Web-Based Technology for Long-Term Program Assessment

Heidi Diefes-Dux, Kamyar Haghighi
Purdue University, West Lafayette, IN

Abstract

During its first round of assessment plan implementation, the Department of Agricultural and Biological Engineering (ABE) at Purdue University collected data utilizing a variety of assessment tools including ABET-compliant course profiles and constituent surveys. The man-hours involved in the development of program unique assessment tools and data collection and analysis is astounding, especially when a university adopts a decentralized stand on individual program assessment. The question is constantly raised about whether individual engineering departments can afford to devote so much faculty, staff, and student time to the data collection and analysis process. This paper will highlight how ABE has addressed this issue through in-house development of a web-based data collection process.

I. Introduction

In December 1998, the Academics Program Committee (APC), an ABE departmental committee comprised of faculty, staff, and student representatives, was charged to coordinate and lead the departmental ABET effort for a Fall 2001 review. At that time, the only school of engineering at Purdue University to have made any headway in deciphering EC 2000 was Civil Engineering, and the Deans of Engineering placed the development and implementation of assessment plans clearly at the department/school level. This means that each engineering school was charged with creating their own means of data collection, interpretation, and analysis. For large schools with substantial resources, such as Chemical Engineering, it was possible to hire outside consultants to develop assessment tools, collect data, and analyze results. A small department like ABE does not have similar resources. The APC committee, with support of the ABE faculty, had to develop their own assessment tools and, with the staff support, conduct and analyze the results in-house.

II. Program Outcomes - A Common Survey Item

The assessment tools that ABE has developed include surveys of alumni, employers, graduating seniors, faculty, and students. When collecting data, a common set of questions is needed to compare the responses of the different constituents. Program Outcomes (PO), broad descriptions of what a graduate will be expected to know and be able to do after completing an academic program [1], can be used as a basis for the common questions. Performance criteria (PC) are specific and more directly measurable skills and abilities [2]. Under each PO, there are on average 5 PCs for a total of 60 PCs. While POs are generally regarded as not directly measurable, the number of performance criteria that fall under each PO is unwieldy for individual student and alumni evaluation and program modification/change. In an attempt to have an acceptable return rate of completed surveys, ABE kept the length of each survey appropriate for the perceived passion each constituent has for our program. Therefore, ABE elected to have the constituents evaluate the program based on overall achievement of each PO.

More program details were evaluated in the Senior Exit and Alumni surveys though the language of the PC was not explicitly used. The faculty explicitly evaluated by the PCs in the course profiles [2], another assessment tool used by ABE.

Table 1 lists the Program Outcomes for one of the ABE accredited programs: Food Process Engineering (FPE). The PO list appears in all surveys typically with two 5-point Likert scales that ask the respondent to assess for each PO the level to which the program addresses the PO and the level of career importance (or anticipated career importance) of the PO.

Table 1. FPE Program Outcomes (*draft*).	
Graduates of our program will demonstrate:	
Basic Engineering Skills	
1.	an understanding of the fundamental principles of mathematics and science;
2.	an understanding of food process engineering principles;
3.	the ability to design and/or conduct experiments to analyze food systems and processes;
4.	an understanding of, and the ability to, identify, formulate, model and solve problems for food process engineering systems;
5.	an ability to design a system or process to meet desired needs in the area of food process engineering;
6.	effective use of appropriate techniques, skills, and state-of-the-art engineering tools necessary for engineering practice;
Professional and Personal Skills	
7.	an understanding of the global and societal impact of engineering practice, research and discovery;
8.	a knowledge of contemporary issues;
9.	appropriate and effective writing, speaking, and listening skills;
10.	the ability to function on, and contribute effectively to, a multi-disciplinary team;
11.	the ability to understand and practice ethical responsibility in personal and professional life;
12.	an appreciation for the value of life-long learning to maintain “life-balance” and achieve maximum potential.

For ABE's initial round of assessment under EC 2000, overall low scoring POs were further investigated to identify specific areas of improvement. The detailed questions of the Senior Exit Survey, Alumni Survey, and course profiles provided quantitative and qualitative feedback on specific courses and course content that enabled ABE to identify areas needing improvement. Diefes-Dux and Haghighi [3] describe the details of the improvement process, specifically how survey results are used in making recommendations and implementing program change.

III. On-line Surveys

After conducting a number of surveys on paper, it became evident that the cost and time involved for bulk mailings and data entry, especially open ended responses, could be minimized by placing the evaluations on-line. Three surveys are now available on-line: the Senior Exit

Survey, the Alumni Survey, and the Employer Survey. The content of each survey is briefly described below.

A. Senior Exit Survey

Seniors complete the senior exit survey at the end of their final semester as part of the requirements of their capstone design course. This survey is in six parts. The first part is concerned with personal information: contact information, ABE club and Purdue student organization membership and leadership, professional society memberships, and intent to take the Fundamentals of Engineering (FE) Exam. The second part of the survey gathers data on the student's immediate career plan following graduation.

