

Innovative Outcome Portfolios for ABET Assessment

Susan M. Morgan, W. Bradford Cross, Mark P. Rossow
Southern Illinois University Edwardsville

Abstract

The EC 2000 criteria require the assessment of program outcomes. While some engineering departments are using student portfolios for this assessment, the faculty charged with developing the undergraduate assessment plan in the Department of Civil Engineering at Southern Illinois University Edwardsville decided that student portfolios would be cumbersome to manage. In order to assess the outcomes directly, the faculty developed a new type of portfolio--the "outcome portfolio." Outcome portfolios are collections of material by outcome category. The portfolios are designed to allow the faculty from specific courses to choose representative student materials throughout the semester for inclusion. At the end of each semester, each faculty member reviews each portfolio and determines if the students appear to be performing satisfactorily or not. The faculty then meet as a department to discuss their findings and determine what, if anything, needs to be changed in the curriculum to improve student performance.

Introduction

The Department of Civil Engineering at Southern Illinois University Edwardsville (SIUE) is in the process of preparing for its first ABET accreditation visit under the new Engineering Criteria 2000. Criteria 2 and 3 require engineering departments to "adopt ongoing processes for review, assessment, and continuous improvement."^{1,2} In the process of compiling and developing potential assessment methods, the faculty charged with developing the Department's assessment plan considered and adopted a range of traditional assessment techniques, such as surveys, grades, and industry focus groups. Traditional student and course portfolios were considered during this process. Student portfolios have been promoted and used for engineering program assessment by others.^{3,5} However, the faculty decided that using traditional portfolios to assess department outcomes would prove cumbersome since student portfolios are "costly in terms of evaluator time and effort."³

It would be difficult to assess the Department's outcomes without extensive examination of a large number of student portfolios. A small number of traditional portfolios are used within the University for university-wide assessment as well as tenure and promotion decisions. However,

expansion of the in-place university-wide portfolio program would require much greater participation on the part of engineering students. Resources for expanding this program are not currently available in the School. Therefore, the faculty developed a new type of portfolio--the "outcome portfolio." This portfolio provides a mechanism for the faculty to collect materials from across the curriculum to assess the Department's performance in meeting most of the Department's outcomes.

The Outcome Portfolio

The Department has 18 outcomes, which are based closely on the ABET 2000 "Program Outcomes." The Department chose to adopt verbatim all 11 ABET outcomes and added 7 outcomes (including 5 ABET-prescribed "Program Criteria"). The faculty noticed that there were common themes among the outcomes. In fact, 16 of the outcomes can be grouped in six general categories--communication, design, engineering tools, laboratory experience, problem solving/analysis, and professional practice (Table 1). The outcome portfolios were developed around these categories. Two outcomes (program graduates demonstrating that they have professional skills and abilities that are valued by civil engineering employers and that they are able to function on multi-disciplinary teams) will not be assessed through the outcome portfolios; however, other methods are in place to assess them. Of the outcomes covered by the portfolios, two (program graduates demonstrating that they have an understanding of professional and ethical responsibility and a proficiency in a minimum of four recognized major civil engineering areas) will each be assessed in two portfolios.

Each portfolio will be kept in a separate binder or binders. The binders will be stored in a file cabinet readily accessible to Department faculty. The faculty will choose materials for inclusion in the portfolios, and the Department secretary will be responsible for reminding faculty to collect the material and will organize and file the materials.

Each portfolio is divided into sections. These sections are:

- a table of contents
- an introductory statement of purpose for the portfolio and an overview of material included
- a reflection on or evaluation of portfolio contents and outcome(s) measured by faculty members
- student materials.

A typical table of contents contains the following sections: introduction and statement of purpose, reflection on and evaluation of content, and student materials and summaries of evaluation forms. Following is a typical introduction and statement of purpose; this example is from the communication outcome portfolio.

The Department of Civil Engineering at Southern Illinois University Edwardsville, in determining our goals, has developed one outcome associated with the skill of communication. This outcome is:

Table 1. SIUE graduate outcomes by category.

