

## **Asynchronous Assessment: Using Electronic Portfolios to Assess Student Outcomes**

**Gloria M. Rogers, Julia M. Williams  
Rose-Hulman Institute of Technology**

### Abstract

In Criteria 3 of ABET 2000, portfolios are identified as one method of documenting and assessing student outcomes. Portfolios offer several advantages in outcomes assessment (multiple samples of work over time, a view of learning and development, etc.), but their disadvantages (problems with storage and administration, security concerns, etc.) must be balanced against those benefits. In implementing the RoseE-Portfolio at Rose-Hulman Institute of Technology, the faculty, administration, and students have confronted these issues; the result is a web-based portfolio system that focuses on a student's "best work" and requires a "reflective statement" in which a student demonstrates the relevance of the work to the learning outcomes objectives. This article outlines the stages of the RoseE-Portfolio development from the initial concept to its testing through a Pilot Project and the current status of the plan. In offering the results of the project thus far, the authors offer suggestions on how other institutions may gauge the appropriateness of a portfolio system to their own student learning outcome goals.

### Introduction

The current interest in the use of portfolios to document student outcomes in engineering education has been driven by the adoption of revised engineering accreditation criteria, *Engineering Criteria 2000 (EC2000)*.<sup>1</sup> In Criteria 3, portfolios are mentioned as one way to document and assess student outcomes. In a white paper issued in 1996 by the Joint Task Force on Engineering Education Assessment, portfolios were referred to as being correlated with nine of the eleven desired attributes of engineering graduates identified in EC2000.<sup>2</sup>

A portfolio has been described as a "purposeful collection of student work that exhibits the student's efforts, progress, and achievements. The collection must include student participation in selecting contents, the criteria for selection, the criteria for judging merit, and evidence of student self-reflection."<sup>3</sup> While there is agreement on the definition of a portfolio, there is no one correct way to design a portfolio process. The design should be driven by a clear understanding of the desired outcome from using portfolios and the specific skills to be assessed. The desired outcome will determine the design and focus of the portfolio process. Portfolios are not an end in themselves and must be developed with a clear vision of the desired outcome.<sup>4</sup>

There are multiple benefits and some disadvantages in using portfolios of student work as a means of assessing student outcomes.<sup>5,6</sup> Portfolios can:

- Provide multiple samples of student work over time.
- Give a broader, more in-depth look at student skills and knowledge.
- Allow raters to base assessment on more "authentic" work to determine student's efforts, progress, and achievements.<sup>7</sup>
- Provide a view of learning and development.
- Allow multiple components of a curriculum to be measured at the same time.
- Provide a process of reviewing and grading portfolios that offers an excellent opportunity for faculty exchange and development, discussion of curriculum goals and objectives, review of grading criteria, and program feedback.
- Provide results that are more likely to be meaningful at all levels (i.e., the individual student, program, or institution) and can be used for diagnostic/prescriptive purposes as well.
- Increase the "power" of maximum performance measures over more artificial or restrictive "speed" measures on tests or in-class sample.
- Increase student participation (e.g., selection, revision, evaluation) in the assessment process.

The use of portfolios also has some disadvantages that need to be considered when choosing an assessment method. They include:

- Problems with storage and administration.
- Cost in terms of evaluator time and effort.
- Challenge of establishing reliable and valid rating criteria.
- Concern of faculty that a hidden agenda of the process is to validate their grading or evaluate the effectiveness of their teaching.
- Security concerns that may arise as to whether submitted samples represent the students' own work, or adhere to other measurement criteria.

