

A Portfolio-Based Assessment Program

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Introduction

In this paper we describe the process, successes, and pitfalls of the decade-old portfolio assessment program at the Colorado School of Mines (CSM). We will also discuss how we anticipate building a new version of the assessment program into our current campus-wide curriculum reform efforts. CSM has agreed on its overall educational goals and has articulated them in a Profile of the CSM Graduate; these goals determine what materials are collected for the portfolios we maintain and evaluate for selected students. The data compiled from annual portfolio reviews help the faculty to identify strong and weak aspects of our programs and address the latter in a continuous improvement loop.

In this paper we will briefly describe the history of our assessment program and its current process, discuss why we chose the portfolio approach, provide examples of the materials we collect to address various goals, give examples of curricular changes resulting from our assessments, discuss some of the strengths and weaknesses of portfolio assessment, and look to the future of our assessment efforts at CSM.

A Brief History of Assessment at CSM

In the late 1980s, Colorado, like many other states, became interested in higher education accountability and assessment and passed legislation (HB1187) requiring the Colorado Commission on Higher Education (CCHE) to "develop an accountability policy and report annually on its implementation." In addition, the legislation required that institutions of higher learning be held accountable for improvements in student knowledge between entrance and graduation; that these improvements be publicly announced and available; that institutions express clearly to students their expectations of student performance; and that these improvements be achieved through effective use of time, effort, and money. The state required each institution to report assessment of general education, discipline-specific education, retention and completion, alumni/student



satisfaction, after-graduation performance, minority student statistics, and costs. According to the timeline established by CCHE, each institution was required to submit its institutional goals and objectives for approval in 1988 and then submit an assessment plan after the goals were approved. In 1989 the first assessment reports were submitted. The legislation stipulated that CCHE could retain two percent of an institution's appropriation if it found the assessment report "unsatisfactory."

Unlike several states in which institutions with very dissimilar student bodies, goals and missions were required to use identical measures, Colorado allowed each institution to develop an individual assessment plan appropriate for its size, student body, mission and goals. After considerable input from alumni, recruiters, faculty, and students, CSM chose to develop a portfolio assessment program which we have been using since 1989. The School has had both North Central and ABET accreditation visits since then, with positive feedback on our assessment program from both. Although the State of Colorado is changing its accountability focus to performance standards, we intend to continue our portfolio assessment program because we believe it provides us with valuable information about our students and our programs.

The Portfolio Assessment Program

As a major part of its CCHE-approved assessment plan, CSM proposed using a portfolio system based on maintaining comprehensive longitudinal records for a statistically-based sample of CSM students. The plan was developed with input from all campus constituencies. In brief, each year a random sample of incoming students is selected for whom we develop portfolios. For these students we collect and report such typical quantitative data as SAT and ACT scores and GPAs; in addition, we include in the portfolios samples of classroom work from a variety of courses as well as surveys and other feedback on the students' satisfaction with the institution. Each spring the portfolios are evaluated by a faculty Assessment Committee whose summary provides the heart of our annual report to the campus and CCHE.

At the beginning of each semester, the registrar provides the assessment coordinator with class lists for all portfolio students. Based on these lists, professors and department heads are contacted twice during the semester and reminded to collect pertinent materials. The materials collected for freshmen and sophomore students are forwarded to the Assessment Committee and are filed in each student's portfolio for evaluation later in the year. Each major department retains the materials on its juniors and seniors to be evaluated by a departmental assessment committee.

The Assessment Committee, with approximately 10 members from disciplines across campus, meets regularly during the academic year to discuss assessment issues and then for two days after the end of the school year to evaluate freshmen and sophomore portfolios. The current committee has representatives from engineering, mathematics, chemistry, physics, geology, and liberal arts. Their evaluations and recommendations (always in the aggregate), along with those from the separate



departmental committees, form the basis of the annual report to the CSM campus and to CCHE.

Table 1 - Educational Goals

*	Technical ability, knowledge	(Tech)
*	Communication skills (oral, written, graphic, computer)	(Comm)
*	Critical thinking, intellectual development	(CT)
*	Ability to self-educate	(SE)
*	Familiarity w/ humanities, social science	(HSS)
*	Leadership, teamwork	(TM)

Based on our institutional mission and goals as defined in our Profile of the CSM Graduate, we decided to assess the areas shown in Table 1. Once these goals were set, we developed a matrix of places in the curriculum where they should be emphasized and a list of course materials to collect which should reflect them. This matrix was used by the Assessment Committee and the departments to identify which specific materials would be collected each year. Examples of materials collected in these categories are provided below.

