Implementing an Assessment Course

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Abstract:

There is increased interest in assessment on college campuses across the nation and specifically in many engineering programs, as ABET focuses on Criteria 2000. Within the University of North Dakota (UND) School of Engineering and Mines, selected as one of four pilot schools to undergo accreditation under ABET's Criteria 2000 in the fall of 1997, an assessment course has been implemented to address a special need in the Corporate Engineering Degree Program (CEDP). CEDP offers undergraduate engineering degree programs using videotape courses and on-campus laboratories to employees of a consortium which currently includes 3M, GE Plastics, Lucent Technologies, Intel Corporation, Hewlett Packard, Hutchinson Technology Inc., Conoco, Raychem, Little Hoop Community College, Kennecott Utah Copper Corporation, IES Industries Inc., ALCOA, Nortel, and Control Tech Inc.

Under National Science Foundation (NSF) grant number DUE-9455466, entitled "Enhanced Curriculum for Undergraduate Engineering Adult Learners in Industry," a one credit course was developed in the fall of 1995 to assess the CEDP adult learners' backgrounds to determine whether several of the standard introductory engineering courses would be of potential value to these students. Since many of the students have a great deal of related experience and extensive knowledge in their respective fields, some of the introductory courses in engineering may not be necessary. Depending on the outcome assessment of a students background, certain introductory courses may be waived for individuals.

This one credit course was implemented on a pilot basis in the spring of 1996 with nine students. The first class was evaluated by five UND faculty working under the NSF grant during the summer of 1996. Faculty evaluation, student feedback, and comments from the NSF grant evaluator will be presented. In the fall of 1996 and spring of 1997, the course was again offered with several minor modifications. Outcomes from these classes will also be presented. This course represents an application of engineering assessment that is of direct benefit to students.

Introduction

A one credit course, primarily focusing on assessment, was developed at the University of North Dakota to evaluate students coming from industry into UND's Corporate Engineering Degree Program (CEDP)**.** The CEDP is a videotape program coupled with required on-campus labs leading to an undergraduate degree in engineering. Many of these students are graduates of technical colleges and have ten to fifteen years of industrial experience. With an investment of resources in mind (students' time, company funds for tuition reimbursement, etc.), UND faculty began asking "why should these students (with so much industrial experience) have to enroll in entry-level courses/labs?" Thus, in order to make the best use of both the students' time and the institution's resources, a course was developed to assess the students' technical backgrounds. It

was felt that using student portfolios for assessment would lend support for the accreditation of the CEDP and that ABET's Criteria 2000 should make it easier to validate CEDP outcomes for accreditation.

History of CEDP

In 1988, 3M of St Paul, Minnesota, entered into an agreement with the University of North Dakota (UND) to offer undergraduate engineering courses to employees who normally would not be able to obtain engineering degrees through a more traditional on-campus education[1]. The first course was offered via videotape beginning in January, 1989. In 1993, GE Plastics, Hutchinson Technology, Inc., and Dupont formed a consortium with 3M to provide financial support and guidance for the CEDP. As of March 1, 1997, there are fifteen members in the consortium. The consortium provides advice regarding the needs of the students from an industry viewpoint in addition to providing financial support for the additional costs of delivering the courses via videotape.

Students whose employers are members of the consortium are able to take math, chemistry and engineering courses that lead to undergraduate degrees in chemical, electrical and mechanical engineering. Laboratories are taught in a condensed format (time frame but not content), primarily during the summer. Students normally take one or two classes each semester. The need for the assessment course came primarily from our experience with these students.

Responding to a Need

A number of CEDP students, over the past several years, have pointed out that they either had experience in a specific academic area, had taken technical school classes in the area, or both, and were wondering if there was any process in place to validate their backgrounds. Much to their chagrin, they were informed that the material had to be taken through an accredited college in order to meet university requirements for graduation.

John W Prados, in a report[2] evaluating the CEDP for UND, pointed out that

> "... many of the CEDP students through their work experiences have already developed a number of the competencies that the criteria requirements were designed to assure. It makes no sense to require such students to repeat experiences that develop skills they already possess. A more reasonable approach would be to assess the competencies of entering students in the areas addressed by the criteria and to tailor educational experiences that fill the gaps in each student's background. Portfolios of student work could then be used to demonstrate to an accreditation team that a student has, indeed, acquired the competencies specified by the criteria."

In February, 1995, UND received a three year grant from the NSF, entitled "Enhanced Curriculum for Undergraduate Engineering Adult Learners in Industry." [3] During that summer, while the grant's Faculty Working Group was toiling over the grant objectives, the idea of developing an assessment course was conceived. Ideas for the course and the possible classes

that could be affected were identified. Betty Shuman, a doctoral student in UND's Center for Teaching and Learning at UND who had both experience and interest in assessment, was selected to work with two members of the grant's Faculty Working Group to develop the course. These three individuals formed a course development team that met weekly during the fall semester of 1995. By December, a twenty-six page manual detailing the course was completed.

