Integration of a New Course Evaluation Tool into a Comprehensive Departmental Assessment Plan

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Abstract – In an effort to immediately use valuable student feedback from final course evaluations, Valparaiso University’s Hesse Learning Resource and Assessment Center has worked with the Department of Electrical and Computer Engineering to optimize the format of the surveys themselves and procedures used to extract key information from those surveys in a timely manner so it can be used as part of departmental assessment efforts. Although preparing the necessary evaluation summary forms involves a great deal of work, the authors have developed a very organized method for focusing faculty and staff efforts in completing the project in a timely manner. The authors will present a detailed discussion of the structure used to prepare the course evaluations, how they are processed and summarized, and how the results of these efforts have become an integral part of the department’s assessment efforts, leading to real improvements in the quality of student outcomes.

Index Terms – Course Assessment, Evaluation, Surveys

INTRODUCTION

Forms of evaluation and assessment have existed for many years with many definitions and uses. One comprehensive definition presented by the Joint Committee on Standards for Educational Evaluation holds that evaluation is “systematic investigation of the worth or merit of an object.” [1] This definition indicates that evaluation or assessment should be done with a purpose in mind. Assessment generally has at least one of three purposes: to improve, to inform, and/or to prove.[2] Assessment can achieve all three of these purposes in the pursuit of excellence in engineering education.

Engineering Criteria 2000 requires that an assessment system demonstrate that educational objectives are being measured and show that the results of those measurements are being applied to further develop and improve the program’s effectiveness. [3] This can be accomplished by evaluating an engineering program in two very important and different ways.

The program outcomes must be assessed by determining whether students are meeting course learning objectives. These results show how well a program is accomplishing the established program outcomes. This type of assessment is typically done by integrating assessment tools into the regular grading process along with self-evaluation on the course surveys.

Assessment, however, requires not only attention to outcomes but also to the experiences that lead to those outcomes. [4] Course surveys or questionnaires cannot only be used to help measure the achievement of course learning objectives as discussed above, but also to determine ways to improve the course and the program. Assessment of a course within an engineering program would be incomplete without determining the reasons why students are or are not meeting course objectives. Assessment data collected will be useful in improving courses only if they are detailed enough to indicate why students are failing to meet minimum requirements on course objectives. [5] It is through the use of these detailed results that engineering programs are able to continually improve the education being provided for the students.

With this in mind, development of effective course surveys is very important in the assessment of a program. This is why it was one of the first tasks focused on by the partnership of the Hesse Learning Resource and Assessment Center and the Department of Electrical and Computer Engineering at Valparaiso University.

In the subsequent sections of this paper, several distinctive characteristics of this assessment effort are highlighted. In particular, the evaluation forms are carefully designed to provide a diversity of question formats, the results are thoroughly and quickly presented to the faculty in a standardized and graphics-rich format, and the results are directly integrated into the department’s comprehensive assessment effort and annual tenure review process.

The format of these course surveys has been optimized to include only those questions that will provide the most useful feedback, both formative (open-ended, providing suggestions for improvement) and summative (numerical evaluations of success or failure). The questions are organized into four broad categories: evaluating the quality of the course, the quality of the instructor, the students’ achievement of the course learning objectives, and ways to improve the course.

By using this structure, the course surveys can be used to generate immediate results that can easily be used by faculty to continually improve their courses. This processing involves creating a detailed report for each course as well as summary charts that help pinpoint and target problem areas within the department. Issues of instructor style can be separated from student learning outcomes, which promotes more effective assessment of the success or failure of each course.

Effective analysis and reporting of the results of course surveys can make the assessment of program outcomes far
more effective than simply studying the raw data. Faculty can easily review and compare similar sections in different course surveys, reducing the assessment workload. It also allows for easy comparison of the results of prior offerings of a course to current results. Faculty members are then able to quickly make decisions to improve the course each time it is offered.

**EVOLUTION OF COURSE EVALUATION**

During the first several decades of its operation, the College of Engineering at Valparaiso University did not focus a great deal of time or effort on assessment of courses, faculty, or students. Of course, at the time, very few engineering programs recognized the importance of such assessment, and it was only in the closing years of the twentieth century that organizations such as the Accreditation Board for Engineering and Technology (ABET) made it clear that engineering programs would not only be expected to assess their results, but that doing so could actually lead to substantial improvements in the quality of the education provided to students.