Why Portfolios?

After nearly a decade of portfolio assessment, we have concluded that this method of assessment has some definite advantages. First, many educators agree that there has been serious dissatisfaction with overdependency on standardized testing. In addition, there is a strong voice in the assessment community that evaluation activities should draw upon and support teaching activities, not intrude on or even detract from them.¹ We believe that portfolios address both of these concerns. We collect material that is already being used in the teaching/learning process and that therefore already has meaning to both students and faculty. Many of these samples can be used in a variety of ways. For example, a single paper from a freshman humanities and social sciences class may tell us something about a student's writing ability, critical thinking skills, and ethical stance.

There is evidence that tracking students over time gives the best information about how to improve student learning. Since the goal of our process is to provide our colleagues with both formative and summative information about the teaching/learning process, portfolios provide a particularly rich means of accomplishing this goal. We discuss below some of the changes that have taken place in our curriculum as a result of the assessment process. In addition, we have been able



to use data from our sample to study such issues as graduation rates, number and sequence of humanities and social sciences courses taken, and comparisons between the published "normal" core sequence for students and what they actually take.

Finally, most assessment experts agree that no single instrument is adequate and that we need to use several assessment techniques simultaneously. We believe that portfolios allow us to collect a variety of materials in a non-intrusive way. We believe that there are additional advantages to portfolio assessment. It builds on existing assessment activities and is not radical; it can be implemented piece by piece (even in a single course); it can be adapted to the local culture and to the local motivations for assessment; it can be cost effective; and it can be explored by involving only a small number of students, faculty, and administrators initially.

Examples of Portfolio Materials

A critical task of the portfolio approach is to identify coursework in each year that reflects the students' abilities in one of our goals areas. Table 2 lists the materials collected from freshmen in the sample and the curricular goal which into which it gives some insight. Table 3 does the same for seniors in one CSM major. For example, we collect team-produced final reports from our introductory design course and analyze them for evidence of communication skills and critical thinking abilities. We also evaluate individual written reports from students' humanities courses for the same skills and abilities. Students' final exams in their technical courses are used to assess technical abilities.

The Perry test listed in the two tables refers to hour-long interviews conducted with a smaller sample of students that give a direct measure of students' ability to understand and deal with the complexities and vagaries of open-ended problems. It uses William Perry's Model of Intellectual Development and thus is one direct measure of critical thinking abilities. Our data on this measure are available in the literature^{2,3}.

Another critical task is to establish the guidelines for evaluating the collected student work. This occupied a great deal of the Assessment Committee's time and talent in the first several years of the program. What they developed has worked well: the guidelines are straightforward, analytical, and give reproducible



Table 2 - Freshmen Work Collected

- project team report	Comm,CT
- humanities class report	Comm,CT,HSS
- oral report video	Comm
- final exams in calculus, chemistry, geology, physics	Tech
- Perry test	CT

Table 3 - Senior Work Collected, Dept X

- design team report	Tech,Comm,CT
- seminar essay	Comm,HSS
- design oral report video	Comm
- final exams in select courses	Tech
- GRE or ETI	Tech
- Perry test	CT

results among faculty evaluators. The instruments for evaluating critical thinking and technical abilities are given in Tables 4 and 5. The evaluator is asked to judge the student's ability in universal categories, for example the ability to use evidence in critical thinking and the ability to solve multi-step problems in technical competence.

Table 4 - CT Evaluation Form

Student Name _____ Entry Year _____
Materials Evaluated _____ Date _____

Ranking scale: 5 = strongly done
4 = well done
3 = satisfactorily done
2 = poorly done
1 = not done

I _____ Problem statement
(problem clearly stated, solution addresses,
tech, econ, social aspects addressed)

II _____ Evidence
(evidence used, all pertinent,
logic is clear, convincing)

III _____ Judgment
(alternatives shown, consequences stated,
qualifications stated, risk vs. benefit)

IV _____ Creativity

Table 5 - Tech Evaluation form

Student name _____ entry year _____
Materials Evaluated _____ Date _____

Ranking scale: 5 = very high competence
4 = high competence
3 = adequate competence
2 = weak competence
1 = no competence shown

Subject _____

I. Knowledge
_____ terminology
_____ elementary principles
_____ advanced principles

II. Problem-solving
_____ single concept applications
_____ multiple concept applications



We read through the student's written work and form a judgment in each category, rating each student's competence (see the five-point scales in Tables 4 and 5) based on our judgment of what a graduating senior should be able to do. Comparisons of several Assessment Committee members' evaluations show reasonable consistency.