The Assessment Course

The following overview of the course is provided in the course manual introduction[4]:

> Engineering 100: Professional Development is a one credit course designed to help prepare students for their participation in the Corporate Engineering Degree Program (CEDP). In addition to providing information relative to degree areas (i.e., Electrical Engineering, Mechanical Engineering, or Chemical Engineering), the program will provide an opportunity for students to develop experience-based portfolios. The program is based on the assumption that students entering UND with job-related experience may already have extensive knowledge in various areas of their fields of study. This experience, in many cases, may be equivalent to what is being taught in some of the engineering courses or general education classes. Documentation of work experience through portfolio development may qualify students for an exemption from courses normally required to receive an engineering degree. At the end of the semester, the student and academic advisor will assess the contents of the portfolio and develop an individualized curriculum plan (ICP) based on the student's demonstration of knowledge and experience in the field of engineering.

Thomas Angelo[5] points out that a number of differing measurement devices should be used to obtain a more accurate measure of a particular outcome. In Engr 100, a measure of the student's knowledge and experience is determined by the following four assessment methods: self-assessment by the student completing questionnaires; assessment of the educational experience of the student in the specified areas; assessment of the work experience through written description and documentation; and assessment through verbal communications with the student. It is through a compilation of these multiple assessment methods that the student is evaluated in each of the targeted technical areas. Confidence is gained in the evaluation of the students by using these multiple assessment methods. The primary mechanism used for assessment in Engr 100 was the development of student portfolios.

Portfolio Assignments

The students were given a Professional Development Manual which provided a course syllabus and all of the portfolio entry assignments described by Ludlow, et al., in their contribution to the 1996 ABET annual meeting[6]. The distance-learning students were assigned portfolio entries that were due approximately every two weeks throughout the semester. The following assignments were given:

> *Prepare and submit copies of transcripts from all other institutions of higher learning*

along with catalog course descriptions and syllabi from all "technical" classes. Include copies of your college transcripts and a signed statement of academic integrity. This assignment was used to start a file for the student and to evaluate the course work they had taken which fulfilled both the University general education requirements and introductory technical course requirements.

Prepare and submit a personal biography. The biography is to be at least three pages long and organized to include general information, educational background, work experience, computer experience, and professional goals. This assignment was used to compare the student's job-related experience with some of the introductory course material presented to the traditional students, and also to evaluate the student's written communication skills.

Provide a description of an engineering project in which you had a significant role. Relate your involvement and role with respect to the project (e.g., project leader, testing or design team member, individual or group project). This assignment was used to further support and amplify the evaluation of the student's background experiences and communication skills.

Complete the self-assessment questionnaires and document your corresponding work experience. In this assignment, the student completed a series of questionnaires and rated experience, knowledge, and/or skill on the following scale: "1" for low/none, "2" for medium, and "3" for high. These questionnaires corresponded to the objectives and topic areas covered in the introductory classes that may be fulfilled in the "Professional Development" course. In addition, the student submitted examples of previous work, including technical drawings, computer programs, logic diagrams, etc.

Describe your experience and training with respect to environmental issues, social considerations, economic concerns, safety issues, multicultural working environment, statistical quality control, and statistical process control. This assignment was used to assess some of the issues mentioned in Criteria 2000 and other ABET documentation.

Read "The Virtual Staff" [7] *and submit a one to two page paper that addresses the ethical issues raised in the article. Submit a two to three page paper addressing ethical considerations raised in the movie* China Syndrome[8] *from the perspective of executive management, middle-management, and the media*. This assignment was used to evaluate each student's ethics background and training.

After viewing a video on learning styles, complete a Learning-Style Inventory[9] *and prepare a short paper that analyzes the results in terms of the significance to the student*. This assignment describes and identifies the student's preferred learning styles and provided information to the academic advisor about the student's academic strengths and learning needs.

Submit examples of the types of writing routinely performed on the job, such as technical reports, lab notes, memoranda, external correspondence, and customer information. All documents need to be cleared by their supervisors before submission to UND. This assignment was used to evaluate the level of the student's written communication skills.

Prepare a 15 minute video of a technical presentation. This assignment evaluated the student's oral communication skills.

With the course outline and the portfolio assignments in place, we were ready for the pilot offering of the course.

Pilot Offering of the Course

In January, 1996, this course was offered as a pilot to nine CEDP students. Students were contacted by phone to obtain volunteers for this initial offering. A number of the students were already well into the program, so the potential benefit of the course to them was minimal, but at least they would have an opportunity to gain some benefits of the course prior to graduation. Three students from each discipline -- chemical, electrical, and mechanical engineering -- were selected to take the pilot course. A forty-five minute video was prepared which introduced the students to the course, to their faculty advisors, and to the department chairs. This video was sent to the students along with the Engr 100 course manual at the onset of the course. From this point on, the students proceeded to work on portfolio assignments on their own except for an occasional phone call to their advisors. As portfolio entries arrived, they were logged into the students' files and reviewed for content but not assessed. The assessment and waiver process did not occur until the course was complete and all of the portfolio material had been collected.