The department of electrical and computer engineering (ECE) at Valparaiso University first began to build the infrastructure necessary for a comprehensive assessment plan early in 1999. At that time, the only type of assessment system currently in place was an ad hoc Teacher/Course Evaluation (TCE) form completed by each student at the end of each semester. These forms were consciously designed to be entirely formative, with no quantitative evaluations of the quality of the course or the instructor.

As part of the development of a comprehensive assessment plan, it was agreed that the department should develop a uniform TCE form, and that it should have characteristics of both formative and summative evaluation. The ECE department was the first in the College of Engineering to develop a standardized course evaluation form, so the faculty did a great deal of research while designing it. After reviewing the course evaluation forms used by a number of peer and aspiration institutions, the faculty made some key decisions regarding the form they would use:

1. Each form would have both summative and formative components, allowing students to provide a numerical evaluation of the course as well as open-ended feedback for its improvement.
2. Each form would have a set of standardized questions relating to the quality of the course and to the quality of the instructor, which would allow for valid comparisons between courses.
3. Each form would also have a series of questions on which the students would be asked to assess their own ability to demonstrate each of the learning objectives associated with the course.
4. Finally, each form would have space for special instructor-selected questions that would allow the faculty to investigate student perceptions of unique instructional methods or novel pedagogical approaches.

The faculty selected six standardized questions related to the quality of the course and six other standardized questions relating to the quality of the instructor. At the same time, it was necessary to identify and agree upon a set of learning objectives for every course offered within the department.

These discussions were also leading to the development of a new assessment plan that would include two key principles to ensure successful implementation of the process with faculty support. These key principles were (1) to minimize faculty time commitment outside their normal course preparation and (2) to carefully design the data collection and analysis processes so that they could become transparent to the faculty. [6]

At the same time the department was establishing the framework necessary to improve the rigor of its course evaluations, the College of Engineering was taking a major step forward in providing the infrastructure necessary to implement that framework. Supported by a grant from the AT&T Foundation and made possible by an endowment from the family of former Dean Herman Hesse, Valparaiso University's College of Engineering established the Hesse Learning Resource and Assessment Center (HLRAC) in July of 2001. The center was established inside the engineering building with a full-time coordinator and 30-35 part-time student tutors. Based on its mission to “support recruitment, retention, and assessment in the college,” the HLRAC was designed to improve nearly every aspect of the College’s operation.

Information and special projects flow in and out of the center on a regular basis, providing many types of support for faculty and students. Two primary goals shaped the assessment efforts of the coordinator within the College of Engineering.

1. Forming a partnership with professors in engineering and related fields to communicate student needs and desired supplementary support to the classrooms.
2. Providing prompt organization of assessment results for the College of Engineering.

The center’s efforts began during Fall 2001 with administration of ECE course surveys, a career fair survey, annual student surveys, and alumni surveys, each of which were created and analyzed by the center for the first time. The assessment efforts of all three departments in the College were immediately bolstered, and faculty in each department sought ways to align their assessment plans with the resources of the HLRAC.

It was through the joint effort of ECE department faculty and the director of the HLRAC that the first standardized ECE course evaluations were delivered to students at the end of the Fall semester in 2001. As desired, the form included 12 standardized questions as well as one question for each course learning objective and a variable number of instructor-selected questions. Each of these questions was asked using a five-
point Likert-type scale, with the least positive response indicated by a 1.0 and the most positive response indicated by a 5.0. In addition, the back of each form included four standardized open-ended questions as well as optional instructor-selected open-ended questions.

**MEASURING COURSE EFFECTIVENESS**

When developing surveys to measure course effectiveness, it is important to remember that this assessment tool is asking the individual students to share their perceptions of the course. Written surveys provide many advantages such as the ability to cover a large amount of material while collecting unique student feedback that can easily be reported. Along with the advantages comes a disadvantage: the results are highly dependent on the wording of the questions, making the construction of the survey more difficult than it would appear. Some recommended ways to reduce the disadvantages of a survey are to carefully construct the instrument using both open-ended questions and forced-choice questions. [7]

Although Likert rating scales are the most commonly used forced-choice rating scales, they do offer some limitations when developing a survey. It is difficult to write the questions in an appropriate manner as to prevent biased results and to get the true opinions of the students. For these reasons, a slightly different method was used called the semantic differential rating scale. It consists of antonyms with anywhere from four to seven spaces between them for the student to indicate the space that best reflects their opinion. [8] Using this method provides an efficient way to collect the data like the Likert scale without as many limitations on the questions that can be used.

