DEVELOPMENT AND VALIDATION OF SURVEYS

Measuring Student Engagement In Engineering

Two New Products from The Center for the Advancement of Scholarship on Engineering Education

Development and Validation of Surveys Measuring Student Engagement in Engineering

With NSF support (via grants DUE-0404802 and DUE-0618125), CASEE sought to develop and validate engineering versions of the National Survey of Student Engagement (NSSE) and the Faculty Survey of Student Engagement (FSSE). These engineering versions (E-NSSE and E-FSSE) assess the extent to which engineering students are being engaged by identified "best instructional practices" and are achieving certain learning outcomes desired of engineering graduates. These surveys were first pilot-tested at six engineering programs across the United States. Tests of validity and reliability were conducted on both instruments. The instruments were then refined and shortened based on the psychometric properties of the items in the original instruments. The revised instruments were tested at five engineering programs and analyzed using factor analysis as well as correlations of test-retest reliability.

The Faculty version of the survey (E-FSSE) asked faculty members to "Think about graduating seniors in your program. Please rate their ability, on average, to do the following:" and listed 50 learning outcomes derived from ABET, Inc., the EC2000 study, and the original versions of the NSSE and FSSE. Another section asked the faculty to respond "based on one particular upper-level undergraduate engineering course section you are teaching or have taught in the past five years." This section listed instructional practices as well as student behaviors. The final section asked faculty to rate various instructional practices in terms of both perceived importance and actual completion.

The Student version of the survey (E-NSSE) asked students to rate themselves on the same learning outcomes and behaviors as in the FSSE. Students were also asked to rate the frequency of various instructional practices their engineering faculty demonstrated during the courses they took in their engineering major.

Both surveys included demographic information about the respondents. The current round of testing required respondents to complete the surveys twice, and 19 faculty members and 261 students had full data. More information is inside this pamphlet and at **http://www.nae.edu/casee**.

CASEE Center for the Advancement of Scholarship on Engineering Education

New Directions in Engineering Excellence

http://www.caseeconduit.org/NDEEindex.html

CASEE's NSF-sponsored (via grant HRD-0533520) Engineering Equity Extension Service (EEES) project (see www.nae.edu/casee-equity) supports the development of engineering talent through a train-the-trainer model that incorporates the research base in gender equity and engineering education into the curricula, classroom climate, and academic preparation of students in grades six through fourteen. The ultimate goal is to increase the number of women who earn bachelor's degrees in engineering. In support of this goal, we have produced three related booklets that address recruitment, retention, and advancement of women and girls, including women of color and women with physical disabilities, in engineering and pre-engineering courses. The booklets provide easy to use, visually attractive resources for educators of all types (K-12 teachers, college faculty, and outreach visitors) to recruit, retain, and advance women in the field of engineering by better engaging the diverse skills, interests and backgrounds of their female students and by connecting educational activities to engineering opportunities.

Each booklet will:

1. Review the current literature on recruitment, retention, or advancement of women in engineering education,
2. Provide strategies and examples of successful recruitment, retention, and advancement models, and
3. Identify practical steps and activities for the educators to take.

These recommendations will include variations according to the age of the students, the learning environment, the type of learning activity, and the outreach environment. The booklets are accompanied by electronic materials including videos and presentation slides.

Recruitment

Retention

Advancement

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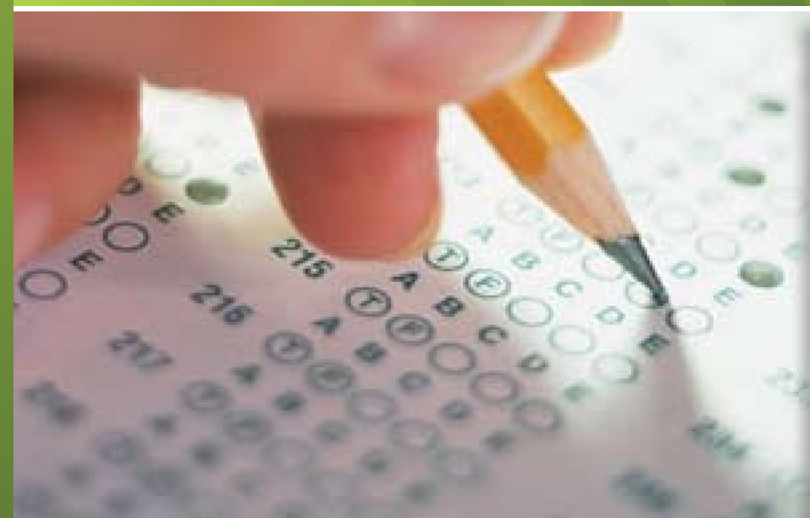

