



## Assessment Tools for Attitudes and Skills

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The Foundation Coalition, a program sponsored by the National Science Foundation, has implemented bold initiatives to change the way engineers are educated. The Foundation Coalition (FC) incorporates several strategies to: a) reform engineering curricula, b) increase student performance, and c) evaluate reform with appropriate, authentic assessment. Continuous improvement through assessment and evaluation of engineering programs is a core value of the FC. As a result, a number of useful assessment instruments have been developed by FC participants. This document showcases a few of these assessment tools: the UMD Team Process Check (TPC), Team Knowledge Test (TKT), Web-based Student Survey System, Freshman Engineering Attitude Survey (FEAS), Freshman Engineering Perception Test (FEPT), and Sophomore Engineering Perception Test (SEPT). Contact information for the developers of these tools is provided. If you would like try these tools in your program, contact the developers.

### Assessing Teaming Skills at UMD

The assessment team at University of Massachusetts--Dartmouth developed two instruments that can be administered on paper or on-line. The tools are the UMD Team Process Check (TPC) and the Team Knowledge Test (TKT).

#### Team Process Check

The TPC is intended to serve as a self-report assessment of a team's functioning to be administered periodically during the life of a team. The measure attempts to assess several areas of functioning such as communication, task management, and decision making. A number of revisions of the instrument have been made, and reliability and validity data have been collected in introductory engineering classes. The bulk of the data have been analyzed and reported together in an ASEE paper. Additional analyses will be done and additional data collected in future semesters.

#### Team Knowledge Test

The TKT is the first draft of a measure intended to assess individual team members' general knowledge of team issues and concepts. The TKT has been used as a pre-post measure of team knowledge over a semester's team experience and before and after the use of team training material that the developer posted on a website and asked faculty to assign as part of engineering courses.

It is the developer's intention that these tools, if validated, can be incorporated into a continuous improvement process of assessment and team training.

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### Web-based Student Survey System at UMD

The Foundation Coalition (FC) Assessment Team at the University of Mass-Dartmouth has developed prototype surveys to assess student outcomes mandated by EC2000 and other FC goals. The web-based surveys focus on the EC2000 a-k criteria that are not routinely assessed by standardized tests or class exams. Specifically the survey assesses teaming, communication, life-long learning, and technology use. These surveys, originally developed to be given to all engineering students in a college of engineering, have been analyzed and divided into scales which could be given to students in specific courses, departments, or programs. The surveys feature multiple questions for each subject area. Such multi-item scales are more reliable, stable, and valid than single items.

For measuring teaming, communication and computer use, the survey system has three types of scales: student attitudes, student self-assessment of improvement, and student reports on the frequency of classroom experiences. For measuring lifelong learning, three different approaches are included in the survey system: use of metacognitive processes which tap students' ability to acquire new skills on their own, student sense of self-efficacy in learning, and a behavioral check list measuring students' participation in engineering related activities indicative of independent learning.

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## Perception and Attitude Tests at Texas A&M University

Student perceptions and attitudes about their educational experiences have been found to make an important contribution to the retention of students in undergraduate science, math, engineering, and technology (SMET) programs. For example, studies conducted at Texas A&M<sup>1</sup> suggested that women as a group had lower retention, despite higher incoming preparation and higher performance, compared to men. Findings of this nature have also been made elsewhere<sup>2</sup>, supporting the assumption that student perceptions do help drive persistence, and may be based upon issues independent of a student's academic preparation and grade performance.

Student persistence in SMET disciplines is a matter of national concern in the context of contemporary life, which is increasingly affected by scientific, mathematical and technological innovations. Hence, generating and sustaining positive attitudes and appropriate perceptions about SMET disciplines, and about learning experiences in SMET programs, has become a matter of great importance among academicians. The measurement of student perceptions and attitudes has therefore become a focus of research in a variety of academic programs. The following two sections describe tools used at Texas A&M University to measure student attitude and perception in the freshman and sophomore years.

### Freshmen Perception and Attitude

Two instruments have been used, in paper and web-based form, to provide a quantifiable measure of students' subjective experiences during their freshman year in the engineering program at Texas A&M University. The Freshman Engineering Attitude Survey (FEAS) was designed to measure freshman engineering students' attitudes towards communication skills, integration of knowledge, life long learning, technological skills, and teaming experiences at the end of the freshman year. The Freshman Engineering Perception Test (FEPT) was designed to measure students' perceptions of their pre-college experience and its usefulness, their academic preparation, and their study and work preferences. The FEPT is administered as a pre- and post- test during the freshman year and both the pre- and post- versions target a number of the same factors as the FEAS, in addition to addressing math/science fundamentals. The additional focus of the post-test FEPT was measuring students' perceptions of academic experiences specific to their freshman engineering program. Individual item responses are made on ordinal response scales. Both the FEPT and the FEAS yield separate measures for each of several multi-item subscales and both instruments have undergone evolution, and have been used in outcomes research and evaluation for various programs. The relationship between the two measures is currently under study and item analyses as well as studies of the instruments' validity and reliability are ongoing.

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### Sophomore Perception

The Sophomore Engineering Perception Test (SEPT) instruments have been in use since 1999 in conjunction with three sophomore-level engineering science courses. The SEPT was initially designed as a follow-up to the FEPT and was largely modeled after it in content and scaling. The SEPT was quickly appropriated for more specific use in monitoring and providing feedback to faculty members teaching common cornerstone courses often taken late in the sophomore year or early in the junior year and required for most majors in the college of engineering.

Pre- and post- test versions of the instrument are administered within the same semester course and both versions address communication skills, integration of knowledge, life long learning, technological skills, and teaming experiences, as well as specific math, science and engineering concepts. The tests can also include items specific to the activities and interests of the professor. The most recent form of the instrument has included numerous open ended questions about students' mastery of course material and the quality of instruction of key topics. These items and other modifications have been added by individual faculty members who used the instrument and class results for purposes of continuous curriculum and instruction improvement or for formal evaluation research in engineering education.

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### References

- <sup>1</sup> Graham, J.M., & Caso, R. (2001). *Retention of women in undergraduate engineering programs: An empirical investigation of the role of educational resilience*. Paper presented at the meeting of the Women in Engineering Programs and Advocates Network, Alexandria, VA.
- <sup>2</sup> Hayden, D.C., & Holloway, E.L. (1985). A longitudinal study of attrition among engineering students. *Engineering Education*, 75, 664-668.

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](mailto:froyd@ee.tamu.edu) or 979.845.7574. The Foundation Coalition is funded by the National Science Foundation, EEC-9802942.