

Assessment in the Light (?) of ABET Accreditation Criteria*

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Harvey Mudd College was one of three institutions visited by ABET in 1997/98 as part of the pilot program to aid in the implementation of Criteria 2000. Engineering at Harvey Mudd is non-specialized and characterized by a commitment to design. In particular, it is known for a high-level of student-team project work performed for outside sponsors in the Engineering Clinic. This paper describes assessment activities initiated as a result of our ABET visit. Particular emphasis is placed on those ABET criteria related to design and on our design specific assessment actions. Activities assessed include student presentations, sponsor surveys, and project schedules and budgets.

INITIAL REACTION

WHEN ABET Criteria 2000 was first agreed upon and published, it seemed that attention was focused mainly on how a program might meet Criterion 3, A-K. These are stated below with those criteria relating most directly to design in italics.

- A. Ability to apply knowledge;
- B. *Ability to design . . . experiments . . . interpret data;*
- C. *Ability to design a system . . . to meet needs;*
- D. *Ability to function on multi-disciplinary teams;*
- E. Ability to . . . solve engineering problems;
- F. *Understanding of professional . . . responsibility;*
- G. *Ability to communicate;*
- H. Understand impact of engineering solutions;
- I. Knowledge of contemporary issues;
- J. Ability to use . . . tools for engineering practice.

It might be argued that all of these relate to engineering design. Because design education is central to the Harvey Mudd approach, and because the Harvey Mudd College curriculum is so closely identifiable with the above list, we volunteered to take part in the second year of the ABET 2000 pilot program. Our visit took place on October 6th through 8th, 1997.

The design stem of the HMC curriculum consists mainly of: Introduction to Engineering Design, E4; Experimental Engineering, E54; and three semesters of Engineering Clinic experience. Documentation includes: E4 final reports, E54 laboratory notebooks, and Clinic final reports. Furthermore, we argued Clinic projects are real projects formulated, paid for, and monitored by industry sponsors. Thus, in our view, the long and documented history of successful projects

establishes compliance with Criterion 3. In addition, our program is non-specialized, thus mapping into Criterion 3 part D nicely, a source of concern to traditional programs.

ABET RESULTS

When our report was received, we learned that the following four issues were to be addressed:

1. Establish a formal evaluation process to periodically review and consider revisions to education objectives based on the mission of the institution, ABET criteria and the needs of the program's various constituencies, as required by EC 2000 Criterion 2.
2. Establish a system of ongoing evaluation that demonstrates achievement of program objectives and uses the result to improve the effectiveness of the program, as required by EC 2000 Criterion 2.
3. Document the measurement process used to confirm that outcomes important to the mission of the institution and the objectives of the program are being achieved, as required by EC 2000 Criterion 3.
4. Document the results of the assessment process and the application of these results to the further development and improvement of the program, as required by EC 2000 Criterion 3.

HMC REACTION

In summary, although our program was rated 'outstanding', we lacked formal, documented assessment practices directed toward systematic, continuous program improvement. Our first reaction was somewhat predictable.

However our next reaction, focusing now on

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design, was to distinguish between an impressive collection of excellent Clinic and E4 final reports and a systematic way to improve student performance on these projects.

Presidential action was critical in helping the Department address assessment. Prior to the summer of 1998 President Jon Strauss made two important decisions: (1) providing summer support for the Department Chairperson (J. Richard Phillips) and a faculty member (Ziyad Duron) to develop strategies; and (2) proposing to the faculty a new staff position fully dedicated to college-wide assessment.

By September 1998 Phillips and Duron had outlined a mechanism for addressing assessment in the Engineering Department, including:

- hold a retreat to consider assessment issues early in the fall semester;
- form an assessment committee as a standing engineering department committee, focusing on ABET criteria;
- schedule and conduct regular departmental retreats on assessment;
- continue summer funding for faculty to address assessment;
- establish a 'Center for Engineering Education Assessment';
- improve formalization of Clinic [a corporate-sponsored team approach to integrated problem-solving] assessment;
- revitalize departmental visitors committee similar to the Clinic's advisory committee;
- develop external visibility in the 'assessment world'.