#### Rose-Hulman assessment process

In the spring of 1996, faculty, staff, and students were appointed to form the Commission on the Assessment of Student Outcomes (CASO).<sup>8</sup> They were charged with developing an institutional assessment plan that would provide a means for continuous improvement of the curriculum, services, and facilities of the Institute and meet the needs of regional and program accreditation. The members of CASO represent most dimensions of the Institute. There is a faculty representative from each academic department, staff from major administrative units, and students representing the Student Government Association. After assembling all the stated goals of the Institute, the goals were presented to constituent groups—faculty, staff, students, alumni, recruiters, employers, board of trustees and national board of advisors—to get their involvement in the development of student learning outcomes. Based on their feedback, we began a process of refining and revising the institute goals. This process was repeated within the Rose-Hulman community as modifications were made. By creating the plan in the context of

feedback and consultation, we avoided isolating the plan from the Institute at large while an effort was made to simultaneously fostered support for the plan itself.

Assessment of student outcomes represents a significant portion of the plan, and much of its development occurred in the summer of 1997. At that time, a sub-team of CASO was hired for the summer to devote particular attention to student outcomes assessment for the plan. The goal for student outcomes is: **Instill in our graduates the skills appropriate to their professions and lifelong learning.** There are nine subgoals that further specify these skills: ethics, teams, communication, global awareness, experiments, design, engineering practice, interpreting data, and contemporary issues. Each of these skills has multiple, specific performance criteria that give the skill definition. While we knew the skills we wanted students to possess at graduation, we were unsure what data collection method we would use to determine that students possessed them. Faculty researched various data collection methods they might implement. These methods included course grades, questionnaires and surveys, standardized tests, qualitative methods, and portfolios. We developed four primary criteria for selecting a data collection method. The method should:

- Offer rich, quality information about our students in a breadth of outcome areas.
- Produce valid results and reflect the uniqueness of Rose-Hulman.
- Intrude minimally on the time of students and faculty.
- Serve students by engaging them in reflecting on their own education and helping them as they prepared for their careers or graduate education.

After a review of literature on a variety of data collection methods, we determined that portfolios would best meet the criteria established and should be the primary source of data collection for assessing student outcomes and provide us a means to evaluate the effectiveness of our programs. The stated purposes of adopting the portfolio process are to:

- Provide students with a mechanism to document their progress toward achieving Institute learning outcome goals.
- Provide students with a means to showcase their work in a multi-media format.
- Engage students in reflection about their own learning as students at RHIT.
- Engage faculty in authentic assessment of Institute-wide student learning outcomes.<sup>9</sup>
- Provide an efficient method for faculty to review and assess student submissions.
- Promote evidence-based decision making in the improvement of Institute processes.

### RosE-Portfolio Design<sup>10</sup>

The RosE-Portfolio was designed and developed by Rose-Hulman faculty and staff. The design was driven by how the portfolio was to be used by both faculty and students. CASO members identified the following primary RosE-Portfolio design requirements:

- Ease of use
- Student-controlled access (other than faculty raters and advisers)
- Ability to archive student material in multi-media format
- User access of the RosE-Portfolio using multiple search criteria
- Students' ability to update and replace materials
- User access of the RosE-Portfolio on-line, anytime
- Faculty ability to rate student portfolios on-line, anytime
- Faculty ratings automatically logged and aggregated
- Faculty raters ability to provide students with feedback on-line
- Student submissions focused on Institute-defined learning outcomes

Once the design specifications were identified, an alpha version of the RosE-Portfolio was developed for evaluation.

The RosE-Portfolio is designed as a web-based system allowing students to access their RosE-Portfolio using their network username and password. The design includes a compression feature that automatically compresses documents when students submit them in their RosE-Portfolio. This minimizes data storage space needed. Each of the three major system components (Input, Output and Process) has been examined carefully to best utilize available resources with given constraints. In general, the input component of the electronic portfolio system covers materials submission, modification of existing information in portfolio option, on-line rating and feedback options (to be implemented), and end-user's preference selection (to be implemented). Searching, extracting and viewing items from portfolios, and generating ad hoc and routine reports (to be implemented) are within the output component. The process component is the "brain" of the system which controls security handling of the portfolios, keeps track of versions and defines relationship between the identified objectives and submitted materials, logs transaction activities, joins student background information from campus legacy system (to be implemented), runs queries and posts search results.<sup>11</sup> The database currently being used is Oracle. It provides all the archiving and search functions necessary to meet the design specifications.

