

Conference Report on Assessment and Evaluation of Science, Engineering, & Mathematics Curricula

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INTRODUCTION

Funded by the National Science Foundation (USE-8953553), Rose-Hulman Institute of Technology organized a workshop on assessment and evaluation of curriculum reform efforts in science, engineering, and mathematics. The workshop was held on 26-27 March 1993 in Washington DC. Both technical/teaching and assessment/evaluator personnel from several colleges where innovative curriculum initiatives were in progress attended. The list of attendees appears in the preceding panel introduction paper. Assessment/evaluation efforts at represented institutions were in various forms and stages at the time of the workshop. This meeting provided an opportunity for persons to share philosophies, methodologies, rationales, and results of local assessment efforts with colleagues. And while the workshop produced no *answers* common themes and issues did emerge. We offer a condensation of the issues raised for consideration of the community of change.

We designed the workshop to be a gathering at which participants could discover new ideas and share their successes. This paper briefly describes the main topics discussed and ideas shared during the two-day session.

WHY ASSESS?

In a discussion of the importance of assessment to curricular change attendees gave many compelling reasons to assess. Among them were:

1. to improve what we are doing;
2. to know if the change that has been made is effective;
3. accountability;
4. to refine future goals;
5. to support continuation and dissemination;
6. to understand how students learn;
7. to assist instructors in the improvement of their teaching;
8. to convince administration and other faculty in an effort to expand institutionalization;
9. to provide students feedback on how they are doing;
10. to prove/verify theories;
11. to improve what we are doing; and,
12. to develop models for assessment/evaluation.

WHAT QUESTIONS DO WE WANT TO ANSWER ABOUT INNOVATIVE CURRICULA PROJECTS?

In developing an assessment plan it is important to know what questions we want to answer. The following are among the responses given by the workshop participants:

1. How are students different—before/after?
2. Did we achieve our goals?
3. What do students come to us with?
4. What do we want students to know?
5. How well do students do beyond course/curriculum?
6. What impact does the course have on the “system”?
7. For which groups of students does it work and why?
8. Does it produce better students?
9. How adaptable/transportable/flexible/expandable is the curriculum?
10. How are students learning?
11. Is it cost effective?
12. What fundamental teaching theories are involved?

WHAT GROUPS DO WE STUDY?

Once the questions are defined for any given project, one needs to determine what groups are to be assessed to get the necessary data. Depending on the questions, the following groups were among those identified as being possible candidates for assessment:

1. students;
2. faculty (both in and out of program);
3. employers;
4. control/comparison groups;
5. prospective students;
6. industrial advisory boards;
7. academic advisers;
8. recruiters;
9. non-participants;
10. administrators;
11. graduate schools; and
12. minority and underrepresented students.

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WHAT VARIABLES DO WE WANT TO STUDY?

Making comparisons among students and within programs requires that decisions be made as to which variables and/or characteristics should be taken into consideration for evaluative purposes. Participants identified the following possible variables:

1. SAT/ACT scores;
2. high school grade point;
3. high school rank percentile;
4. college major;
5. sex;
6. socio-economic index;
7. parents' education;
8. ethnic background;
9. educational history;
10. measure of critical thinking skills;
11. learning styles; and
12. measures of intellectual development.

WHAT HAS WORKED?

In sharing what has provided meaningful data, workshop participants identified several techniques, instruments, and strategies which have been helpful in their assessment efforts.

1. grades in the innovative course as well as subsequent dependent courses;
2. student interviews;
3. faculty evaluation of student progress/skills;
4. journal writing;
5. process checks (students response to "how they are doing");
6. paper/pencil tests (subject matter, attitudes, skills);
7. overall grade point averages;
8. assessment by external evaluators,
9. input of student representatives to faculty group (both long term and short term course corrections);
10. retention data;
11. use of matched comparison and random groups; and
12. feedback from accreditation boards.

WHAT HASN'T WORK?

In developing assessment plans it is often helpful to look at the experience of others to determine the strategy to be taken. Participants shared what type of data did not prove to be useful in assessing their programs. (Note the similarity of some of these items with those listed above as working!)

1. class grades (it was felt that they did not reflect success or knowledge);
2. getting students to participate in out-of-class testing;
3. drawing conclusions from data perceived as skewed;

4. standardized testing;
5. "home grown" tests on content (e.g. conceptual understanding and affective domain);
6. the use of anecdotal information in an effort to get other faculty "buy in"; and,
7. the use of the concept of "cost effectiveness."

WHEN ASSESSMENT IS DONE WHO DOES IT?

Each campus must make a decision about the allocation of resources when developing an assessment strategy. One of the most critical decisions to be made is who will conduct the assessment. Workshop participants identified the following as possible assessment agents.

1. local institutional research personnel;
2. academic departments assess their own majors;
3. outside auditor;
4. faculty members assigned responsibility for assessment;
5. university-driven reviews;
6. campus-wide faculty committee to evaluate portfolios containing longitudinal data;
7. accreditation boards;
8. visiting boards or committees chosen by the institution;
9. education or educational psychology departments on the home campus; and
10. students.

WHO IS PROVIDING LEADERSHIP FOR EVALUATION?

The impetus for assessment varies depending on the nature, scope, and source of funding for the program. However, several agents promoting the need for assessment activity were identified.

