The Engineering Communication Portfolio: Writing, Reflection, and Technical Communication Assessment

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By the terms of the ABET 2000 criteria for engineering students' learning, students must demonstrate the "ability to communicate effectively;" one method for collecting data on students, ABET suggests, is a portfolio. At first glance, assessing student learning outcomes in communication effectiveness would seem an easy task. For some engineering departments, good communication is defined by the department writing manual and can be assessed by counting up the number of grammatical errors in a document. Effective assessment of effective communication, however, must identify exactly what constitutes communication (beyond good grammar and correct spelling) and evaluate communication authentically. For these reasons, portfolios offer important advantages for those whose responsibility is to assess engineering communication.

This paper will analyze the difference between individual student assessment and program assessment, demonstrating the ways in which portfolios can offer important information for outcomes assessment at both levels. The presentation will discuss the basic principles of portfolio administration, such as portfolio design/format and portfolio set up, and then discuss ways in which portfolio objectives, including evaluation rubrics, may be developed. Special emphasis will be placed on communicating portfolio objectives to students and the efficacy of reflective statements as a way to make the portfolio rating process more efficient. The end result of portfolio assessment is a clearer picture of students' communication skills and valuable feedback for students and professors.

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If you listen very carefully, you might just hear something new and startling, the sound of colleges and universities undergoing monumental change. Certainly the content of what is taught at the university level has changed dramatically in the past twenty years, with the opening of the literary canon, the teaching of new technologies like the Web, and the erasure of disciplinary boundaries. But changes in content are not the whole story. Delivery too has been radically altered: asynchronous classrooms, on-line courses, Web-based class chat and bulletin boards. It would have been impossible, therefore, for the roles of student and teacher to remain unaffected by these changes. In particular, the rise of assessment marks a profound alteration in our notion of who is responsible for learning. In former days, college professors relied primarily on lecture formats for delivering content; it was a student's problem if he or she didn't learn the material. Currently, the teaching professor recognizes the value of hands-on, active learning, in the form of team projects, writing to learn exercises, and interactive Web-based tutorials. The teaching professor now recognizes her responsibility to determine if the manner of her teaching is conducive to effective learning by all of her students.

In this climate, education assessment has emerged as both the primary method for determining a student's level of learning and the primary threat some faculty see to their academic freedom in the classroom. The purpose of this paper is not, however, to argue the merits of educational assessment. As long as constituents--whether the industries and businesses who hire a college's graduates, government bodies that fund a university's budget, or parents who pay the tuition bill--find fault with college graduates, assessment will be a part of every educational program. My purpose is to examine the impact of assessment on one educational program, engineering education, and show the degree to which our own field of technical communication may be enhanced by the demands of assessment. Rather than look upon assessment requirements fostered by the Accreditation Board for Engineering and Technology as a demon, I believe ABET has prompted an improvement in the status of technical communicators working in the academic environment; as a result of our efforts to improve the communication skills of engineering students, we will help mold the next generation of engineering professionals who will one day design our technological future.

THE NEW ENGINEERING PROFESSION, THE NEW ENGINEERING EDUCATION

Recent changes in the practice of engineering have transformed what newly hired engineers may expect in their high-tech careers. The engineers who entered the profession even as late at the early 1980s could look forward to long hours spent on the shop floor or the design laboratory, devising solutions for the complex problems of modern life in a technological society: development of new composite materials, invention of life-saving biomedical devices, and the like. Current surveys of working engineers reveal how much the profession has changed, with interpersonal skills like team work, communication, and global awareness ranking much higher than technical abilities for career success. As a result, the Accreditation Board for Engineering and Technology, the body responsible for accrediting engineering programs in the United States, has undergone equally radical changes. First, ABET has adopted a set of skills that engineering programs must demonstrate that their graduates possess (see Table 1).

a	an ability to apply knowledge of mathematics, science, and engineering
b	an ability to design and conduct experiments, as well as to analyze and interpret data
c	an ability to design a system, component, or process to meet desired needs
d	***an ability to function on multi-disciplinary teams***
e	an ability to identify, formulate, and solve engineering problems
f	***an understanding of professional and ethical responsibility***
g	***an ability to communicate effectively***
h	***the broad education necessary to understand the impact of engineering solutions in a global and societal context***
i	***a recognition of the need for, and an ability to engage in life-long learning***
j	***a knowledge of contemporary issues***
k	an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Table 1 : EC 2000 Criterion 3: Program Outcomes and Assessment (ABET 2000, my italics)

Clearly the Student Learning Outcomes, referred to by the shorthand ABET a-k, place more emphasis on students' abilities to work and interact with others (outcomes in bold above), rather than the mere possession of superior technical skills.

