Assessment and Evaluation

http://www.foundationcoalition.org

Current interest in enhancing student learning in engineering is widespread. Because the curriculum has a major effect on what students learn, design and implementation of curricular programs is a high priority for innovative engineering colleges. The Foundation Coalition (FC) incorporates several strategies to: a) reform engineering curricula, b) increase student performance, and c) evaluate reform with appropriate, authentic assessment. This document provides case studies of diverse institutions in the FC and showcases examples of how assessment and evaluation data have been used to facilitate curricular decision-making.

What is assessment and evaluation?

Assessment is defined as data-gathering strategies, analyses, and reporting processes that provide information that can be used to determine whether or not intended outcomes are being achieved.[1] Evaluation uses assessment information to support decisions on maintaining, changing, or discarding instructional or programmatic practices.[2] These strategies can inform:

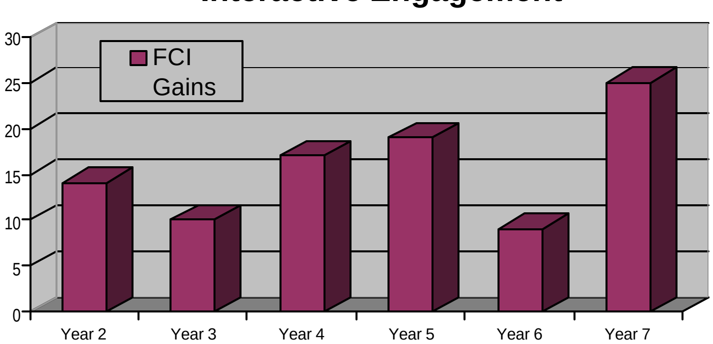
- The nature and extent of learning,
- Facilitate curricular decision making
- Correspondence between learning and the aims and objectives of teaching, and
- The relationship between learning and the environments in which learning takes place.[3]

Why should you care about assessment?

Assessment of student learning can be used for several purposes. Student learning studies can be used to communicate learning achievement for specified outcomes, for example EC2000 Criterion 3, to provide learning evaluation to the student and the teacher, to motivate the student, and to reinforce classroom strategies that work well and target those warranting further investigation.

In addition to monitoring student learning, assessment can be used to examine program efficacy. Such assessment can indicate the degree of success of a program after its completion or can be ongoing during a program to foster continuous improvement. Programmatic assessment can be used to manage projects and communicate project outcomes, evaluate the effectiveness of institutional programs, and determine direction of future processes to improve the program over time.

FCI Gains: Traditional and Interactive Engagement



How do you get data?

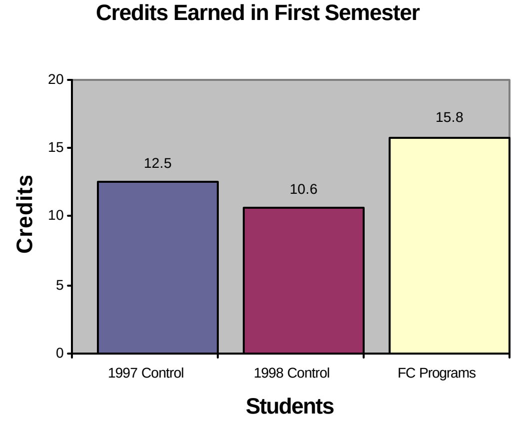
Quantitative studies yield numerical data that give a topical view of program impact. Data collection may involve pre-tests and posttests on course material, surveys, observations, or analysis of institutional data such as grades, enrollment trends, retention, and graduation rates. Quantitative data provide useful summaries of what is happening in a program and can disclose patterns, anomalies, and relationships. However, quantitative data do not necessarily indicate why. Qualitative studies accommodate individual subjectivity and detail and thus delve deeper into the social context behind student performance, attitudes, and behaviors. The study of social change frequently involves qualitative research because of its focus on the social context and patterns. Qualitative research aims to define meanings and actions in particular contexts, to show how meanings and actions are organized, and to interpret patterns in light of broader social contexts and similar settings. For qualitative studies, researchers observe or interact and talk with participants about their perceptions through individual interviews, focus groups, and document collection.

Case Study: Physics Reform at ASU

Arizona State University (ASU) used assessment and evaluation techniques to study how reformed engineering curriculum (e.g., interactive and cooperative learning, curricular integration, the infusion of technology, etc.) in physics impacted student learning and classroom environment. ASU used two assessment approaches. First, quantitative data such as pre- and posttest results of student comprehension were gathered using the Force Concept Inventory[4] (FCI). Second, the Reformed Teaching Observation Protocol (RTOP), a measure of the degree of reform in the classroom, was used to gauge the following pedagogical changes: lesson design, communication, and student teacher relationships. Analysis of data showed, with the implementation of reformed curricula, student performance on the FCI surpassed all prior years in the FC. Additionally, the RTOP scores revealed significant changes had occurred in physics instruction.