In addition to the features identified for student use, special screens have been developed for faculty raters and faculty advisers. They will be allowed to search using multiple search criteria designed to satisfy their need for information. Faculty raters will be able to search by learning outcome goal and performance criteria. For the purpose of rating submissions, students will not be identified by name, but the submission will be assigned a number. This will enable the faculty raters to be more objective about the student work they will evaluate. Faculty advisers will have access only to the work of their advisees. They can search by outcome goal for all advisees or on any subset of performance criteria. They can also review the entire portfolio for any given advisee. Other features include the ability to search by date of submission and quarter in which the document was created. This will enable the adviser to quickly determine whether or not the advisee is keeping her RosE-Portfolio current.

Because we want to make the portfolio attractive to students, we are currently considering providing each student with their electronic portfolio on CD-ROM when they graduate. That way the portfolio becomes a permanent part of the student's learning experience.

### Pilot Project

Before implementing the RosE-Portfolio system for all incoming students we wanted to evaluate the system to determine the following:

- Ease of use for students and faculty.
- Clarity of outcome goals and performance criteria.
- Ability of students to document their progress toward achieving Institute learning outcomes.
- Clarity of instructions for use of system by students and faculty.
- Student attitudes toward use of the system.
- Robustness of electronic infrastructure to handle multiple formats.
- Faculty comfort with holistic scoring of student submissions.
- Ability of faculty raters to apply the rubrics developed for the rating of submissions.
- Faculty and student confidence that implementation of the RosE-Portfolio process would provide the Institute with information to improve educational programs.

Thirty student volunteers, each paid \$100 and representing a cross-section of the sophomore class—major, grade point average, gender, race—were selected to participate in the pilot study. They were asked to submit their current best work that they felt demonstrated their progress toward achieving the specific performance criteria under each sub-goal. In addition, each student was asked to write a reflective statement that explained why he or she believed the submission met the particular performance criteria. The materials students submitted were of their own choosing from among all of their Rose-Hulman experiences. The material could have been from specific course work, co-curricular activities, or "other" experience (e.g., co-op or internship experience, foreign travel). Because faculty raters were rating student submissions based on a standard developed for graduating seniors, it was important to emphasize that they were expected to select work which best demonstrated their *progress* toward achieving the learning outcome goal.

Students were given ten weeks to complete the project and then participated in an extensive assessment of the pilot project experience that included both written questionnaires and focus groups. During this period of time, they submitted over 130 files to the RosE-Portfolio.

In June, a faculty group of six evaluators spent two days reviewing and rating the materials submitted by students. The team of faculty was made up of two faculty members from the humanities, two from science, and two from engineering. Written materials had been developed for the raters that explained the concept of holistic scoring and the use of rubrics to rate student work.

The primary purpose of the two-day session was to determine the clarity of the written materials and instructions for faculty raters and the ease of holistic scoring and applying the assessment rubrics. We were also interested in finding out whether or not the faculty raters believed that the use of the RosE-Portfolio would produce the type of information from students that would help us to evaluate and improve our programs.