1. faculty;
2. university administration;
3. advisory groups;
4. legislatures;
5. accrediting agencies;
6. agencies funding the development of the course;
7. alumni;
8. parents and other stakeholders;
9. student groups; and
10. professional societies.

WHAT ARE INSTRUMENTS AND METHODS USED?

Specific data, instruments, and methods used in the assessment process are determined by the questions which need to be answered and the resources available. Those which have been used at the participating institutions include:



1. grade point averages in preceding course work;
2. pre-post tests;
3. SAT/ACT scores;
4. Learning Environment Preferences (and the Technical Student Learning Environment Preferences);
5. interviews (student, faculty, administrators - focus groups, matched pairs and individual);
6. portfolios (both faculty and students);
7. Perry model interviews;
8. attitude surveys;
9. Myers-Briggs Type Indicator;
10. Watson-Glaser Critical Thinking Appraisal;
11. home grown assessment instruments (cognitive and affective);
12. exams over common concepts;
13. direct observation of student behavior;
14. LASSI;
15. retention data;
16. video analysis;
17. peer observation (faculty);
18. ethnographic variables;
19. use of comparison groups (study group, matched comparison, and random);
20. student self-evaluation;
21. survey of alumni and other stakeholders; and
22. quality methods used to get student input for continuous improvement of the course.

REVOLUTION OR EVOLUTION? (Mid-Course/Continuous Correction)

It was universally accepted among the workshop participants that it is important to respond in some way to student ideas and acknowledge their concerns—negotiation is appreciated as well. As an innovative course evolves, it should be guided by the feedback of assessment results. The following approaches represent some ways for faculty to involve students in this process of continuous improvement:

1. evaluator as ombudsman/ally;
2. the use of student group interviews to provide an opportunity for follow-up and intervention with students;
3. weekly meetings with faculty where student representatives or any other student in the program can express concerns about the program;
4. use of Resident Assistants, Sophomore Advisors (residence hall student staff) to provide valuable anecdotal information on student progress;
5. process checks at the end of every class meeting where students are asked to assess class activity on the following basis: What have we done? What do we have to do? Where can we improve?
6. Use "post-it" checks after each meeting (one positive, one offering suggestions for improvement).

WHERE ARE THE RESOURCES?

As faculty design and prepare to implement innovative courses and curricula it is always a primary concern as to where they can find resources to support their efforts. Innovative programs need money to support space allocation, equipment, and faculty and staff salaries. With the mandate for assessment, the need for resources becomes even greater. The workshop participants discussed several sources for assessment funding.

1. foundations;
2. corporations;
3. federal agencies (NSF, FIPSE, DOD, etc.); and
4. institutional support with line item in budget.

It was noted that when startup funds from external sources cease to exist, there must be an institutional commitment tied to the results of initial assessment efforts.

WHERE DO WE GO FROM HERE?

The innovative course has been designed, implemented, assessed, and evaluated. The faculty responsible for the program are now faced with the challenge of dissemination. The workshop participants shared several strategies designed to bring colleagues and various publics "on board." These strategies fall into two categories—internal and external to the institution.

Internal:

1. Workshops for faculty and TA's involved in the program;
2. release time and summer support for development;
3. mentorships;
4. retreats;
5. departmental presentations;
6. presentations by external advisory board; and
7. on-campus workshops.

External:

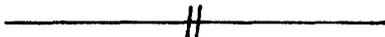
1. Visits from and to faculty on other campuses;
2. conference presentations;
3. host workshops;
4. publish course materials and involve the publisher in dissemination;
5. newsletters;
6. journals;
7. sabbaticals; and
8. involvement of community colleges.

Internal dissemination was deemed harder to accomplish than external dissemination. The most common question asked by faculty is, "How will this effect me?" To be effective, the innovative project needs on-campus, faculty champions, innovators, and leaders. It is important that academic departments take ownership to ensure that the *second wave* of faculty will be committed to the project.



WHERE DO WE REALLY GO FROM HERE?

There was a general consensus that there needs to be a continuing dialog and sharing of assessment strategies, experiences, and data among those involved in innovative science, engineering and mathematics programs. There was discussion about an e-mail network and/or newsletter to support assessment efforts. This discussion will continue at and beyond the 1993 annual Frontiers in Education Conference.



Brian J. Winkel

Brian Winkel edits three journals *Collegiate Microcomputer*, *Cryptologia*, and *PRIMUS*, in addition to continually trying to improve his own teaching techniques by including more problem-solving opportunities for students, cooperative learning, and use of computer technology and *Mathematica*.

Before coming to Rose-Hulman he taught in the liberal arts setting of Albion College. While his background and PhD are in abstract algebra he has found challenge and opportunity for intellectual growth - his own, his colleagues, and his students - in curricular innovation in science, engineering, and mathematics, and he would not want to teach calculus or differential equations any other way than with science and engineering faculty colleagues.

Gloria Rogers

Gloria Rogers serves as Dean for Academic Services at Rose-Hulman Institute of Technology and is involved in a number of projects which involve assessment and evaluation. Dr. Rogers has been involved in the assessment of the Integrated First-Year Curriculum in Science, Engineering, and Mathematics (IFYCSEM) since its inception. A graduate of Indiana State University, she has a BS and MA in Sociology and PhD in Educational Administration. In addition to her work in curriculum assessment, she is interested in group dynamics, and organizational culture.