The ECE course surveys are broken into two main parts. The first part consists of three sections of questions designed using the semantic differential rating scale that make up the summative portion of the survey. The responses to these questions are recorded by the student on a standard Scantron form. The back of the Scantron form is then used for the open-ended questions that make up the formative part of the survey.

The first section of the newly developed course surveys is used specifically to evaluate different aspects of the course itself. It consists of the following six questions and antonyms:

1. How well organized and logically arranged was the course? *Organized ... Disorganized*
2. How much did the homework assignments help you learn the material? *Very Helpful ... Not at all Helpful*
3. Were the exams in this course fair and representative of the material? *Fair ... Unfair*
4. How useful was the textbook or course notes for the course? *Useful ... Useless*
5. How would you rate the workload for this course? *Too Much Work ... Too Little Work*
6. How would you rate the overall quality of this course? *Excellent ... Very Poor*

The second section is focused on the effectiveness of the instructor in the course. It is also composed of six common questions as shown below:

7. How would you rate the instructor’s knowledge of the subject material? *Excellent ... Poor*
8. How would you rate the instructor’s presentation of the subject material? *Clear ... Unclear*
9. How would you rate the instructor’s ability to answer questions? *Excellent ... Very Poor*
10. How enthusiastic and motivational in his teaching was the instructor? *Enthusiastic ... Unenthusiastic*
11. How approachable and helpful was the instructor? *Readily available ... Rarely available*
12. How would you rate the overall quality of the instructor? *Excellent ... Very Poor*

The third section of the survey focuses on how confident the student is in his or her abilities regarding the course objectives. This is one place where the survey will be different for each class. The section starts with two common questions to determine how aware the student is of the course and program objectives followed by questions about the specific course objectives. For example, the following course-specific outcome questions were taken from the course survey for ECE 465, Probability and Statistics for Electrical and Computer Engineers:

13. Are you aware of the expected outcomes of this course and how they relate to the electrical and computer engineering program outcomes? *Yes, Definitely ... No Not at All*
14. How well did the topics covered in this course match the expected course outcomes? *Very Well ... Not At All*
15. Can you calculate and apply the probability distribution of the sampling mean for a particular statistical experiment? *Yes, Definitely ... No Not at All*
16. Can you calculate the parameters of a simple linear regression, including inferences about whether or not the slope is zero? *Yes, Definitely ... No Not at All*

A typical course will have six to ten course learning objectives, and one question is asked about each in order to give students an opportunity to report their self-assessment on every course learning objective.

The last section in the summative portion of the survey is devoted to instructor-selected questions. This is particularly useful in courses where a new teaching technique is being used or the grading system has been changed. Some typical questions that have been used in this section are listed below:

17. How would you rate the overall quality of the laboratory experience? *Excellent ... Very Poor*
18. Were the handouts and class notes an adequate substitute for a textbook? *Yes, Definitely ... No Not at All*
19. Did the in-class projects improve your learning of the course material? *Yes, Definitely ... No Not at All*
Although the results of the first four sections primarily provide summative results of what has happened in the course, they can cause the assessor to look further into how the problem areas thus discovered can be improved. The formative portion of the survey further investigates the underlying causes of these problem areas and how the course should be adjusted to address them.

The last section of the survey consists of open-ended questions to probe the student’s opinions of the course and why objectives were or were not met. The open-ended questions provide the advantage of not biasing responses by steering the students in a particular direction in their answer and are usually interesting enough that students want to answer them. [9] These questions will allow the student to open up and share their views.

This section begins with the following four common open-ended questions on all of the surveys:

1. What aspects of this course were most beneficial to you?
2. What do you suggest to improve this course?
3. What are the major strengths of this instructor?
4. What are the major weaknesses of this instructor?

While these will provide significant results, it is also helpful to allow the individual instructor to add a few questions to this section that are more specific to the course. Some examples are listed below:

5. What additional topics would you like to see included in this course?
6. What do you think of the lecture/exercise format of this course?
7. How useful was the laboratory to your learning experience?