The second radical transformation has to do with the way in which evidence of these skills is collected and determined. In the past, engineering programs needed only to prove that students were required to take a set of courses to assure ABET that a program's graduates were being adequately trained. Now the "bean counting" approach has been replaced by the assessment of student learning outcomes. According to the ABET homepage

> Evidence must be given that the results [of program assessment] are applied to the further development and improvement of the program. The assessment process must demonstrate that the outcomes important to the mission of the institution and the objectives of the program, including those listed above [ABET a-k, see Table 1], are being measured. Evidence that may be used includes, but is not limited to the following: student portfolios, including design projects; nationally-normed subject content examinations; alumni surveys that document professional accomplishments and career development activities; employer surveys; and placement data of graduates. (ABET, 2000)

Consequently the engineering program must collect evidence that it has attempted to measure exactly what students can do and, if students fail to perform, demonstrate that the program has instituted changes in courses, curricula, and pedagogy to insure improvement.

By the terms of the ABET 2000 criteria for student learning, students must demonstrate the "ability to communicate effectively;" one method for collecting data on students, ABET suggests, is a portfolio. At first glance, assessing student learning outcomes in communication effectiveness would seem an easy task. For some engineering departments, good communication is defined by the department writing manual and can be assessed by counting up the number of grammatical errors in a document. Effective assessment of effective communication, however, must identify exactly what constitutes communication (beyond good grammar and correct spelling) and evaluate communication authentically. For these reasons, portfolios offer important advantages for those whose responsibility is to assess engineering communication.

DEFINING THE ENGINEERING COMMUNICATION PORTFOLIO

The current focus on portfolios was inspired, to a large degree, by ABET's suggestions. And yet, given their relative inexperience with portfolios, engineering faculty have found numerous difficulties with using them. The cause of these problems derives, I believe, from adopting portfolios from the unrelated fields of elementary/secondary education and from composition, without giving consideration to the ways in which the portfolio form must be altered in order to make it useful to engineering educators and students.

The history of portfolios in the context of engineering education assessment has been brief. Portfolios have had a longer history in other fields, such as architecture and art, where every student collects samples of his/her best work into a portfolio for the purpose of evaluation by a teacher or review by a prospective employer. While this portfolio concept has some bearing on engineering portfolios, the portfolio model drawn from most often in engineering is the writing portfolio that was initially developed at the elementary and secondary education levels. Calfee and Freedman recount the beginnings of the Bay Area Writing Project in 1972 and the National Writing Project in 1974 as projects that changed the course of writing assessment and brought portfolios to the fore. In response to demands by administrators and politicians that schools be held accountable for student achievement, participants in a series of summer institutes sponsored by NWP devised an alternative assessment strategy to standardized testing. The alternative assessment reflected more accurately the innate nature of the writing process. In a standardized test, a student's abilities are not assessed authentically; the student writes to a prompt, has no time to write and revise, and often writes more poorly than authentic assessment would indicate.

Portfolios offered an important alternative. Students collected samples of their writing that were created over time—a semester, a year, or the student's entire elementary school career. The writing was done in the context of real assignments, rather than as a response to an artificial prompt; for example, students might collect several different essays that were written for different courses, rather than completing a timed essay on one academic subject. Students were encouraged to revise their work, and then to select their best work for inclusion in the portfolio. As a result, evaluators were able to assess students' abilities more accurately, while students were given the chance to reflect on their learning through the process of revision and portfolio selection (Elbow and Belanoff, 1991)

From these early experiments in writing portfolios, a common definition of portfolios has emerged:

> A portfolio is a *purposeful* collection of student work that exhibits to the student (and/or others) the student's *efforts, progress,* or *achievement* in (a) given areas. This collection must include: student participation in selection of portfolio content: the critria for selection; the criteria for judging merit; and evidence of student self-reflection. (Northwest, 1991)

Given their promise of authentic assessment, as well as increasing demands for accountability in higher education, it is not surprising that portfolios have also been used for writing assessment at the college level. College and university educators have also seen the benefits to students that are the hallmarks of portfolio practice: the opportunity for reflecting on his/her own writing process; the picture of his/her progress in writing over time; the portfolio as a showcase of his/her best work.