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E-FSSE Scales

Student Outcomes

Component	# Items	*	**
Ability to apply knowledge of mathematics, science, and engineering	3	.83	2
Ability to design and conduct experiments, as well as to analyze and interpret data	4	.86	4
Ability to design a system, component, or process to meet desired needs	3	.78	3
Ability to function on multi-disciplinary teams	6	.91	6
Ability to identify, formulate, and solve engineering problems	4	.89	4
Understanding of professional and ethical responsibility	5	.92	5
Ability to communicate effectively	4	.91	4
Broad education necessary to understand the impact of engineering solutions in a global and societal context	2	.89	2
Recognition of the need for and an ability to engage in life-long learning	4	.77	3
Knowledge of contemporary issues	4	.92	2
Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	4	.87	3
Ability to manage a project (including a familiarity with business, market-related, and financial matters)	5	.89	5
Multidisciplinary systems perspective	3	.79	3
Understanding of and appreciation for diversity of students, faculty, staff, colleagues, and customers	4	.78	0
Strong work ethic	6	.35	3

** Cronbach's, measure of internal reliability of the scale*

*** Number of items with significant test-retest correlations.*

Instructional Practices

Component	# Items	*	**
Encourage student-faculty interaction	14	.59	12
Develop reciprocity and cooperation among students	10	.75	9
Communicate high expectations	6	.30	4
Give students feedback	6	.65	4
Use active learning techniques	4	.80	4
Emphasize time on task	15	.56	12
Respect diverse talents and ways of thinking	9	.46	7
Build on correct preexisting understandings, dispel false preconceptions	5	.63	1
Provide factual knowledge, facilitate understanding of facts or ideas in context of a conceptual framework and organizing knowledge that facilitates retrieval or application	2	.52	1
Encourage students' motivation to learn	10	.71	9

** Cronbach's, measure of internal reliability of the scale*

*** Number of items with significant test-retest correlations.*

E-NSSE Scales

Component	# Items	*	**
General engineering skills	39	.98	39
Instructors and classes followed best practices	11	.90	11
Relationships with peers	6	.92	6
Teamwork	6	.92	6
Discriminatory behavior	3	.90	3
Professional and personal growth	7	.82	7
Interactions with instructors	6	.81	6
Own work habits	4	.71	4
Respect for diversity	3	.73	3
Instructors' positive behavior	4	.81	4
Negative experiences	4	.50	4
Working with diverse others	2	.83	2
Lifelong learning	2	.83	2
Business skills	2	.83	2
Inclusive behaviors	2	.62	2

** Cronbach's, measure of internal reliability of the scale*

*** Number of items with significant test-retest correlations.*

Conclusions

Overall, the test-retest reliability of the E-FSSE and E-NSSE was satisfactory. The student survey items were all correlated from Time 1 to Time 2, as were a majority of the faculty survey items. Interestingly, while the faculty responses yielded several different factors that describe student outcomes in engineering education, the student responses showed one large scale that was labeled "General Engineering Skills" because it encompassed a majority of the learning outcomes. Future research should examine the reasons behind this difference.

The validity of the individual scales was also satisfactory, with most of the factors having Cronbach's scores above the generally-accepted .7 level. However, future testing is needed to determine whether the weaker factors should remain as-is in the surveys or should be modified to yield stronger scales. In addition, confirmatory factor analyses should be conducted with large groups of respondents. The small sample size of faculty respondents precluded this confirmatory analysis in the present study, although the exploratory analysis previously conducted indicated the 25 different factors.

These results indicate that the E-NSSE and E-FSSE may be used to determine elements of student engagement in engineering departments. In particular, the Student Outcomes scales in the E-FSSE had acceptable reliability (with the exception of the "Strong Work Ethic" scale), as did the highly inclusive "General Engineering Skills" scale in the E-NSSE. The items of the E-NSSE also had significant test-retest reliability, indicating that the survey items will give consistent and dependable results across respondents. On the other hand, the Instructional Practices scales on the E-FSSE were less reliable, and several of the individual items did not have significant test-retest reliability. This indicates that further testing of the E-FSSE may be necessary.