An Innovative Co-op Program at WVU Tech

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Abstract

The paper describes the development and proposed implementation of an industry-university collaboration in experiential learning. West Virginia University Institute of Technology (WVU Tech) and various industries in the Upper Kanawha Valley region have designed a co-op program for undergraduate students that will require them to spend a day every week of the spring and fall semesters of the junior year and a part or the entire summer between the semesters with industries. Several students from the departments of electrical and computer engineering, mechanical as well as chemical engineering are expected to participate in this experiential learning program. Each student will have two mentors, one from the industry and the other is a faculty member from the student's parent department. The year-long program offers the student the opportunity to participate in design projects at a level which is not possible with the more traditional summer or internship employment. In addition to the design experience, students will have benefits in communication skills, exposure to industrial standards, safety training and safety considerations in designs, design implementation, and multidisciplinary teamwork.

1. Introduction

Engineering design is an important component of the undergraduate engineering education. It is also known that workplace experience can provide engineering students with a perspective that is difficult to achieve in either the classroom or teaching laboratory. This paper describes an innovative proposed year-long program which provides engineering students with both design and workplace experience in several engineering disciplines.

Engineering design is recognized as a key component of engineering education and methods of providing undergraduate students with a significant design experience vary widely among disciplines and faculty. Dunn-Rankin, et. al.[1] investigated and reported on the importance of design on engineering education and on the application of engineering science in design practice. It is interesting to note that design practices vary by discipline and project criteria. In surveying numerous industries on their priorities in manufacturing engineering education, Mason [2] noted the importance of hands-on experience uniformly emphasized by the survey.

It is also widely recognized that workplace experience is a key factor in enabling graduates in making a successful transition from academic life to engineering careers. A variety of programs exist for providing this experience, including summer internships, co-op programs, and industry-university educational programs. Cooperative education has come a long way since 1906, the year this unique pedagogy was implemented in educational institutions. Sam Sovilla [3] reviewed its history, current status, and the outlook for the future in a paper published in ASEE in 1998. Jeff Meade [4] listed co-op program as a tool to improve retention and enhancement of the educational experience of students. It was noted that the extra time required by co-op programs, typically one year, and the extra cost associated to the offering institution are some disadvantages. Research on the success of co-op placements shows that completed coursework and length of assignment both strongly correlate to the success of the student experience [5] .

In the fall semester of 2002 a program was designed by the College of Engineering at WVU Tech that would provide hands-on and engineering design experiences in several engineering disciplines. The program involves WVU Tech and various industries in the Upper Kanawha Valley region and is designed to provide the benefits of a co-op, summer internship plus design experience specific to students in various engineering disciplines.

2. Program Description

The proposed Experiential Learning Program is a year-long program which starts in the spring semester, spans the summer, and concludes at the end of the fall semester. It is designed for students in the junior year of the four-year engineering program. The student spends eight hours (preferably one full day) every week at the industrial site during each of the two semesters and has the option of working full time during summer with a minimum requirement of twenty days. Each participating employer determines the policy on wage and benefit packages offered to the student participants. The student participant enrolls in a three-credit course in each of the two semesters and the student-mentor team meets at the beginning of the program to set objectives for the co-op program as well as the courses taken during the year-long program. During the course of the program formal meetings of this group are held to monitor the progress and to ensure that the program is on schedule and will be successfully completed. Throughout the program, the student maintains a journal that documents the work performed at the industrial location. Students are evaluated in writing as to their job performance each working semester, and these performance evaluations are sent to the faculty mentors. In addition to monitoring the project schedule the faculty mentor is responsible to ensure that the planned course objectives/outcomes are met. Also the faculty mentor serves as a resource to the student and the industrial mentor through the course of the program. This process provides a two way sharing of information between the two mentors, which benefits everyone involved. The program budgets for twenty days during the summer, although this time commitment can be adjusted upward if desired by both parties. It is expected that all students will have the option of working full time for the summer. As mentioned earlier, the student participating in the program enrolls in a three-credit course in each of the two semesters of the program. The student normally takes four other three-credit courses during each semester in the junior year while the student participates in the year-long co-op program. In the engineering curriculums under consideration, the first course satisfies an undesignated elective in the student's program, and the second course satisfies a professional elective.

The student/mentor teams meet at the beginning of the program to set objectives and outcomes. At the end of the program, the student presents a seminar on the project attended by other students, faculty members and industrial participants. A written final report is required. The student's primary contact during the program is the industrial mentor. Throughout the program, the student maintains a journal that documents the work performed. It is the student's responsibility to keep the faculty mentor up to date between reviews.

