AC 2007-520: ONLINE ASSESSMENT AND LEARNING INSTRUMENTS FOR COOPERATIVE EDUCATION STUDENTS: THE IMPORTANCE OF CO-OP DATA TO ABET

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Abstract *–The cooperative education programs managed by the Division of Professional Practice at the University of Cincinnati are academic programs committed to offer an education that meets ABET 2000 criteria. Cooperative education offers an opportunity for universities to assess at a formative level how well academic programs prepare students for career-related work experiences. An important goal of the University of Cincinnati is to provide improved market feedback to the degree granting departments to insure the department can meet the ever changing needs of industry. The online assessment tools described in this paper will help to close this feedback loop.*

Introduction

The introduction of the Accreditation Board for Engineering Education Engineering Criteria 2000 (ABET EC 2000) comprises a considerable milestone in the evolution of engineering and engineering technology education. The new ABET criteria strongly accentuate a sensitivity to market needs. Measurement, feedback and continuous improvement form the corner stones of the ABET EC 2000 philosophy. [1]

Cooperative education and internship programs have historically collected employer and student performance evaluation data each term. These evaluations have been used to reflect on and improve student or employer performance, however, the data has not been used in a formal way to provide feedback to engineering departments relative to academic educational goals, nor were the assessment tools designed to do so. [2]

Cooperative education evaluation data has become increasingly important to engineering department administration as part of the overall measurement of the departmental education quality. This primarily stems from the fact that co-op programs work very closely with engineering employers soliciting their feedback on a term by term basis throughout the co-op process. Immediate feedback on market needs can be gained through the proper use of co-op evaluations. Therefore, great emphasis has been placed on developing evaluation criteria that meet the needs of the cooperative education programs and the ABET needs of the college or university. The University of Cincinnati (UC), along with many engineering cooperative education and internship programs recognized this assessment need, and developed new assessment tools in the late nineties in anticipation of the new ABET 2000 engineering criteria.

Until 2003, evaluations were gathered on paper, making the charge of analyzing and summarizing feedback for the departments a time consuming, if even possible task. The ease of using online data collection and evaluation tools has greatly

improved the ability to quickly collect, compile and distribute data. This paper will discuss how online assessment systems not only support the assessment of instructional goals, but also the overall educational goals of departments as well as the Division of Professional Practice.

Examination of Assessment Literature

There are many options that colleges and universities have employed to assess student learning from assessment centers, to coursework cluster analysis, to student self evaluation. As institutions differ so too should their strategies for assessing student learning. Ratcliff and Jones propose a Coursework Cluster Analysis Model as a way to establish a link between the college courses that students completed and the general learning that they demonstrate through evaluation. Particularly in an institution with wide curricular offerings and a propensity to vary the curriculum from one year to the next, this type of analysis can shed light on student development in the general education area however it has not been as effective to demonstrate learning within the major. [3]

Assessment Centers in which students are given a set of simulations to assess their readiness to enter the profession have been used in teacher education by Indiana University of Pennsylvania, Millersville and Slippery Rock Colleges. Through Development Dimensions International these institutions designed and implemented a diagnostic teacher assessment center. The assessment center profiles an education major's strengths and weaknesses in thirteen skills that were identified as critical for effective teaching. The information that is being gathered is also being used to redesign current methods of teaching courses. [3]

Another technique used in assessment is the student self-evaluation in which students are asked to describe their own learning. Most frequently students are asked to complete an essay that reflects upon what they have learned and those essays are evaluated by a team of faculty members. This technique can not only illuminate aspects of the teaching learning process for faculty but also provides an opportunity for student growth through the reflective process. This growth goes beyond the knowledge of the subject matter and begins to delve into the important area of cognitive and affective measures of student development. Whereas facts transmitted in the classroom are unlikely to be retained in long-term memory, decision making styles, critical thinking and ethical reasoning abilities, interpersonal skills and identity formation created by the college experience will guide our performance in the workplace. [3] This form of assessment is often present in cooperative education programs as well.