Changes Linked to the Assessment Process

Since the assessment program was begun to meet a legislative mandate, we focused on satisfying government audiences for the first several years. We were able to document gratifying progress in student learning in most categories and our portfolio approach was praised by the CCHE. However, we have since begun to focus more on using our assessment data to provide feedback to departments and individual faculty so that they can fine tune their programs and courses. For example, one department collected its students' writing samples in the junior and senior years and noticed that they were requiring only perfunctory writing. The professors involved changed their requirements to provide more in-depth opportunities for student writing. Another department noticed that the introductory course exams did not include any questions that could be used to evaluate students' higher level technical thinking; they required only direct recall. The faculty in that department have made a concerted effort to include more multi-step, "synthesis" questions into their course content and on their exams.

There have also been some institutional changes as a result of assessment. The faculty evaluating freshman and sophomore writing have noticed spottiness in the quality of recent student work and inconsistency in the standards of faculty grading. We attribute these problems to our writing program having lost its leadership and have committed the School to hiring one or two communications experts to redesign and oversee our writing-across-the-curriculum efforts.

Another example of change goes back to the Perry data we have collected. According to it, our students show greater improvement in higher-level thinking ability than is normally found in undergraduate students. We attribute much of this to their extensive experience with real-world design problems from their first year on. However, we would like to see even more students reaching higher levels. A group of faculty working with freshman design has taken on the task of analyzing how we can better mentor students in design courses to facilitate their intellectual development.

Strengths and Weaknesses

There are several strengths to the portfolio method: it is non-intrusive on normal classroom procedures; it allows us to view multiples examples of a student's work over time; it is deeply analytical; feedback can be used for both formative and summative course changes. In addition, we have seen a heightened awareness of assessment and the need for continuous improvement on our campus, some real change in courses and programs, faculty involvement in the process through our bottom up approach, and a data-based decision making process.



The only major weakness we have seen lies in our underuse of the rich data we have collected. Specifically, we have not yet devised a way to make full use of the data as a continuous improvement feedback mechanism for our courses and programs. Part of the reason is historical; since the assessment program grew out of a political mandate, most of our early effort was focused on meeting the needs of outside constituents. This led to lack of buy-in from several departments and lack of knowledge about the assessment processes among some campus groups. We are addressing this failing in our current process and have focussed our recent efforts much more on the campus community and how assessment can benefit it.

The Next Step

We see a wonderful opportunity to strengthen our use of assessment as direct feedback, as an integral and natural part of our course and program design. CSM is in the midst of an undergraduate curriculum redesign effort. As a faculty we have rethought and rearticulated our goals, we have developed a curricular framework that contains some exciting innovations, and we have large numbers of faculty from all departments working energetically to redesign specific pieces of the curriculum. As part of the redesign process each of these working groups has been asked to supply an assessment component with their course or program plan. Thus we hope to see assessment built in as an integral part of our new curriculum by faculty who design assessment measures to meet their specific needs. The Assessment Committee is focusing its efforts on advising these faculty groups as they develop appropriate assessment strategies. We believe that our experience over the past decade has provided us with insights and experiences that will make the new CSM assessment process even more effective.

1. Forrest, Aubrey, et. al. Time Will Tell: Portfolio-Assisted Assessment of General Education. The AAHE Assessment Forum, 1990. [2] [3]
2. Pavelich, M. J. and Moore, W. S. "Measuring Maturation Rates of Engineering Students Using the Perry Model." 1993 Proceedings of the Frontiers in Education Conference, pp. 451-455, American Society for Engineering Education, Washington, DC, 1993.
3. Pavelich, M.J., Olds, B.M. and Miller, R.L. "Real-World Problem Solving in Freshman/Sophomore Engineering", in *Fostering Student Success in Quantitative Gateway Courses*, J.Gainen and E.Willemsen, editors, TL#61, Jossey-Bass Publishers, San Francisco, 1995.



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