Category (Portfolio)	Graduate Outcomes
Communication	<ul style="list-style-type: none"> • an ability to communicate effectively
Design	<ul style="list-style-type: none"> • an ability to design a system, component, or process to meet desired needs • an understanding of professional and ethical responsibility • the broad education necessary to understand the impact of an engineering solution in a global and societal context • proficiency in a minimum of four recognized major civil engineering areas • an ability to perform civil engineering design by means of design experiences integrated throughout the professional component of the curriculum
Engineering tools	<ul style="list-style-type: none"> • an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
Laboratory experience	<ul style="list-style-type: none"> • an ability to design and conduct experiments as well as to analyze and interpret data • ability to conduct laboratory experiments and to critically analyze and interpret data in more than one of the recognized major civil engineering areas
Problem solving/analysis	<ul style="list-style-type: none"> • an ability to apply knowledge of mathematics, science, and engineering • an ability to identify, formulate, and solve engineering problems • proficiency in mathematics through differential equations, probability and statistics, calculus-based physics, and general chemistry • proficiency in a minimum of four recognized major civil engineering areas
Professional practice	<ul style="list-style-type: none"> • an understanding of professional and ethical responsibility • a recognition of the need for, and an ability to engage in, lifelong learning • a knowledge of contemporary issues • civil-engineering related work experience in a private firm or government organization prior to graduation • understanding of professional practice issues

g. an ability to communicate effectively.

The purpose of this portfolio is to provide a mechanism for the Civil Engineering faculty to collect materials from across the curriculum in order to assess the Department's performance in meeting this outcome. Student material is collected

from target courses (CE 207L, CE 354L, and CE 493 in fall semesters and CE 207L, CE 380, and CE 493 in spring semesters). Instructors of these courses choose examples of student material that are representative of the performance of the students in that course. Each semester, the faculty assess the performance of the Department based on this material. Any changes implemented are tracked to determine their impacts (positive, negative, or neutral). A summary of these annual assessments is contained in the section Reflection on and Evaluation of Content.

Each faculty member is required to review and evaluate the student materials contained in each outcome portfolio at the end of each semester (Table 2). The need to provide comments in addition to ratings is crucial to the assessment process. The Department then holds a faculty meeting each semester to discuss the results, including the impacts of any changes implemented as a result of the assessment process. The meeting minutes will serve as the reflective/evaluatory statement.

Target Courses

Courses throughout the curriculum have elements that fall within multiple outcome categories. For example, the senior design capstone course will have analysis, design, and communication elements. In order to reduce the burden for the faculty and yet ensure a representative cross-section of courses and student materials would be analyzed, the assessment committee identified target courses for each outcome portfolio (Table 3). This format should minimize the effort to collect and review materials as well as to analyze student performance. In addition, since, for each semester (fall and spring), sophomore-, junior-, and senior-level courses were selected, the Department will be able to analyze performance at each level in the program and determine if adequate improvements in performances are being attained.

Assessment of Student Performance

Faculty are responsible for choosing one or two student assignments per target course to include in the portfolio. Faculty have chosen the types of assignments they believe will be most representative of the outcome categories in which their courses fall (Table 4). Each example of student material will be representative of the performance of the students in that course. Each will include a description of the assignment, the course number, semester, and year. For a particular assignment, one A-level, one C-level, and one D- or E-level work (if available) will be included. Material from several years will be included in each portfolio to assist in analyzing trends among the same student class.

For the professional practice outcome portfolio, examples of material from the senior design capstone course (CE 493) that reflect professional practice (for example, knowledge of contemporary issues) will be collected. However, in addition, participation matrices have been developed. Student participation in tours, in the SIUE Chapter of the American Society of Civil Engineers, and at activities sponsored by local professional organizations (such as the St. Clair Chapter of the Illinois Society of Professional Engineers) will be tracked (Table 5). Participation of practicing engineers in Department activities and courses will be tabulated, and summaries of participation in cooperative education will be developed.

Table 2. Example of faculty assessment form from the communication outcome portfolio for writing skills.*

Faculty Member	Date	Seniors		Comments
		Adequate	Need Improvement	
S. Morgan	12/20/99		X	Sources often not cited

* Separate forms are used to assess sophomores, juniors, and seniors, and the forms are in landscape mode to provide more room for comments.