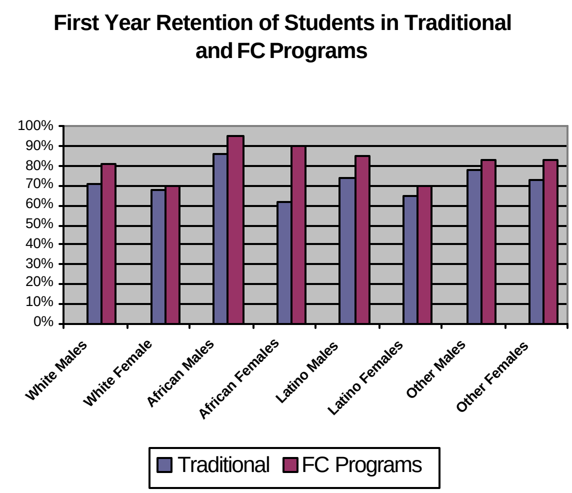
Case Study: UMD Freshman Programs

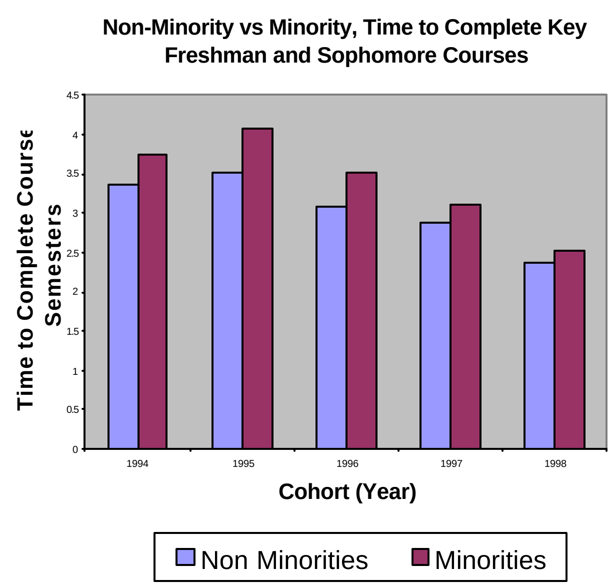
University of Massachusetts Dartmouth (UMD) used multiple assessment tools to evaluate its pilot FC freshman engineering programs. Both quantitative and qualitative methods were used to study student retention, academic performance, attitude toward teaming, life-long learning, and technology use. Comparison of retention data for first-time, full-time students showed that 83% of FC students continued to study engineering at UMD compared to about 62% of students in traditional engineering programs. FC students reported more experiences working in teams, better integration of course material, increased use of technology, and a greater expectation to return to UMD for the sophomore year. Finally, evaluation of student performance measures indicated that FC students outperformed comparison groups in successful completion of earned credits during the first semester, as shown to the right. Based on the results of these assessments, UMD engineering faculty chose to implement FC programs after offering its pilot for only one year.



Case Study: Student Retention at TAMU

In 1993, Texas A&M University (TAMU) initiated engineering curricular reform as a member of the FC. FC efforts were joined with those of the Texas Alliance for Minority Participation (TXAMP) to retain the talented freshmen that entered the engineering program. The project director for TXAMP, a leading member of the FC team, and the data assessment teams for the two programs united and explored the impact of the new FC curriculum in conjunction with the TXAMP program's intervention strategies, bridge programs, clustering, mentoring efforts and other retention strategies. The results shown in the accompanying figures indicate that the best practices from both of these programs resulted in better retention of all students in engineering and less time required for students to complete key freshman and sophomore level courses. Results of this investigation led to adoption of these programs for all engineering students starting in 1998.





Resources

[1]Gagne, R .M., L.J. Bridges, and W. W. Wagne. 1998. Principles of Instructional Design. Orlando, FL: Holt, Rinehart and Winston, Inc.
[2] Hanson, G., and B. Price. 1992. Academic Program Review. In: M. A. Wjitley, J. D. Porter, and R. H. Fenske (eds.). The Primer for Institutional Research. Tallahassee: Association for Institutional Research.
[3] Satterly, D. 1989. Assessment in schools. Oxford, UK: Basil Blackwell Ltd.
[4] Hake, Richard R. 1998. Interactive-engagement vs. traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. American Journal of Physics 66:64-74.

Whether you're just getting started or looking for additional ideas, the Foundation Coalition would like to help you incorporate assessment and evaluation into your engineering program through workshops, web sites, reading materials, and assessment assistance. If you'd like suggestions where to start, see our web site at http://www.foundationcoalition.org or contact our Project Director, Dr. Jeffrey E. Froyd, at froyd@ee.tamu.edu or 979.845.7574. The Foundation Coalition is funded by the National Science Foundation, EEC-9802942.