## Assessment Results

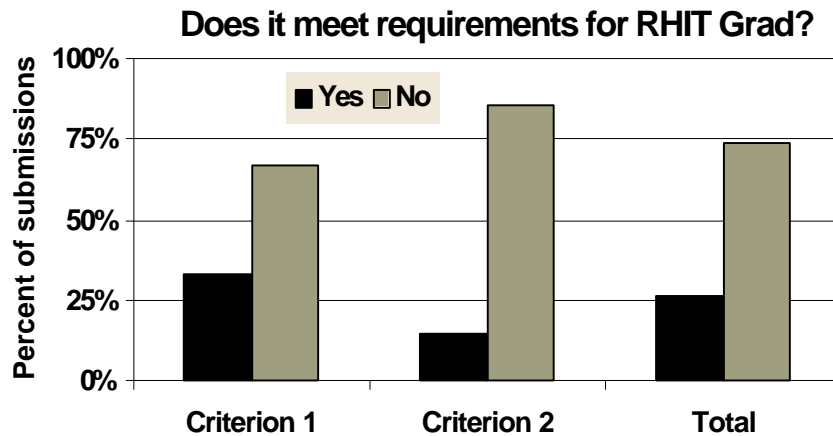
*Students.* The student volunteers reported that they, generally, found it easy to deposit documents in the RosE-Portfolio system. They found the instructions to be clear and the student learning outcomes easy to understand. They felt that the reflective statements were a valuable part of the submission process. Over 50% of the students considered submitting evidence of learning outcomes that were a result of activities outside the classroom. As sophomores, these students reported that they thought the most difficult objectives they would have to document by the time they were graduating seniors were the ones related to ethical and professional responsibility and an understanding of how contemporary issues shape and are shaped by mathematics, science, and engineering. Students were optimistic that the use of the RosE-Portfolio process would provide Rose-Hulman with information that would help to improve programs. Over 50% of the sophomores participating in the pilot project indicated that they would like to continue to use the RosE-Portfolio to document their learning outcomes.

*Faculty.* The faculty reported ease of inter-rater reliability and the use of holistic scoring. They also found that some of the performance criteria were not clearly written and some criteria were too complex with more than one performance expected per criterion. Faculty proposed rewording of some of the criteria for clarity. Examining student submissions was found to be generally instructive in regards to a wide range of student abilities. There was a general concern about the inability of students to develop well-written reflective statements and recommendations were made that the student instructions should emphasize what a “reflective statement” is and the importance of self-reflection.

*Program.* Although the purpose of the prototype was to evaluate and improve the RosE-Portfolio process and not to evaluate any existing program, we thought it might be helpful to give an example of what the results would look like after the rating was complete. The figure below represents the actual results of the rating of sophomore work for those who submitted documents in their portfolios related to the student outcome: **“recognition of ethical and professional responsibilities.”** There were two performance criteria related to this outcome. They were that students should demonstrate:

- 1) Knowledge of ethics in the organizations of which they are members,
- 2) Ability to evaluate the ethical dimensions of professional engineering, mathematical, and scientific practices.

Figure 1: Raters Evaluation of Ethics Subgoal



These data indicate that only 26% of the students who made a submission at the end of their Sophomore year met the requirements established for Criterion 1 and 32% of the submissions for Criterion 2. Overall, 26% of all criteria were met for this outcome. The faculty evaluation team would be asked to review the data and make recommendations for program improvement. This assumes that each program area (major) has identified where within the curriculum students have had an opportunity to learn and practice the skills reflected in the criteria. It might be that students are not exposed to the information or skill until they are in upperlevel courses or that courses in the lower level that address these outcomes are focusing on different criteria. The value of this process is dependent upon the ability of the faculty to carefully analyze the data and make recommendations based on sound evaluation methodology.

#### Motivation for participation

*What's in it for students?* One of the questions that is commonly asked is, why should students be motivated to keep their RosE-Portfolio current and take the project seriously? The design of the system provides opportunities for students to "customize" their RosE-Portfolio web site. They will be encouraged to use their RosE-Portfolio to present their knowledge and skills of a wide variety of learning outcomes as they seek internships, co-ops, or employment after graduation. The Career Services office at Rose-Hulman has been involved in the development of the RosE-Portfolio and is hopeful that it will become a tool used by students to present themselves to recruiters. Students will be encouraged to build a dynamic resume within their RosE-Portfolio where they can "hot link" the best of their work to their on-line resume. This will provide recruiters an opportunity to view samples of writing, design projects, entries documenting their understanding of the importance of a global perspective, ethics, *etc.*, in a multi-media format.