The third part is a comprehensive evaluation of the Purdue education. It starts with the 5-point Likert assessment of the POs; both the level to which the program was successful in meeting the POs and the anticipated importance of each PO in the students' initial permanent employment are assessed. The seniors are then asked to evaluate their level of competency and the quality of instruction by specific subject area using the 5-point Likert scale. The subject areas are broken into three categories: basic and engineering sciences (e.g. math, chemistry, thermodynamics), general education (i.e. English, communication, economics, international understanding), and degree option specific topics (e.g. food chemistry, process design, plant design). This is followed by a free response to the question: "Are there technical subject areas that you believe should be added to the required component of the ABE curriculum? Also, please be specific as to what existing courses should be eliminated to maintain the minimum graduation requirements." Next, the seniors are asked to evaluate on a 5-point Likert scale the effectiveness of laboratory experiences and computer based projects in each ABE core course. Seniors are also asked to evaluate the frequency and effectiveness of exposure to a variety of communication methods (e.g. e-mail, technical writing, business writing, oral communication). Finally the seniors are asked to evaluate their competency in using a number of computer tools (e.g. operating systems, spreadsheets, engineering computation tools, data acquisition tools). A free response section is available to the seniors to suggest improvements to the laboratory, computer, and communication components of the program. This part concludes with a free response section that allows the students to convey in which course they learned about teaming and in which course they had the most effective teaming experience.

In the fourth part, the overall educational experience is evaluated. Again, a 5-point Likert scale is used to evaluate the quality of instruction and the availability of technical and non-technical courses, the quality of teaching faculty and facilities, quality of counseling, advising and scheduling, the quality of career guidance and career related opportunities, and quality of ABE club experiences.

In the fifth part, coop and internship experiences are evaluated. Using a 5-point Likert scale, seniors are asked to evaluate their level of competency and the perceived importance of a series of 24 skills (e.g. analysis/modeling, computer, communication). Seniors are also asked to evaluate their level of competency and frequency of use of a variety of communication methods during their internship/coop.

The survey concludes with a free response to the question: "What other suggestions would you offer to the ABE department that would help us better prepare students for an engineering career in the twenty-first century?"

The overall response rate for seniors was 100% since the completion of the survey is tied to the requirements of the capstone design course. A total of 6 ABE and 4 FPE December 1999 seniors 16 ABE and 12 FPE May 2000 seniors completed the survey. Of those graduating in May 2000, 6 ABE and 4 FPE seniors completed the survey on-line. During May 2000, students filled the survey out in class where the ABE faculty had more control over who was completing the survey. Those that did fill the survey out on-line did so because they had missed the class. This did allow us to test the site and plan for full on-line processing in the coming semesters.

B. Alumni Survey

Alumni that had graduated from the department of ABE within the last 5 years were sent a letter requesting feedback on the ABE program and a hardcopy of the alumni survey. The list of alumni to contact was compiled from the Purdue Agriculture Development Office alumni list and the ABE alumni list. The original letter stated:

> *"One of the goals of the undergraduate program in the Department of Agricultural and Biological Engineering at Purdue University is to prepare our students for professional engineering careers.*
>
> *Since you are an alumni of our program, we believe that you are in a good position to provide feedback on the importance of certain aspects of our program. This feedback is important in our effort to achieve continuous quality improvement in order to maintain a curriculum responsive to the needs of our employers."*

As an incentive to return the survey, an ABE pen was enclosed. This letter was followed-up with a postcard reminder and a web address for the newly developed on-line survey.

This survey closely parallels the Senior Exit Survey. It consists of seven parts. The first and second part asks for contact and career path information. The third part focuses on the evaluation of the Purdue education. The only difference between this section and the same section in the Senior Exit Survey is that references to particular course numbers in the evaluation of laboratory experiences and computer projects are replaced with free responses to the questions: "Are there laboratory experiences that you believe should be a required component of the ABE curriculum?" and "What other software tools do you believe students should be exposed to in the undergraduate ABE curriculum?"

The fourth part is the overall educational experience evaluation; this section appears exactly as it does in the Senior Exit Survey. Part five asks the alumni to evaluate their level of preparation, the career importance, and the frequency of use of the series of communication methods and skills listed in the Senior Exit Survey. Part six is a free response for other recommendations. The Alumni Survey concludes with a series of options for alumni involvement in the department (e.g. alumni events, student recruiting, newsletter article contributions).

The overall response rate for alumni was 17% (42 responses out of 241 contacts). Letters were sent to 140 ABE and 101 FPE alumni. The initial hard copy response was 19 and 20, respectively. An additional 2 ABE and 1 FPE alumni responses were collected via the web after the postcard mailing.