When faculty hold themselves accountable for the students' development in cognitive and affective areas, not simply for discrete bits of knowledge for a particular course, a culture emerges where the assessment process improves student learning. This is the case at Alverno College. Faculty at Alverno College have developed a curriculum designed to help each student develop to his/her full

potential and will not allow any student to graduate who has not demonstrated effectiveness in eight specified abilities. Even before assessment was widely understood and practiced in higher education, the faculty at Alverno College was assessing their graduates as a pre-requisite for graduation. An independent Office of Research and Evaluation validates these performance assessment techniques designed by the faculty in addition to investigating how curricular elements cause learning, how college learning affects the performance of alumnae, and how alumnae abilities compare to outstanding professionals in their fields. Alverno College was clearly focused on assessment of student learning outcomes early on yet for the majority of institutions the focus on student learning outcomes came at the hands of outside accrediting bodies. [3]

While the assessment movement is relatively new to higher education, student and employer assessment is nothing new to cooperative education programs. Historically cooperative education programs have been more effective at gathering programmatic assessment data than other academic units due to our external focus on employer feedback. Cooperative education has traditionally relied upon using multiple data collection methods from multiple perspectives as well as using student-constructed methods of evaluation throughout all phases of student development. However, most assessment tools focused on student and employer performance. Not until the recent focus on engineering program outcome assessment by ABET did co-op programs focus more on program and learning assessment versus performance assessment alone. [4]

Program and Assessment at the University of Cincinnati

Co-op has historic roots at the University of Cincinnati. The concept was developed by Dean Herman Schneider in 1906. Today the Division of Professional Practice offers cooperative education programs for students enrolled in 44 majors distributed over five colleges. The centralized organizational model, enhanced by the Division of Professional Practice's status as an academic unit, has allowed the university to develop a globally significant cooperative education expertise.

At the UC, the College of Engineering and the College of Applied Science enroll a total of 3,100 undergraduate students. All full-time day students are enrolled in mandatory co-op programs, which constitute a significant differentiator of the UC programs in the market place. Last year UC students co-oped with 1,500 employers in 34 states and 16 foreign countries. The UC's academic year consists of four quarters (autumn, winter, spring and summer). The Cincinnati co-op model is based on alternating sections by quarter as illustrated in Table I.

Table I

Alternating Co-op Schedule

				1		2		3		4		5	6					Section 2		
					1		2		3		4		5		6			Section 1		
F	W	S	S	F	W	S	S	F	W	S	S	F	W	S	S	F	W	S		
Freshmen			Sophomore			Pre-Junior			Junior					Senior						

School ▮   Work ▯

The students enrolled in each major are divided into two sections. As one section is in school the other is on a work assignment and vice versa. Each student completes six quarters of co-op, over three of their undergraduate years. Engineering and Engineering Technology students average 1.7 employers per student. This alternating schedule requires the university to offer all sophomore, pre-junior, and junior courses twice during each academic year.

Co-op students are assigned to a Professional Practice (co-op) Faculty Advisor by discipline area. This faculty advisor is responsible for all aspects of the cooperative education program for their assigned disciplines. Co-op students are required to complete an "Introduction to Cooperative Education" class in their first year, apply for and be accepted into the co-op program by meeting specific college criteria. Students are also required to meet with their faculty advisor in advance of each new co-op assignment to discuss future plans and at the completion of each co-op assignment to reflect upon and discuss past experiences. Students are registered for cooperative education during the quarters they are on work assignment and are considered full-time students during their co-op work terms.

Students are required to complete learning objectives, a learning module on a specified topic as determined by the professional practice faculty and a student report (student evaluation) for each work assignment. Employers are asked to evaluate the achievement of student learning objectives as well as students' understanding of the focused learning objective for the term as determined by the Division via the learning module. Employers also complete an assessment that concentrates on skill development based upon the work performed during the quarter. Faculty co-op advisors evaluate student learning as demonstrated by the learning module and review and discuss the objectives and evaluations with the students in the individual student meetings. Traditionally hard copies of a portion of the employer evaluation have been provided to the engineering departments each term which document the actual work performed as well as the employer's perspective on the relevance of that work to the student's discipline and career

goals. Students receive a passing grade for cooperative education if the work experience and the required paperwork are satisfactorily completed. This grade is recorded on the student's transcript. [5]

The assessment instruments used by the University of Cincinnati (UC) were developed using ABET EC 2000 criteria as one of many points of reference. UC also referred to the criteria of other accreditation bodies to which our programs must adhere as well as the university's general educational goals. The assessment instruments were designed to be used with Engineering programs as well as all other co-op disciplines including those from the College of Business and the College of Design, Architecture, Art and Planning. UC uses a three-party assessment system in which feedback from students, employers and professional practice faculty members form a comprehensive feedback loop. Many questions that are used in one assessment instrument are mirrored in another so that UC receives important feedback from multiple perspectives.