*What's in it for faculty?* The RosE-Portfolio system is “student-driven,” eliminating the need for faculty to be responsible for the collection of student material for submission. Faculty advisers will have access to their advisees' RosE-Portfolios for the purpose of reviewing their progress if needed. Academic advisors will receive periodic reports on the status of their advisees' RosE-Portfolios. For example, if a student has not submitted any materials in his/her RosE-Portfolio for a period of time, the adviser will receive an electronic communication asking her to encourage the student to submit materials prior to registering for classes in the upcoming quarter. In addition to the advantages for individual student advising, information can be made available to academic departments by sorting the results of the faculty ratings by department. This process will all be automated and provide quality assessment data that departments can use to validate their own assessment efforts. In addition, one of the additional features of the RosE-Portfolio is that it allows for the development of department-specific folders within the RosE-Portfolio. This will enable departments to identify program-specific outcomes in addition to those that are general to all Rose-Hulman students.

### Potential development

Because the RosE-Portfolio can be accessed at any time from anywhere, the potential of involving our National Board of Advisors, Alumni, and other constituent groups in the rating of portfolios is very real. Inter-rater reliability could be established by bringing all raters together on campus for a half-day session or it could be done in small groups using video conferencing. Once inter-rater reliability was established, RosE-Portfolios could be viewed and rated from anywhere in the world where one could access the Web. The value of the input of our external constituents on the quality of student work would provide a perspective that is not now currently available.

### Designing your own system

Portfolios, whether conventional or electronic, may not be the answer for every school or every program. The decision to design an electronic portfolio system, however, will be driven by how you answer the following questions:

- What is the primary purpose of the data collection?

Portfolios can be used to assess individual students or programs. Portfolios can be used to assess the growth of a student over time or take a "showcase" approach where students are told to submit material that represents their "best" work. Instead of assessing individual students, portfolios of students can be sampled using valid sampling techniques to determine whether or not program or institutional student outcomes are being met. If a showcase approach is to be taken, snapshots of an electronic portfolio can be taken over time to document or benchmark student progress.

- What strategies are you going to use to assess the material submitted in the portfolios?

Keeping in mind the early admonition that portfolios are not an end in themselves, it is necessary to have a clear plan on how the material is going to be categorized and assessed in a meaningful, focussed way that is relevant to your desired student outcomes. Because of the potential time commitment to evaluate portfolios for a number of outcomes, a clear plan needs to be developed on the nature of the rubrics to be used and the ease of access and rating of portfolios. It is important to think ahead of what an assessment report might contain including the results of portfolio assessment. If you are planning to use portfolios for program assessment the answers to the following questions will guide the development of the process:

- Are you going to assess everything in EVERY student's portfolio?

The answer to this question will determine the type of feedback process that is built into the system. If the program has a small number of students it may be desirable to assess every portfolio. However, for a large program it may not be practical or possible to assess every portfolio. If that is the case, consideration should be given to developing a mechanism to sample part of every student's portfolio. This would require a sampling technique to select a part of every student's portfolio over time. This method would ensure that every student would have at least part of their portfolio rated by faculty. This is a feature that can be built into the e-portfolio design. In this example the primary purpose of the portfolio is to assess "programs" and not individual students. However, the design of a well-constructed portfolio process would enable faculty to assess individual student skills and knowledge as well.

- Are you going to assess EVERY goal and performance criteria EVERY year/semester?

Among evaluators there is an expression, "E=MC<sup>2</sup>". This stands for "Evaluation = Measurement X Common sense Squared." If you have eleven student outcomes that you are going to measure (*e.g.*, EC2000) and each of these has an average of six performance criteria, that is the potential of 66 submissions per student. If you have 100 students in your program, this is 6,600 assessment data points. Common sense would dictate that you must develop a plan to assess the portfolios that is based on sound sampling methodology. Sample your portfolios for potential problem areas (*i.e.*, which of the performance outcomes appear to be the most problematic for students?) and develop your assessment schedule to maximize your ability to identify areas for improvement early in the process. Yes, all outcomes should be assessed with the same rigor but the results of that assessment will differ. When evidence indicates that students are having difficulty demonstrating a desired outcome at the appropriate level, improvements can be made in the processes designed to promote the outcome and new assessments made. Outcomes targeted for improvement can be assessed more frequently than the outcomes which students consistently meet. The design of an electronic portfolio system can automate the search and sampling process.