The co-operative program is an excellent opportunity to gain real-life experience while going to school. In the conventional co-op program offered by WVU Tech, students begin their co-operative work experience after their first full year of college and typically work four or five terms. Students can see and experience how their classroom and laboratory training can be used in everyday practice on an engineering project. Some students say that they learn as much during their co-op terms as they do in the classroom. Students are also given real engineering projects to work on and are often considered to be part of a team. Students are given responsibilities commensurate with their schooling and are often turned loose on projects and evaluated on the basis of their initiative and contribution. All other things being equal, an employer will select for full-time employment the student with co-op experience over a student who does not. Many employers hire new people only if they have some experience, removing from consideration many new graduates without such experience. WVU Tech's conventional co-operative program gives the students the experience they can use to get that first job. Often it happens that a company will hire its own co-op students upon graduation since the company has had a chance to evaluate first hand the quality of the work of the individual. Since industries pay competitive wages, many co-op students are able to pay for their room and board while working and going to school, their tuition and fees, their books, and their other expenses and still have money in the bank upon graduation. Not all students can get into the co-op program, however. Most companies require a 3.0 grade point average, although some companies may be less restrictive. Entering students are encouraged to work hard during the first year to maximize their grades and get into the program

Table 1 shows the student participation in the conventional co-op program offered by WVU Tech over the last four years. This program has been in existence for a long time and has been very successful in working with the industries in the Upper Kanawha Valley region. Roughly 30-40% of participants are chemical engineering students due to the concentration of chemical industries in the region. Due to the economic downturn, the number of co-op participants has gone down during the last four years.

Table 1. Student participation in the conventional co-op program

Year	Numbers of participants	Majors of participants
2000/01	18	All engineering
1999/00	22	All engineering
1998/99	29	All engineering
1997/98	38	All engineering

In a typical program, the students go through an initial period of training and plant familiarization. An initial assignment is made, and the student will work closely with the mentor in completing this assignment, and gaining exposure to the procedures involved in problem definition, planning, design, review, procurement, and implementation. The students then move into a true mentoring situation, taking a lead role in the project under the mentorship of their advisors.

3. Experiential Learning in Engineering

The experiential learning program must be attractive to all student participants in the following respects:

3.1 Student perspective

The student participants from WVU Tech have been uniformly positive about their experience in the conventional co-op program and many have expressed interest in this new year-long opportunity. In addition to the design experience, they expect benefits in _

•Communication skills: The program requires oral presentation and a final written report, similar to campus based design courses. In addition to this, the students will benefit from developing communication ability with production and maintenance personnel, vendors, contractors, and management.

• Industry Standards: The students will find the exposure to both company and industry standards to be an important benefit of this program. These include the Occupational Safety and Health Administration's Code of Federal Regulations, National Fire Protection Association standards from IEC, IEEE, ANSI, NEMA, and other such organizations. These codes and standards often represent many years of engineering and research efforts and are the accepted authoritative references for practical applications in the industrial environment.

•Safety training: The students will receive initial safety training and will be involved in ongoing safety reviews throughout the program. Perhaps more important is the emphasis that is placed on incorporating safety considerations in their designs.

•Design Implementation: Project implementation will take a variety of forms due to the differing nature of various projects. In several instances, bid specifications will be required for contractors to perform the installations or fabricate the equipment. In other cases, fabrication could be done on-site with materials procured in the design process. The students will be directly involved in justifying their designs and obtaining budgetary approval for implementing them.

•Multidisciplinary teamwork: In many cases, students will be involved in multi-disciplinary projects involving a variety of engineers, management, technician, operations, and production personnel. These multi-disciplinary experiences are unique and are expected to be broader than what may be made available on campus.

It is to be noted that the proposed program involves a minimum of fifty days of on-site work consisting of fifteen days in spring, fifteen days in fall and a minimum of twenty days in summer. This is similar in time to the time involved in a summer internship, the difference being that it is spread over a full year. The work schedule on the program will accommodate the natural delays in any project which result from meeting scheduling, fulfillment of information requests from vendors, preparation of bid/purchase documents, etc. As a rule, the students should be able to participate in procurement, installation and testing of their designs for majority of their work.