In October 1998, the faculty unanimously approved the assessment staff position and established a committee of deans, faculty, students, and alumni to develop the assessment program for the college. The assessment position was filled by a long-term administrator (Karen Yoshino) who was near completing a doctorate in higher education.

Engineering at Harvey Mudd College had not systematically reviewed its goals for several years. These goals were resurrected and considered in light of the ABET assessment criteria together with current activities of the department that would fit into an assessment program. The result is a matrix [1] which maps the entire program including: goals, objectives, students, and feedback mechanism to program.

In November 1998 an incomplete draft matrix was presented to the engineering faculty, together with an assessment glossary, and a list of outcomes developed by the college-wide Curriculum Planning Committee. The faculty were asked to further develop the matrix by providing suggestions on assessing criteria in need of assessment mechanisms.

In January 1999 the Department dedicated sufficient time within a day-long retreat to review and reconsider departmental goals and decide on next

steps to develop an engineering assessment program. This discussion was informed by information the college could easily develop about various constituent or stakeholder groups.

DESIGN-SPECIFIC ACTIONS

At this point, we have concentrated our design-related assessment activities on the Engineering Clinic. We expect that consideration of E4 and E54 will follow.

As part of our pilot visit we offered a number of examples of outcomes instruments related to Clinic. Details of these and other self-study materials are available on the World Wide Web [2].

New design-related assessment activities are:

- redesign of presentation evaluation forms *and keep statistics* on the responses;
- redesign client survey forms to enable assessment use;
- survey and evaluation of our design review program for projects involving fifth-year students;
- keep data on projected vs. actual time and budget required for Clinic tasks and closing this loop with students involved.

To elaborate on the first activity, Engineering Clinic team presentations are part of the culture at Harvey Mudd College. These are regular events, in which students integrate their team-based learning in solving real-world problems of their corporate sponsors with their communication skills by presenting their project to the public.

Evaluations of the Clinic team presentations have been steadily used by the Department for many years. Evaluation forms completed by corporate and student observers were circulated and viewed by student teams, faculty advisors, and the Clinic Director. Under this method it was extremely difficult to detect trends beyond a given team's performance. This situation presented a useful way to demonstrate how to convert existing activities into assessment feedback loops. By devising a compiled report of the evaluation forms, the Clinic Director could see how teams were performing between each other, and how the teams together were performing against standards defined by the Department. Since that phase, Yoshino has worked closely with the Clinic Director to produce a revised assessment instrument which maps directly with the assessment program. Note that under the new form, the evaluator is identified as to constituent group, performance objectives are stated for all to understand, and this form has the (yet untested) potential to detect changes in performance of the team from one semester to the next. Example forms are included as attachments to Reference 1.

Activities 2 through 4 are in a preliminary state. It's expected that results from these and other

design-related assessment efforts will prove to be of great value to our Engineering program. These results will be published when appropriate.

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REFERENCES

1. J. R. Phillips, Z. Duron and K. Yoshino, 'ABET 2000 post-visit blues?' *Proc. ASEE/PSW Conference*, Las Vegas, NV, March 1999.
2. [Http://www.eng.hmc.edu/ABET/ABET.html](http://www.eng.hmc.edu/ABET/ABET.html).

J. R. Phillips graduated from the University of California at Berkeley with a BS in Chemical Engineering. His graduate degrees, M.Eng. and D.Eng., also in Chemical Engineering are from Yale University. He joined the Harvey Mudd faculty in 1966, was Director of the Engineering Clinic for 17 years, and served as Department Chair from 1993 to 1999.

Ziyad H. Duron, the Jude and Eilene Laspa Professor of Engineering at Harvey Mudd College, is widely recognized as an expert in the full-scale field testing of large structures and a leader in the development of related field-test procedures. His degrees are from Harvey Mudd College (BS), Massachusetts Institute of Technology (MS) and California Institute of Technology (Ph.D.). Dr Duron also serves as a consultant to the Aerospace Corporation.