Assessment and Waiver Process

During the initiation of Engr 100, eleven to twelve credits were identified in each of the three departments offering degrees. The courses eligible for waiver were for the most part introductory in nature and not critical in terms of ABET requirements. In addition, the classes being assessed were not critical for meeting the general education requirements of the university; even with the waiver of all twelve allowable credit hours, the minimum requirement of 125 credit hours for graduation at the University of North Dakota was still met.[10]

As the students portfolio items came in during the semester, they were reviewed primarily for completeness, and the student was notified if additional detail was required. At the end of the semester, the three CEDP faculty advisors met and assessed the students' portfolios. At this time, the portfolios were scrutinized more thoroughly. The portfolio sections were reread with the basic question in mind as to how this student compared to an on-campus student who had completed the class in the area being evaluated. If the student was not up to the level of our average on-campus student, the course was not waived. The student had two options at this point. She/he could plan to take the same class as the on-campus student, or if the student felt that she/he had sufficient background in this area, the student could provide additional information for the faculty to evaluate. If the faculty thought that the student was borderline, then we had the option of calling and discussing the particular area with the student or having the student provide additional documentation for evaluation. If the student had competencies above the average of the on-campus students, a waiver was recommended. Each of the portfolio entries were evaluated in this manner.

At this point a petition was generated for each student, which in essence set up an individualized curriculum plan (ICP) for that student. For each department, the eleven or twelve hours of course work that could be waived were listed on the petition form. One of three possible choices was selected for each course: 1) course waived; 2) course already taken; or 3) waiver denied. A place for comments on each course was also included. This petition was then signed by all of the faculty advisors involved in the assessment, the student's department chair, and the engineering dean. Once the assessment process was completed, the student was sent a copy of the waiver

petition, and the student's graduation status sheet was updated accordingly.

Outcomes

The first group of students who completed the course were able to waive an average of 7.5 credits each. Since the students enroll in an average of 3 - 7 credits a semester, the students saved one or two semesters of course work by not having to repeat a portion of the academic curriculum they had learned through their engineering experiences. Large volumes of material were gathered in each portfolio and several students completely filled 1½ inch loose leaf binders with their portfolios. The students did an excellent job in providing material that was meaningful to us in evaluating their backgrounds. In several cases project information was "company confidential," so this was evaluated early and returned promptly to the student.

Engr 100 has now been offered three semesters in a row. Because of its time flexibility, a number of requests were received for a summer offering of the course. That request is being accommodated for the first time in the summer of 1997.

Students were very positive in their evaluation of the course. They were extremely gratified to have their education and experience assessed. Even though students thought they spent a great deal of work on the course, they were very satisfied and proud of their efforts. However, students were not the only ones with positive comments on the course.

Closing Thoughts and Conclusions

Very positive comments were received from the NSF grant evaluator, Dr. Jerry Westbrook[11], on the course and on the portfolios generated by the students. He stated:

> "The student portfolio concept is very innovative and provides the documentation which will be useful to ABET in their assessment of the program. The university is proceeding cautiously in giving credit for student experience."

When the faculty reviewed the portfolio tasks, they felt they obtained a good understanding of the capabilities and backgrounds of the students. They also sensed that sufficient information was obtained from the students. However, the faculty determined that, in the future, some of the experiences should be validated further. For instance, a memo from the supervisor substantiating an activity or training session may be appropriate. Another improvement would be to include a conference call to the student by the faculty portfolio reviewers at the time of the formal portfolio evaluation. Overall, the faculty was extremely satisfied and thought the class was a success.

The students spent from 40 to 200 hours gathering and preparing material for the course. Side benefits from the course were that they were able to compile an up-to-date resume and also assemble all of their past education credentials. They thought the text *Studying Engineering*[12] should continue to be used. In addition, the students thought that the learning styles inventory was one of the more interesting components of the course, and that it very accurately represented them. Students were also very encouraged that they were able to validate knowledge and

experience in specific areas and apply this to their degrees. Based on Dr. Westbrook's observations, faculty comments, and student feedback, we plan to continue offering this course.

The assessment process for Engr 100 is defined and working. There is a positive reaction by the participants, including both the students and the faculty. In addition, it has been very well received by the industrial community. However, having the assessment process accepted and implemented by the university in general (faculty and administration) may be more challenging. As we go through this assessment process, old policies, procedures, and paradigms will have to be changed. These changes will be at the department, school, and university levels. It will be challenging for the academic system to accommodate the changes that the assessment process brings about.

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Biography

ARNOLD F. JOHNSON has been an Assistant Professor of Electrical Engineering at the University of North Dakota since 1988. He earned his B.S.E.E. at the University of North Dakota in 1959 and his M.S.E.E. at Iowa State University in 1962. He also took both undergraduate and graduate courses in Business Administration at the University of Minnesota, and spent 15 years in industry as an engineer. For 13 years, Professor Johnson farmed and taught for UND in an MBA program at the Grand Forks Air Force Base.