In the student's assessment of their professional practice assignment they are asked to assess the experience itself, their learning from the experience, their skill development and the co-op position as well as to plan for their future growth and development. Students are also asked to focus on three areas of new learning each term. One area has been determined by UC and is assessed via a learning module which focuses upon topics such as organizational culture, technology, professional ethics and the integration of theory and practice. The other two learning areas are determined by the student and employer in the form of learning objectives for the term.

In the employer's assessment of the professional practice student they are asked to evaluate the student's skill development in several key areas, the relevance of the position to the student's discipline and career goals, provide an overall assessment of the student's performance during the work term and provide input to assist the student's growth and future development. Employers are also asked to evaluate student learning as demonstrated through the learning module on the quarterly topic as well as their mastery of the two learning objectives that each student sets per term.

Finally the co-op faculty member assesses student learning as demonstrated in the learning module as well as providing an overall assessment of the work term. This assessment combines the input from the student assessment instruments, the employer assessment instruments and the individual meeting that takes place between the faculty member and the student in which all pieces of assessment are brought together, reviewed and discussed between the student and their professional practice faculty advisor. This comprehensive assessment methodology was developed to maximize the overall comprehension of student learning through cooperative education as well as to contribute to students' growth beyond the co-op work experience through critical self reflection and a series of dialogues with employers and faculty members. [6,7, 8, 9]

Benefits of Moving to Online Assessment

Data collection and analysis can be a tedious task especially when it is manually driven. The time and resources required to compile and report data gathered through paper assessment tools has been a roadblock for providing ongoing feedback to the engineering departments. The ease in data collection and compilation is probably the greatest benefit of moving to online assessment; however, there are many other benefits to be realized.

*Higher quality / more complete information***:** The ability to tie university and placement databases into the online assessment system eliminates the need for students to self-report demographic data, ensuring more accurate assessment information. Tracking of missing evaluations and the ability to re-remind students and employers to complete required information can be automated or easily monitored. Forms are readily accessible and always available, unlike paper forms, which can be misplaced.

Real-time data access / reporting: Evaluation data and standardized reports can be viewed by students, employers, faculty and staff as soon as answers are submitted.

Ease of form modification or specialization: Online forms can be quickly and easily modified as needed. Additionally, assessment systems can be developed to provide custom evaluations based on major, co-op quarter, or other unique parameters as desired.

Ability to easily manage and store substantial amounts of data: When creating a fully integrated assessment system, programs may have many different instruments completed by various constituents per placement. Online systems can easily manage the storage, compilation, and reporting of this data.

Challenges in Online Assessment

Online cooperative education and internship assessment creates many challenges for any university. The system can be equated to a picture puzzle, with each form and function constituting a piece to the puzzle, and having similar interconnectivity. It is very important to create the pieces with the end puzzle picture in mind.

Resources are always a challenge for system development and maintenance and UC has been successful in gathering and utilizing all available resources. These resources included grant or other program funding, co-op students, research assistants, and college or university IT systems and personnel. Online assessment development requires expertise in experiential education and in information technology, and the ability to meld the two together seamlessly.

Most co-op and internship programs utilize integrated or separate recruiting and placement databases. In addition, data may be pulled from existing university databases or be saved in preexisting electronic assessment data files. When creating a new system, the challenge is to pull from, combine, or replace current databases into one fully integrated system. Uniformity in data is important, since maintaining student and employer data without a common data structure or warehouse can cause reporting discrepancies (e.g. General Electric could be counted multiple times as an employer if entered as GE, General Electric, and General Electric Co. by different students).

