Progress Report on Assessment Fund Award for the Undergraduate BioEngineering Program

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Over the past several months the BE (BioEngineering) Faculty have been revising their concept of how the undergraduate program can be described in terms of making its assessment common place and automatic. To this end, we have established the Mission, Goals, and Objectives of the program. Further, we have made some preliminary attempts to measure and document the Outcomes (i.e. what actually was produced by the program). Procedures to develop and implement program improvements are in the process of being adopted as program policies. The process for policy adoption will take many months and, like assessment, will be an ongoing activity.

Mission and goals

The mission of the BE Program is to provide students a unique opportunity to study the fundamentals of engineering and biology and the application of engineering to biological systems. To fulfill this mission the BE Program will:
a. Provide students with the essential fundamentals of engineering,
b. Train students to become engineers with the skills to design, manufacture, test, and/or operate systems in which living organisms or biological products are a significant component, and
c. Produce graduates that have the skills to function in modern society as is expected of a professional engineer with a baccalaureate degree.

Expected Outcomes (a.k.a. objectives)

The program objectives are for students to learn to:
Find a solution to a problem with differential equations;
Find a solution to a problem involving mechanics, electro-magnetics, and optics;
Find a solution to a problem involving inorganic and organic chemistry;
Find a solution to a problem involving general and microbiology;
Find a solution to an engineering problem involving statics, dynamics, fluid mechanics, and thermodynamics;
Design a system, component, or process where biology plays a significant role;
Design and conduct experiments to find information for a design;
Use modern engineering techniques, skills, and tools to identify, formulate, and solve engineering problems;
Function effectively on a multi-disciplinary team;
Identify the professional and ethical responsibilities when practicing engineering;
Communicate effectively in large and small groups;
Identify the impact of engineering solutions on the surrounding context;
Engage in life-long learning through participation in professional conferences workshops, and courses and by reading and writing for the relevant literature; and Intelligently discuss contemporary issues.

Assessment Measures of Outcomes

Measures (or evidence) of outcomes that show how well objectives were achieved include:
a. student portfolios of design projects;
b. passing rate of seniors and graduates on the nationally normed Fundamentals of Engineering Exam;
c. alumni survey that documents career development activities, professional accomplishments, and their perception of their learning outcomes;
d. employer survey that documents how well graduates were prepared for their careers;
e. placement data of graduates;
f. current students survey that documents how well students are progressing towards the objectives; and
g. industry survey that documents the perception potential employers have of the outcomes.

Measures that show to what degree the mission and goals are appropriate to societal needs include:
a. alumni survey that documents program evaluation, professional accomplishments and career development activities;
b. employer survey that documents how well their needs are being met;
c. industry survey that documents the perception of potential employers of how well the goals and objectives match their needs;
d. placement data of graduates;
e. minutes from meetings of an advisory board composed of employers, potential employers, and community members; and
f. minutes from faculty curriculum meetings.

The BE Program has been using many of the above instruments for several years. All graduating students complete a two-semester senior design project during which they assemble a portfolio including a design journal and a full engineering report. They are also encouraged to assemble any previous design work into the portfolio. Parts of the design portfolios are available on a web site. Passing rates for the nationally normed Fundamentals of Engineering have also been recorded as have the placement of graduates.

Minutes of faculty curriculum meetings and BE Program Advisory Board (BEPAB) meetings are not complete. Future meetings will be documented and made available to Program faculty and BEPAB members through a web site.

This project developed four surveys that are attached. There is a Student, a Professional (alumni), an Employer, and a BEPAB member survey. Each survey asks about the goals and objectives of the program from the viewpoint of the respondent. The questions for each survey had to be written in language that reflects the kind of evaluation each of the four clientele groups is uniquely qualified to make.

The student survey is targeted at current students. It asks the students to provide their sex, year in school, and personal career goals. Then they can give their opinion on the progress the Program has made to fulfill its goals and objectives. Most questions are multiple choice using a five

division metric: 'Not at all'; 'Poorly, many of deficiencies'; 'Fairly well, very few deficiencies'; 'Adequately, no deficiencies'; and 'More than required'. (More discussion of the metric will follow the survey descriptions.) The information from this survey will allow tuning of the curriculum to the progress students expect to make towards the objectives.

The professional survey is targeted at graduates of the program. After asking them for information as to their career progress they are asked to use the five part metric to give their perception of their outcomes from the program. This information, modified by the length of their career, will allow program faculty to evaluate what needs to be worked on to balance the program for career development.

The employer survey is targeted at supervisors and upper administrators at organizations employing graduates of the program. After asking for some critical information about the organization, they are asked to use a six division metric to give feedback on how well the program prepared their employees for work. The additional division in the metric is 'Does not apply to my needs'. This information allows program faculty to tune the program to the needs of industry. Not only is there a measure of the balance in outcomes but there is an additional component measuring the fit of the objectives to the needs of industry. Having objectives in tune with employers needs is important for a successful program.

The advisory board survey is targeted towards our BEPAB members but may see use for broader community input. The six division metric is used. This allows a better measure of how well the goals and objectives are in tune with societal needs as well as professional career needs.

The divisions and the descriptors of the metrics were designed to give the most useful information for program improvement rather than a rating. The descriptors are quite literal. Value is based on how program faculty sees the outcome and objective in the context of the mission. Some people may interpret 'Adequately' as equivalent to 'Good' and 'More than required' as equivalent to 'Excellent', others may see 'no deficiencies' as excellent and 'More than required' as wasting resources. 'Not meeting my needs' is also factual and will need to be given value according to other factors. This interpretation is the responsibility of the program faculty.

Procedures for evaluating measures and making changes as indicated

This may be the most difficult phase of the assessment process. The program faculty will be able to access the measures form a secured web site. This database is easily accessed to generate reports summarizing essential data. Because the information is openly available, it will encourage faculty discussion and program changes.

Regular faculty and curriculum committee meetings supplement web access and email discussions. Suggested changes come from all quarters but the faculty must be informed and adopt any changes. Radical changes are processed through the college administration and faculty self-governance.

Faculty discussions are now based on factual information rather than each individual's anecdotal observations. This facilitates coming to decisions that then are implemented in an open

environment for evaluation. Faculty expertise and dedication are still the most important components in the on-going efforts to improve the program.

Reflective discussion

Establishing an assessment program requires a dedicated faculty. Without some buy-in, there is no progress. We have already seen some areas that we are changing. Making the changes is going to be more difficult than agreeing that there is a problem and changes need to be made.