- What resources do you have available?

Assessment of any kind is not “free.” To be done properly, assessment takes time, money, and skill. The development of the RosE-Portfolio is the culmination of two and a half years of planning, design, development, testing, improvement and implementation planning. It has involved multiple hours of faculty, staff, and student time. Although the use of portfolios may not be the most expedient way to collect assessment data, there is a consistently inverse relationship between the quality of measurement methods and their expediency.

## Summary

When assessing student outcomes, multiple methods should be considered. The use of portfolios can add a breadth and depth of information that is not available by any other method. Developing an electronic portfolio system can reduce the disadvantages of the use of portfolios and enhance the overall effectiveness of data collection, assessment, and improvement of engineering programs.

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<sup>1</sup> Engineering Accreditation Commission, *Engineering Criteria 2000*, Accreditation Board for Engineering and Technology, Inc., <http://www.abet.org>.

<sup>2</sup> "Assessment White Paper: A Framework for the Assessment of Engineering Education," Joint Task Force on Engineering Education Assessment, American Society of Engineering Education, <http://www.asee.org/pubs2/html/assessment.htm>.

<sup>3</sup> Paulson, L.F., Paulson P.R., & Meyer C. "What makes a portfolio a portfolio?" *Educational Leadership*, 1991, 48(5), 60-63.

<sup>4</sup> Arter, Judith A., *et.al.* "Portfolios for Assessment and Instruction," ERIC Digest, 1995. No. ED388890.

<sup>5</sup> Ibid.

<sup>6</sup> Prus, Joseph and Reid Johnson, "A Critical Review of Assessment Options," in monograph, "Assessment & Testing, Myths & Realities" *New Directions for Community Colleges*, No # 88 Winter '94, Bers & Mittler, Editors .

<sup>7</sup> The term “authentic” here refers to work that is created in a context independent of assessment, i.e., a design project submitted for a class, a journal documenting a foreign study experience, etc. This is not work that is created specifically to be assessed, i.e., an essay test, a survey, etc.

<sup>8</sup> Rogers, Gloria and Julia Williams, “Assessing Institutional Goals and Student Learning: Strategies for Success.” *A Collection of Papers on Self-Study and Institutional Improvement: 1998 Edition*, North Central Association of Colleges and Schools Commission on Institutions of Higher Education, 1998, 145-150.

<sup>9</sup> See note 7.

<sup>10</sup> Rogers, Gloria Martin and Julia Williams, “Building a Better Portfolio.” *ASEE PRISM*, 30-32, January 1999.

<sup>11</sup> Chow, Timothy, “Electronic Portfolios -- What To Do With Them?” Rose-Hulman Institute of Technology, Terre Haute, IN. Unpublished abstract submitted for Association of Institutional Research’s 39<sup>th</sup> Annual Forum [1999].

## GLORIA ROGERS

Gloria Rogers is the Vice President for Institutional Resources and Assessment at Rose-Hulman Institute of Technology. In addition to her work with the Rose-Hulman Commission on Assessment of Student Outcomes, she is active on a number of national initiatives in assessment and implementation of *EC2000*. She was one of the Principal Investigators on the ABET Pilot Study for the Implementation of Engineering Criteria 2000 grant and serves on the Advisory Board for the ABET “Regional Engineering Faculty Workshops,” funded by the National Science Foundation’s Action Agenda Program. She is a member of the Advisory Board for the “Field-tested Learning Assessment Guide” (FLAG), and has served as an

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external evaluator for a number of science and engineering initiatives. She is the co-author of the “Stepping Ahead: An Assessment Plan Development Guide” that has been distributed to over 9,000 engineering educators.

**JULIA M. WILLIAMS**

Julia M. Williams is Assistant Professor of English and Coordinator of Technical Communication at Rose-Hulman Institute of Technology. She is co-chair, with Gloria Rogers, of the Commission on the Assessment of Student Outcomes, the campus-wide committee charged with the development of an institute-wide assessment plan.