Online systems typically integrate features beyond assessment and require a change in office procedures. Determining how to best apply the system to current office processes, developing training and integration plans, and communicating the changes is one of the biggest challenges. This requires discussions with faculty, staff, and other university personnel to ensure that the new systems and process will be a good fit and do not negatively impact others work. In many cases, trial and error allowed us to find potential problems and begin to design around them. As the online system evolves it is slowly recreating the entire information flow within the Division.

Technical Description of the online systems at the UC

Cooperative education programs typically apply on-line systems to a multitude of tasks. Currently, most cooperative education programs use technology to manage their recruiting and placement functions. UC has used a program called Place Pro, designed and purchased from Robotechnologies. Place Pro is a web based system housed and supported by Robotechnologies. UC has back-end access to pull from, but not push to, this database. Place Pro houses more than 10 years of UC Cooperative Education student, employer, and placement data.

Place Pro could not adequately support the comprehensive assessment system used by UC. Therefore, the Division of Professional Practice chose to build a system that could. The UC Professional Development and Learning (PAL) System was developed fully in house by a team of faculty and IT/computer science/computer engineering/digital design cooperative education students. Over a five-year period, the system grew from a very simple on-line form to collect student reports, to a fully functional cradle to grave registration and assessment system.

PAL's main SQL database and server side programming (ASP) reside on the UC server cluster. This program can access and pull data from the Place Pro database, to ensure a common format across all data sets (for example, that student and company names are consistent across both databases). A web based system is used for the client-side interface. This system can be access 24/7 from any

location with Internet access. Our "clients" are our students, employers, and faculty members in the Division.

Functional Description of the online systems at the UC

The UC system consists of three interconnected components, a student system, an employer system and a faculty system. Within each of these three components there exist multiple assessment instruments which feed data into one central assessment database.

The student system: Each quarter students must first register their quarter placement with the online system. This serves the dual purpose of collecting student placement data and using it to register students with the university for their co-op quarter and it "turns the system on" so students are able to see all of the forms and instructions. Students then have the ability to review, save, edit and submit the necessary documents, including viewing their co-op evaluation history.

The Employer System: The Employer system has two parts, one for the main company contact and one for the students' direct supervisor. The direct supervisor can view the students completed learning module and complete the employer evaluation and learning objectives assessment online. Employers are not able to view students confidential comments related to the co-op work assignment, as UC places a high value on encouraging honest feedback from our students regarding their co-op positions. The main company contact can view the evaluations for all students working for their company, view placement history and also view and update company job descriptions, and alert UC of impending employment needs.

The Faculty System: The faculty system has multiple components. The primary component is the system which will be used by Professional Practice (co-op) faculty members to monitor assessment data on co-op student learning. This system allows co-op faculty members to view the assessment data that has been submitted by both students and employers. It provides email functions that allow faculty members to send reminders to those students and employers who have yet to supply assessment data. The system will enable faculty members to view reports of aggregate student learning data in real time which would have previously required significant man hours to compile and analyze.

Communication of Data to Faculty and Administration

The ultimate goal is to effectively gather data that can be communicated to faculty and administration for programmatic improvement. Even before these online systems engineering departments have always received co-op and intern feedback in some form. At UC, copies of a portion of the employer evaluations were compiled by major and provided to the department heads.

With the development of the new assessment systems, it is feasible to provide more comprehensive assessment data in a desirable format to the engineering departments. Since departments need to report to ABET, they will benefit greatly from information on their students' participation in co-op as well as information on students' and employers' perceptions of the academic preparedness. Due in part to the US Department of Education's Fund for the Improvement of Postsecondary Education (FIPSE) secured in 2004 by the University of Cincinnati, academic departments are now provided with real time data not only on an individual student's skill development but also on the skill development of an entire class of students.

The University of Cincinnati is embarking on the second century of cooperative education by creating a vibrant new partnership with faculty interested in curricular reform. Using over 200,000 data points produced annually through co-op employer evaluations we are able to create a feedback loop that shows the impact of teaching through student co-op performance. This information is being used in curricular reform projects around campus to both illuminate areas for reform and to measure the impact of changes on co-op student performance. The University of Cincinnati has been awarded a $1 million US Department of Education Fund for the Improvement of Postsecondary Education [FIPSE] grant to be used for the Development of a Corporate Feedback System for Use in Curricular Reform.

