Criteria 2000 Visit
Harvey Mudd College
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J.R. Phillips
Engineering Chair

ABSTRACT

Harvey Mudd College was one of the institutions visited by ABET in 1997/98 as part of the pilot program to aid in the implementation of Criteria 2000. Our visit took place on October 6th through 8th, 1997.

Engineering at Harvey Mudd is non-specialized and characterized by a high level of student-team project work performed for outside sponsors, the Engineering Clinic. As such, the program is classified as non-traditional under Criterion 8.

The program is compared to Criterion 2, "Educational Objectives", and 3, "Outcomes and Assessment". From the start Harvey Mudd Engineering has been highly structured while responding to clear and long-standing goals. With respect to process, we chose to present the assessment and evaluation program that existed as opposed to creating something for this visit. Our assessment instruments are presented. Finally, the outcomes of our visit are discussed. Because this was a pilot visit, an open discussion is in order.

The Institutional Setting

Harvey Mudd College (HMC) is a coeducational, undergraduate college of engineering and science with 638 students and 77 full-time equivalent faculty. It is located an hour east of Los Angeles, California in a cluster of five undergraduate colleges organized roughly along the lines of Oxford and Cambridge. The College is young having graduated its first engineering class in 1961. It is highly selective and privately supported. Degrees may be achieved in engineering, computer science, mathematics, biology, chemistry and physics. The entering first-year class contains 183 entrants, just under half become engineering majors, and nearly all will graduate in four years and proceed to engineering practice, graduate school, or a myriad of other endeavors.

Program Educational Objectives

As set forth in the Catalogue, "Harvey Mudd College seeks to educate engineers, scientists and mathematicians well versed in all of these areas and in the humanities and social sciences so that they may assume leadership in their fields with a clear understanding of the impact of their work on society."

To restate, the College goals for graduates are:

1) Achieve breadth of technical education;
2) Develop leadership skills;
3) Develop understanding of the impact of their work on society.

Consistent with these general goals, the Harvey Mudd Engineering Department has developed a non-specialized, project-based curriculum with a very strong commitment to Humanities and Social Sciences. Furthermore, a set of "Goals for Graduates," set forth in 1963[1], has provided a more detailed framework for curriculum planning and change.

The Departmental goals for graduates are:

1) Acquaint students with engineering practice;
2) Develop skills, by use, in computation;
3) Foster creative ability through projects;
4) Gain insight into management and leadership skills through group projects;
5) Develop appreciation for non-technical aspects of design;
6) Foster willingness to responsibly attack open-ended problems.

Once again, these desired outcomes are clear and appropriate, but not always easily quantifiable or directly measurable.

The Harvey Mudd Program

The curriculum which was devised to realize these goals includes the first three semesters as a common core with only the first-year engineering projects course, E-4, and an introduction to Engineering Systems course being administered by the engineering faculty. Formal entry into the engineering program begins in the middle of the second year. By College policy, our curriculum requires about 30% humanities and social sciences.

Furthermore, the Engineering curriculum is divided into three stems: Systems, Engineering Science, and Design. The detailed curriculum has changed significantly over the years, as can be seen by referring to the College Catalogue, but the goals have remained unchanged.

The Design stem of our curriculum, E-4, E-54, and three semesters of Engineering Clinic experience, can be directly mapped into our "Goals for Graduates." Documentation that shows that this process produces the desired results includes, E-4 Final Reports, E-54 Laboratory Notebooks, and Engineering Clinic Final Reports.

The resulting non-specialized B.S. degree requires:

1) 12/13 courses in humanities/social sciences;
2) ll/lO courses in science/mathematics core;
3) 13 required courses in engineering plus three electives.

And the engineering major consists of:

1) Engineering Science
   - Chemical/Thermo
   - Computer
   - Electrical
   - Materials
   - Mechanical

2) Systems
   - Introductory
   - Advanced (2)

3) Design
   - Freshman Engineering Project (E-4)
   - Experimental Engineering (E-54)
   - Engineering Clinic (3)

4) Emphasis
   - Technical Electives (3)

The Clinic provides professional experience that draws on a broad knowledge base by requiring students to undertake challenging design problems. An educational innovation at Harvey Mudd College, the Clinic brings together teams of students with faculty advisors to work on carefully selected industry-sponsored projects. Coordination with industrial liaisons ensures that the project experience corresponds as closely as possible to that encountered in actual practice. The students plan and execute their projects; coaching, monitoring and evaluation are provided by the professors. The questions they face are of the sort that professional engineers must face regularly; the solutions they devise must be satisfactory in practice as well as theory.

