12 pages, double –spaces, plus title page and references. Three to four team members should be on each team. Three is optimum. All team members will contribute equally. An appendix to the paper will note each member's contribution. I reserve the right to vary the grades for team members based upon my observation of each person's contribution to the project.

Presentation:

Each team will make a 10-12 minute presentation to the class concerning their team project at the end of the semester. They may use any suitable presentation media, including handouts, PowerPoint, flip charts, or video.

Option 2 – Industry engagement project **(Preferred!)**

Paper:

The paper will be the direct application of what you have learned in this class to an industry project.

I will require a short, one page, preliminary, proposal from the team for a topic subject by February 1, 2008. I must approve the scope and subject of the project. The paper will conform to APA guideline for construction and references. It will be from 10 –12 pages, double –spaces, plus title page, drawings and references. Three to four team members should be on each team. Three is optimum. All team members will contribute equally. An appendix to the paper will note each member's contribution. I reserve the right to vary the grades for team members based upon my observation of each person's contribution to the project.

Presentation:

Each team will make a 10-12 minute presentation to the class concerning their team project at the end of the semester. They may use any suitable presentation media, including handouts, PowerPoint, flip charts, or video. Representatives from industry will be invited.

Letter of acknowledgement:

You will be required to obtain a letter of acknowledgement from the company that you are doing this project for. It should state the problem, thank the team members by name for solving a problem, acknowledge the instructor and the class (ET 362 under the direction of Dr. Robert Anderson), and if possible, what the economic benefit was to the company.

Note – You can find you own project anywhere, or I can find projects in the Sylva/Asheville are