Using aggregated data from employer assessments of cooperative education student work performance to measure curricular effectiveness forms a cornerstone of outcomes based assessment at the University of Cincinnati. One problem is that results may get buried in both measurement and statistical uncertainty. Enrollment numbers of a single work term may be too small to provide high measurement certainty. University of Cincinnati research shows that the situation can be alleviated by applying Six Sigma Process Stability Analysis (PSA) to data covering multiple academic years of pedagogically stable programs. Stable programs are in this context defined as mature offerings, having relatively small annual fluctuations in curricular offerings. The stability of a process allows the aggregation of statistically relevant data over a sustained period of time to look at student skill development as a function of the curriculum. This presentation focuses on demonstrating the effectiveness of a methodology relying on comparing means and standard deviations of student work term performance indicators. The results are communicated through Mean Standard Deviation Matrixes (MSDM's) or Delta Mean Standard Deviation Matrixes (ΔMSDM's). [9]

As departments recognize the value in the data collected, they may become more demanding in their data requests. Because it is time consuming and complicated to summarize and compare written responses, better methods of mining common responses and reporting them back to the departments would be beneficial even with an online system. With the improved ability to collect assessment data, we will also need to be more diligent in regressing and analyzing this data. It may be

possible to connect the assessment database into university statistical analysis software to allow us to look more closely at trends in responses at points during a students' co-op career. This elevates the analysis beyond that of the cooperative education office and brings in data that the university routinely collects to provide a more thorough basis for regression and analysis of data. This potential to provide assessment data that is external to the institution and grounded in business and industry may become an important contribution that cooperative education can provide to higher education in the knowledge economy.

To achieve this goal the creation of a comprehensive and flexible reporting system for students, employers, faculty and staff in the program and in the supporting departments is needed. Ideally all reporting can be queried, viewed, downloaded or printed from the online system. Adding the ability to integrate statistical analysis tools into the system, or to allow for an easy data pull into statistical programs if desired is an important feature that will enable this reporting system to meet the growing need for assessment data that can truly inform the educational process. Incorporating customized questions based on curriculum changes, program changes, specific assessment needs, or other unique needs that can be asked on a periodic basis will enable the online system at the University of Cincinnati to evolve into a new paradigm for cooperative education at UC based not only upon co-ops ability to enhance student learning but also to enhance organizational learning as the institution incorporates co-op data into an ongoing dialogue.

References

1. Cates, C. L., Cedercreutz, K., and Trent, L. W. (2003) The current evolution of cooperative education at the University of Cincinnati. *Proceedings of the 2003 American Society of Engineering Education Conference for Industry and Education Collaboration.*
2. Schuurman, M., Todd, A., Cates, C. & McClintic, R. (2004). Online assessment and learning instruments for co-op and internship students: closing the loop. *Proceedings for the 2004 American Society for Engineering Education Conference for Industry and Education Collaboration.*
3. Banta, Trudy W. et al. (1993) *Making a difference: Outcomes of a decade of assessment in higher education.* San Francisco: Jossey-Bass.
4. Cates, C., and Jones, P. (1999) Learning Outcomes: The Educational Value of Cooperative Education. Presented at the Annual Cooperative Education Association Conference, Columbia, MD.
5. University of Cincinnati (2002) *Co-op Curriculum materials, Professional Practice.* McGraw-Hill Primis Custom Publishing.
6. Astin, A. (2002) *Assessment for Excellence: The Philosophy and Practice of Assessment and Evaluation in higher education.* Westport, CT: Oryx Press.
7. Banta, T., Black, K., Lund, J. and Oblander, F. (1996*) Assessment in practice: Putting principle to work on College Campuses.* San Francisco: Jossey-Bass.
8. Palomba, C., & Banta, T. (1999) *Assessment Essentials.* San Francisco: Jossey-Bass.

9. Cates, C., & Cedercreutz, K. (in press). The use of cooperative education in curricular reform: The ABET feedback cycle realized. *Proceedings for the 2007 American Society of Engineering Education Annual Conference.*