Criteria 2000

At this point, it seems appropriate to restate the relevant program outcomes that are specified in both Criterion 2 and Criterion 3, ABET 2000. For Criterion 2, “Educational Objectives”, engineering programs must have in place:

1) Consistent, detailed, published educational objectives;
2) A process for determining, and periodically evaluating, objectives;
3) A curriculum and process to achieve objectives;
4) A system of on-going evaluation and use of results to improve program.

With respect to Criterion 3, "Outcomes and Assessment", engineering programs must demonstrate that their graduates have:

1) An ability to apply knowledge of mathematics, science and engineering;
2) An ability to design and conduct experiments, as well as to analyze and interpret data;
3) An ability to design a system, component, or process to meet desire needs;
4) An ability to function on multi-disciplinary teams;
5) An ability to identify, formulate, and solve engineering problems;
6) An understanding of professional and ethical responsibility;
7) An ability to communicate effectively;
8) The broad education necessary to understand the impact of engineering solutions in a global and societal context;
9) A recognition of the need for, and an ability to engage in, lifelong learning;
10) A knowledge of contemporary issues;
11) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

A comparison of the Harvey Mudd College and Engineering Department desired attributes for graduates with those listed above for ABET 2000, Criterion 3, shows that they are in very substantial agreements. The Criterion 3 outcomes are, perhaps, a little more detailed, but it is appropriate to draw the conclusion that the Harvey Mudd Engineering Program is in compliance with ABET 2000, Criterion 3.

That the HMC Engineering program is well designed, and effectively conducted, to meet our goals has not been questioned. In addition, many examples of continuing processes of assessment that have been used to improve our program over the years were cited in our Self Study. What seems to be a matter of interpretation relates primarily to Criterion 2, item 4: A system of on-going evaluations and use of results to improve program.

Assessment

To demonstrate that our program was meeting our goals, and whether our goals were in agreement with those of Criterion 3, we offered a number of outcomes instruments. Details of these and other self-study materials are available on the world wide web.2

1) "Class of 1997 Annual Report" (Placement);
2) Clinic Advisory Committee "Clinic Client Survey" 1997;
3) Clinic Program "Liaison Satisfaction Survey" (Attendees) 1997;
4) Team Leader Survey 1993;

5) Faculty Advisor Survey 1994;
6) Student Experience Task Force Questionnaire 1997;
7) Student Course Evaluations 1997;
8) Clinic Presentation Feedback (Student) 1997;
9) Employer Survey 1997.

With respect to process, we chose to present the assessment and evaluation program that existed, as opposed to creating something for this visit. Examples include:

1) Regular and special Department meetings;
2) Annual one-day, off-campus retreat;
3) Periodic Departmental curriculum studies;
4) Periodic Engineering Department Visitors Committee Meetings;
5) Clinics Advisory Committee Meetings (five per year);
6) Clinic Student Team Leader Meetings;
7) Departmental Curriculum Committee operations.

During the exit interview it was indicated that we will be cited as deficient in areas related to the evaluation process. This will be discussed at the time of presentation. It's our understanding that we will be expected to show progress in this area.

Conclusions

Harvey Mudd was visited by our ABET team on October 6th through 8th, 1997, as part of the pilot program to aid in the implementation of Criteria 2000. As far as program conduct and results, conforming to the spirit of Criterion 3, it would be fair to state that we were rated as "Outstanding". However, deficiencies were cited with respect to evaluation process.

References

1. Wilson, W.E. et al, "Survey of Freshman Engineering", Claremont, CA: Harvey Mudd College, May 23, 1964 (A seminar held at HMC for Southern California engineering and pre-engineering faculties).

2. http://www.eng.hmc.edu/ABET.html