Using this format, ECE course surveys are prepared for each course every semester by the Hesse Center. This preparation procedure requires minimal support from faculty members including any course objective updates and instructor-selected questions. After the surveys are given in class, they are returned to the Hesse Center for the generation of a course survey report for each class. The raw data of the responses is obtained using a Scantron machine, but that is only the beginning of the course analysis.

The summative section of the results is analyzed by first determining the number of students choosing each response category. To describe these responses, code numbers are assigned to each response category and a mean rating is calculated. The code numbers are assigned with 5 being the left (most positive) antonym and 1 being the right (most negative) antonym in the semantic differential rating scales. This method allows for easy comparison from one course to another and for a departmental average to be calculated for each common question.

The formative portion of the survey is then summarized on the course survey report by typing the responses verbatim at the end of the report and sometimes grouping similar responses. By summarizing these results together, the course instructor can then easily draw conclusions about the students’ opinions.

In addition to the individual course survey reports given to faculty members, two more comprehensive reports are prepared for the department chair. This report helps the chair to see an overall picture of the effectiveness of courses taught in a semester and the performance of the instructors.

The first of these reports focuses on the questions relating to the instructor and is called the Instructor Overview Report. This report is primarily used to report and compare mean ratings achieved by the instructors on the questions in this survey. An average of the mean rating for each question in this section across all his courses is calculated and compared to the departmental average for each question. The average of these individual question mean ratings is then calculated to represent the overall average performance of an instructor during a semester.

This instructor summary is presented to the department chair to make important decisions about course teaching assignments and the possible need for professional development among tenure-track faculty who do not meet departmental expectations. Typically, results from a single semester will not be used to make a quick decision, but trends over a period of two or more such reports will provide the feedback necessary to effectively assign faculty to courses that best match their teaching styles and professional interests.

The second report concentrates on the questions relating to course-specific outcomes. While similar to the first, this report goes a step further to provide a visual representation of how well each course is achieving its outcomes. An average is calculated of the individual mean rating on all the course objective questions in order to provide an overall performance rating for the course. These are then used to create a performance rating bar graph, which allows for easy comparison between courses. This chart also includes data from previous semesters to evaluate the effectiveness of changes that have been made to a course.

This report is much more heavily integrated into the department’s assessment plan than is the instructor-specific report. Since it focuses on the students’ self-assessment of their own learning rather than their interactions with a particular instructor, it is more appropriate to use this tool in making department-wide decisions about the curriculum and its courses. This report is the first item reviewed at each departmental assessment meeting, and its contents are frequently the first indicator that changes need to be made to a course or its learning objectives.

While the preparation of these reports brings to an end the work done by the Hesse Center, the assessment process does not stop when these reports are complete. The ECE department faculty completes the continual improvement process when they study these results and look for ways to improve their courses.
IMPROVING COURSE EFFECTIVENESS

The ECE department assessment plan provides a comprehensive structure for assessing the extent to which the courses, curriculum, and instructional methods used within the department contribute to the achievement of the program outcomes. These outcomes are carefully selected to support a set of program educational objectives for each of the two degrees offered within the department. These relationships between courses, program outcomes, and program educational objectives are shown graphically in Figure 1.

While the courses, curriculum, instructional methods, and outcomes are determined by the department faculty, they must be selected in such a way as to support a set of program educational objectives, and these objectives must be determined in collaboration with the program's constituents. The departmental plan for ensuring that the program educational objectives match the needs of its constituents is shown schematically in Figure 2. As shown in this figure, the ECE faculty are responsible for integrating feedback from program constituents in determining whether and how to update the program objectives.

The HLRAC provides a vital link in maintaining relationships with program constituents through interactions with employers and alumni, but the most important role of the center is in assessing the degree of success achieved by the department in accomplishing its outcomes and objectives. A schematic representation of this process is shown in Figure 3. This figure illustrates the interaction between departmental faculty, the courses taught within the department, and the assessment tools used to measure those courses. The faculty perform two activities at each departmental assessment meeting: first, they review the assessment results, and then they review the assessment tools themselves. In this way, they ensure that the courses are being taught well, and they further ensure that their measurement techniques are both accurate and efficient. The outcome of each meeting is a set of recommendations for the revision of the assessment plan and/or improvements to the courses and the curriculum being offered by the department.