C. Employer Survey

Employers of ABE graduates, coops, and interns were mailed a letter similar to the Alumni Survey letter, a hard copy of the survey, and an ABE pen. A reminder postcard and the URL of the new survey web site followed this initial letter. A list of employers contacted was originally generated by the ABE Placement Coordinator and expanded by mailing a copy of the Employer Survey with the Alumni Survey and asking alumni to pass the survey on to their employer.

The employer survey is brief. It essentially consists of contact information, Purdue ABE graduate, intern, and coop hiring numbers, and an assessment of the POs. Employers use the 5-point Likert scale to assess the mastery of & level of importance of POs in their organization. A free response section is also included to allow employers to provide additional comments or indicate any specific topics, courses, computer skills, and/or emerging technologies that they believe the ABE program should emphasize.

The overall response rate for employers was 33% (48 responses out of 146 contacts). Letters were sent to 70 ABE, 70 FPE, and 6 ABE/FPE employers. The initial hard copy response was 16, 12, and 6, respectively. An additional 7 ABE and 7 FPE employer responses were collected via the web after the postcard mailing.

IV. Web-Based Structure

All online surveys are created using PERL and HTML. The survey sites consist of standard form widgets: text entry boxes for contact information and free responses, radio buttons for Likert scale items, and pull-down menus for forced selection items such as yes/no responses. The data submitted through the survey web pages is automatically placed into a delimited text file, which is readily imported into a prepared database. Once the data is in the database, spreadsheets perform the data analysis and produce graphs that are made immediately available to the user for program evaluation. To date, about 90% of the PO driven charting is done automatically [3].

V. Development Time and Costs

It was fortunate for APC that one of the student representatives was well versed in PERL and HTML programming. Students obtaining Computer Technology degrees would have similar skills and are often looking for hands-on experience. This student volunteered to develop the on-line Senior Exit Survey, a job for which he was hired to complete along with the Alumni and Employer Surveys. Overall, this student worked on this project for one year, for about 10 hours per week.

A huge concern is the maintenance of the site after the student designer leaves the department. Much effort went into coordinating a technology transfer from the student to a permanent staff member. It was felt that a permanent staff member is needed to maintain and monitor the site to provide continuity while other designers may be brought in periodically to develop new on-line assessment tools. ABE recently hired a new staff person, Academic Programs Specialist. It is estimated that the maintenance and monitoring of the site will comprise 2-5 hours per week of this person.

VI. Future Uses of the Web in Assessment

Plans for continued on-line development include making all ABE department surveys used for program assessment web-database ready, with the ultimate goal of 'one-click' updating and graph production. Faculty and student assessment of the POs by ABE course are the next surveys to be translated to on-line surveys. It is envisioned that course profiles [2] which are developed and maintained by faculty will also be available on-line. Placing the course profiles on-line for updating presents a greater design challenge as 1) current profiles would need to be made available for downloading, 2) a means for uploading edited profiles would need to be available, and 3) a flag would need to be sent to the faculty body maintaining and monitoring the assessment process [3].

To ensure continuous improvement of the program, ABE can expect that changes will be made to the educational objectives, program outcomes, and curriculum as well as the evaluation and assessment plan. Obviously, this impacts the on-line data collection both at the user-interface level and in the data analysis process. APC believes that further training of the Academic Programs Specialist will enable this level of in-house maintenance of the assessment tools.

Conclusion

The time and costs associated with continuous assessment of a program can be manageable. The use of available technology and talent in using the technology early on in the development of assessment tools will minimize staff time in the long term. A local champion comfortable with technology and a passion for assessment is needed to maintain and monitor a web-based assessment process. It is anticipated that the survey return rate will improve as we transition from paper-based surveys to web-based surveys over the next few rounds of assessment.

Bibliography

1. Aldridge, M.D and Benefield, L.D. A Model Assessment Plan. *Prism.* 7(9) (1998)
2. Diefes, H.A. and Haghighi, K. Development and Implementation of an ABET-Compliant Course Profile & Assessment Model, ASEE National Conference, St. Louis, MO. (2000)
3. Diefes-Dux and Haghighi, K. Implementing Change: A Model for Closing the Continuous Improvement Loop the First Time and Every Time, ASEE National Conference, Albuquerque, NM. (2001)

HEIDI A. DIEFES-DUX

Heidi A. Diefes-Dux is an Assistant Professor of Freshman Engineering at Purdue University with a joint appointment in the Department of Agricultural and Biological Engineering. She serves on the ABE Academic Programs Committee which has taken the lead in educating the faculty about the ABET assessment process. She received her B.S. and M.S. in Food Science from Cornell University and her Ph.D. from ABE in 1997.

KAMYAR HAGHIGHI

Kamyar Haghighi is a Professor in the Department of Agricultural and Biological Engineering at Purdue University. He is the Chair of the Academic Programs Committee and is currently leading and coordinating the departmental efforts to prepare for EC 2000 and ABET 2001 review. He received his M.S. and Ph.D. from Michigan State University.