Table 3. Example of target courses chosen for two outcome portfolios.

Outcome Portfolio	Target Course	
	Fall Semester	Spring Semester
Communication	CE 207L Computer Applications CE 354L Soil Mechanics Laboratory CE 493 Engineering Design	CE 207L Computer Applications CE 380 Intro. to Environmental Engineering and Science CE 493 Engineering Design
Professional practice	CE 199 Cooperative Education CE 299 Cooperative Education CE 399 Cooperative Education CE 341 Steel Design CE 493 Engineering Design	CE 199 Cooperative Education CE 299 Cooperative Education CE 380 Intro. to Environmental Engineering and Science CE 399 Cooperative Education CE 493 Engineering Design

Table 4. Examples of course materials chosen to represent student performance.

Outcome Portfolio	Target Course	Example Material
Communication	CE 380 Intro. to Environmental Engineering and Science	<ul style="list-style-type: none"> Personal P2 project report
	CE 493 Engineering Design	<ul style="list-style-type: none"> Course memos Final report Videotape of final presentation
Professional practice	CE 380 Intro. to Environmental Engineering and Science	<ul style="list-style-type: none"> Student attendance at activities sponsored by professional organizations
	CE 493 Engineering Design	<ul style="list-style-type: none"> Cost analysis of final design Final report

Table 5. Example of participation matrix for the professional practice portfolio.

Semester	Sponsor	Activity	Number of Students
Fall 1999	CE 486	Edwardsville Wastewater Treatment Plant tour	11
Fall 1999	CE 488	Trade Waste Incinerator tour	6
Fall 1999	S. Morgan research	Milam Landfill tour	4

Implementation

The outcome portfolio assessment method described is being implemented during the Fall 1999 semester. Therefore, as this paper is being written, no data are yet available to analyze the process. It is anticipated that minor revisions to the data collection and/or assessment forms will be required as implementation occurs. However, major revisions are not expected.

Conclusions

"Assessment and evaluation are crucial in the feedback and improvement of educational programs."⁴ While student portfolios can be used to assess student performance across a department's curriculum, the outcome portfolio method will reduce the time faculty members need to gather materials relevant to particular outcomes and provide a convenient forum for concentrated feedback. Rather than searching for relevant material in individual student portfolios, the material has already been gathered in one location. The faculty can then spend more time assessing the example materials. In addition, the outcome portfolio avoids some of the problems associated with student portfolios, such as requiring a large number of students to collect materials and students only including their best work.³ To streamline the assessment process further, simple assessment tables, such as the example presented in Table 2, can be used.

While the Department of Civil Engineering at SIUE is small (approximately 130 undergraduate students and 40 masters-level graduate students), the outcome portfolio method described is applicable to any size department and to any number of outcomes. The key to the method is to develop meaningful categories in which to group the outcomes or to target the method toward specific outcomes.

Bibliography

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SUSAN M. MORGAN

Susan Morgan is an Assistant Professor and the Graduate Program Director in the Department of Civil Engineering at Southern Illinois University Edwardsville. Dr. Morgan is a licensed Professional Engineer in Illinois. She received a B.S. degree in Civil Engineering from Southern Illinois University Carbondale in 1991 and a Ph.D. from the Department of Environmental Systems Engineering at Clemson University in 1995.

W. BRADFORD CROSS

Brad Cross is an Associate Professor in the Department of Civil Engineering at Southern Illinois University Edwardsville. Dr. Cross is a licensed Professional Engineer in Maryland and Illinois and a licensed Structural Engineer in Illinois. He received a B.S. degree in Civil Engineering from the University of Maryland in 1984 and a Ph.D. in Civil Engineering from the Johns Hopkins University in 1992.

MARK P. ROSSOW

A faculty member in the Department of Civil Engineering at Southern Illinois University Edwardsville since 1979, Professor Rossow received his doctorate in Applied Mechanics from the University of Michigan in 1973. His research interests lie in computer applications in solid and structural mechanics and in the development of educational software.