Again, the department faculty are responsible for integrating the results of the measurements completed by the HLRAC, leading to improvement of the courses and curriculum or, when appropriate, revision of the assessment tools used to measure those courses.

Of course, the TCEs are only one of several such tools used to continually assess the program's achievement of its outcomes and, thereby, its objectives. Among the other key metrics used by the department are:

- Student performance on the Fundamentals of Engineering Exam
- Results of course-specific performance metrics, such as scores received on particular questions of a final exam or evaluations of a design project report
- Results of student self-assessments on the senior exit survey, which is given to all students when they complete the program
- Results of the annual alumni survey, which is given to engineering alumni on the fifth anniversary of their graduation

Each of these metrics is administered and analyzed by the HLRAC in an effort to help the department faculty make informed decisions about how best to improve their programs.
In addition to being used as part of this achievement loop, the TCE results are used in two other ways. First, they are included as an explicit element in the annual merit evaluation of every faculty member. Reflecting the central importance of the university’s teaching mission, each faculty member’s performance in the category of teaching contributes at least 60% to their overall rating for tenured faculty and 70% for untenured faculty. The department chair has the authority to adjust these TCE scores when determining an annual rating for teaching (for such reasons as a new course preparation, a particularly difficult subject, etc.), but the TCE results form the baseline score for these annual evaluations.

In addition, the TCE scores form the foundation of the special evaluation given to tenure-track faculty each year to gauge their progress toward earning tenure. The tenure decision is made on the basis of five criteria (Teaching, Creative and Scholarly Work, Service, Professional Development, and Collegiality), but excellence in the other four areas cannot balance failure to excel in the classroom.

By focusing so many aspects of the department’s operation on the results of course evaluations, a natural concern is that the faculty who are perceived to be the easiest graders will receive the highest ratings, which will falsely make them appear to be better teachers than more rigorous instructors assigned to more challenging courses. However, it is through the use of a combination of instructor-specific questions, which can be negatively influenced by rigorous teaching, along with self-assessments of course learning objective achievement, which tend to be positively influenced by rigorous teaching, that a balance can be achieved.

This emphasis on the importance of the TCE results has led to significant improvements in several courses that had previously seen poor student assessments. Three examples help to illustrate the concrete improvements that have been achieved since instituting these course evaluations four years ago:

1. When student self-assessments of their ability to perform fundamental calculations of engineering economics dropped below 3.5/5.0, changes were made to the syllabus, textbook, and course structure. Within one year, the self-assessment scores had risen back to nearly 4.5/5.0. Exam scores in the course and performance on the FE questions related to engineering economics also improved after this change.

2. When student self-assessments of their ability to apply probability and statistics to problems of electrical and computer engineering dropped below 3.0/5.0, changes were made to the instructional methods, textbook, and course topic distribution. Self-assessment scores rose to more than 4.75/5.0 the next year. Exam scores and course grades also improved after this change.

3. When student self-assessments of their ability to recognize and respond appropriately to ethical dilemmas dropped to below 3.5/5.0, changes were made to the course to increase the amount of time spent studying ethics at the expense of some other topics. Also, the instructional methods were adjusted to reduce the theoretical discussion of ethical frameworks and to increase the number of case studies discussed in class. Student self-assessment scores rose to above 4.1/5.0 the next time the course was taught.

These three examples demonstrate that course evaluations, when designed appropriately, analyzed thoroughly, and studied carefully, can help to identify windows of opportunity for substantial improvements in student self-assessments (and performance) associated with critically important learning objectives.

**Conclusions**

While the adjustment to the new outcomes-based assessment process has taken a considerable amount of time and effort, the resulting improvements have been significant in Valparaiso University’s College of Engineering. Through the combined effort of department faculty and the director of the HLRAC, an efficient course assessment process has been developed to probe the achievement of course objectives and the reasons for student performance.

The backbone of this process is a thoughtfully planned ECE course survey that questions all parts of the course from the textbook being used to the student’s achievement of course objectives. The summative and formative nature of the surveys allows for a unique balance of results to be reported by the Hesse Learning Resource and Assessment Center to the ECE faculty. This assessment tool and partnership has facilitated many significant improvements in the education provided by the ECE department at Valparaiso University.

**References**