These characteristics are the benefits engineering educators and students may draw from using portfolios to assess learning. Among engineering programs experimenting with portfolios currently, the Colorado School of Mines and Rose-Hulman Institute of Technology have adopted the portfolio idea, but with significant changes from the writing portfolio model. At CSM, engineering students are selected to participate in the portfolio project, but the engineering faculty and programs decide which materials will be collected (Olds and Pavelich, 1996). In addition, students do not use their portfolios as a opportunity for reflection, nor can they show their portfolios to prospective employers, as a way to showcase their work and abilities. The CSM student portfolios have, however, been instrumental in demonstrating student learning outcomes and have inspired significant curricular changes in order to improve pedagogy and learning. At Rose-Hulman, in contrast, students decide what materials they will include in their portfolios; they even have the opportunity to provide links to prospective employers who would like to examine their work as part of the job application process (Rogers and Williams, 1999). Assessment of student portfolios at Rose-Hulman has brought about important changes in curricula and pedagogy (Office of Institutional Research and Assessment, 2000).

THE FUTURE OF ENGINEERING PORTFOLIOS

What lies ahead for engineering portfolios? Clearly there is more work to do if engineering portfolios are to gain wider acceptance for assessing engineering education. In an informal survey I conducted in June 2001 at the American Society for Engineering Education Conference in Albuquerque, New Mexico, I asked those audience members who were using portfolios at their institutions to stand. Only two audience members stood up, and this session was a part of the Education and Research Methods Division, the conference organization is most explicitly dedicated to innovative pedagogy and assessment.

The future may proceed this way. First, many more engineering programs will attempt portfolios as one data collection method. Their work in adapting the portfolio model to meet their assessment needs will mean more experimentation with the form. As a result, we may see a proliferation of engineering portfolios, with program results being shared with others. Unfortunately, there seems to be resistance among some programs

to learn the pitfalls of portfolios from other engineering programs or other disciplines, like writing assessment. Portfolios may gain a reputation that they do not deserve. More research is needed that demonstrates the benefits of portfolios over other data collection methods.

Of course many programs will wait to see how other engineering programs fare with engineering portfolios. In October 2000, engineering programs at the Colorado School of Mines and Rose-Hulman Institute of Technology were both accredited, and both institutions rely on engineering portfolios for the documentation of some student learning outcomes. Only after more institutions are recognized for their efforts in portfolio development will the engineering portfolio gain wider acceptance. Finally, the most important transformation must occur within the culture of engineering education itself. Until engineering faculty, programs, and industry commit to this assessment method, engineering portfolios will remain a great idea and not a practical reality.

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ABOUT THE AUTHOR

Julia M. Williams is Associate Professor of English and Coordinator of Technical Communication at Rose-Hulman Institute of Technology, Terre Haute, Indiana. In 1996, she developed the campus-wide Program in Technical Communication, which currently serves all engineering students in a variety of technical and non-technical courses. She is also the co-chair, with Dr. Gloria M. Rogers, of the Commission on the Assessment of Student Outcomes (CASO), the committee responsible for the development of an institute-wide assessment plan. CASO has created the RosE-Portfolio, an electronic portfolio system used to document student learning outcomes (currently marketed by ICTT, Inc., as the e-portfolio). Her recent article, "Transformations in Technical Communication Pedagogy: Engineering, Writing, and the ABET Engineering Criteria 2000," appeared in the Spring 2001 issues of *Technical Communication Quarterly*. She is co-author, with Bernadette Longo and Art Young, of The Norton Guide to Technical Writing (forthcoming 2002).