3.2 Industry Mentor Perspective

The industrial mentors benefit from this program in several ways. Plant personnel benefit from the program by developing legitimate engineering resources with minimal interruption of normal schedules. New interns require a substantial amount of training for safety purposes when entering large production facilities. They also require a significant amount of training on the business systems utilized, interfacing with the various personnel and the engineering methods employed at the location. This learning usually requires one-on-one attention from an experienced engineer on their initial tasks. By spreading out the time commitment over a full year it is much easier to schedule this time into a regular year round pattern that repeats every year. Students can be assigned to assist in large projects or given projects where the students are primarily responsible. Some projects with a lower sense of urgency but of significant importance that may not normally get the priority are ideal for the program. The student is responsible to perform the necessary engineering development, design and implementation, under the mentoring relationship. Ideally, the project improves production and benefits the plant engineer with the knowledge gains.

In summary, those participating in this new program are expected to clearly prefer this to a conventional co-op/summer internship for these reasons:

- The students being on site once a week at the beginning of the program results in their being brought up to speed without placing an undue burden on the mentor's time.
- The productivity of the students is much greater when their time is spread over a full year rather than concentrated in a summer or a semester.

- The experience in the conventional co-op program has often been that the student is just beginning to work independently when the program ends.

3.3 Faculty Mentor Perspective

There are several benefits to the faculty who will get involved in the program.

- Improves ties to the engineering community/industries thereby providing opportunities for faculty to do consulting, research etc
- Provides faculty with the important exposure to industry problems and industrial practices
- Improves the academic part of the program with enhanced participation from industries

4. Unique Aspects of the Program

The proposed new program has several aspects that make it unique. A primary aspect of this program is that it goes for a full year. From the industrial mentor's point of view, it has an advantage over a traditional summer or co-op program in that it involves a smaller time commitment in the early stages of the program when bringing the student up to speed. While the time commitment on the student's part is similar to a full time summer job, there are advantages to spreading this time over a full year period, allowing the student to get a more meaningful experience. This is due to the time required by vendors and other parties on whom project work is often dependent. The student may initiate several aspects of a job where interfacing with production departments, purchasing, contractors, material suppliers and other engineering resources is required but some time must elapse prior to a response. These factors can limit the traditional summer and/or co-op student to short projects, or preclude the student from participating in the completion of a project.

The program does require that the university and industrial partners be in close proximity, and that the student can arrange his/her schedule to accommodate either a full day or two half days away from campus every week during the semesters. While the twenty-day summer commitment may not be attractive to all students, it is expected that at least some will accommodate this time commitment. The program structure allows for flexibility beyond the twenty-day summer commitment, which is particularly attractive to students interested in taking summer courses.

5. Possible Projects

The program requires the students to perform significant design during the course of the project. In some cases, students will spend the majority of their effort on a single project, while other students will be involved with several different projects. It is expected that the proposed the experiential learning program will provide students a very valuable opportunity to gain industrial experience over an extended period of time by working in an engineering department on industrial projects under the direct supervision of a project engineer.

6. Conclusions

This paper describes an innovative approach to experiential learning in engineering with industrial partnership. This program involves a year-long effort where an upper level engineering student majoring in electrical, computer, chemical or mechanical engineering spends one day a week in industry working on a team that includes a practicing engineer as an industrial mentor and a faculty mentor from the student's academic department. This particular program involves assignments in various engineering disciplines.

The program offers several advantages over the more traditional co-op and summer internship programs. By extending a similar level of co-op effort over a full year, the student is more productive and gains valuable industrial experience through intense hands-on training. At the same time, the industrial mentor is able to interface with the student more effectively over an extended period of time without unduly burdening his/her own performance. The program includes several of the most desirable aspects of the conventional co-op program while maintaining a four-year program of study. As a result, the program is likely to be very successful. This program could serve as a model for universities across the country and could be successfully implemented in other locations.

Bibliography

1.DunnRankin, D., Bobrow, J. E., Mease, K. D., and McCarthy, J. M. Engineering Design in Industry: Teaching Students and Faculty to Apply Engineering Science in Design, *Journal of Engineering Education*, Vol. 87, No. 3 (July 1998), pp. 219-221.

2. Mason, G. Results of an Industry Survey on Manufacturing Engineering and Manufacturing Engineering Education, *Journal of Engineering Education*, Vol. 87, No. 3 (July 1998), pp. 211-213.

3. Sam Sovilla, E. Co-op's 90-Year Odyssey, *ASEE PRISM*, Vol. 8, No. 1 (January 1998), pp. 18-23.

4. Meade, J. Has Co-op's Time Come (Again)?, *ASEE PRISM*, Vol. 2, No. 4 (June 1992), pp. 24-27.

5. Hackett, R. K., Martin, G. R., and Rosselli, D. P. Factors Related to Performance Ratings of Engineering Students in Cooperative Education Placements, *Journal of Engineering Education*, Vol. 87, No. 4 (October, 1998), pp. 455-458.

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