**Work in Progress – The Evaluation Tools Database for Assessing Engineering Education Innovations**

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**Abstract** - This paper describes a one-year project that addresses a national need to build the evaluation capacity of engineering educators to effectively evaluate engineering education programs, projects, and innovations. The project goal was to lay the foundation for the construction of an inventory of evaluation tools that could be used as part of evaluation by engineering educators. Project leaders conducted a search through ten years of archived literature to identify existing evaluation tools. An initial database was developed to document a variety of characteristics about the tools. A panel of stakeholders was assembled to assist in the review of tools and the structure of the database. Recommendations for refinement, further development, and dissemination of the inventory were offered by the panel and are documented in this paper.

**Index Terms** – Assessment, Evaluation capacity building, Engineering education, Evaluation tools

For the last 15+ years, engineering education has experienced reform efforts, compelled by increased stakeholder expectations for a well prepared engineering work force and fueled by competitive funding from the National Science Foundation (NSF). Sustaining program and project evaluation efforts over time is now recognized as a critical aspect of reform efforts in engineering education.

A key aspect of any evaluation is the tools used to collect data. Examples of these tools include standardized tests used to assess student achievement, scales that measure student motivation, questionnaires used to obtain feedback from recent graduates, and interview protocols designed to gain input from industry representatives. The quality of these instruments impacts findings from evaluation studies and decisions informed by the data. Thus, having a database of available tools that are cataloged in ways to help users identify the best measure for a particular purpose is necessary.

The purpose of this paper is to document the development of a database of evaluation tools specifically targeted for NSF Course, Curriculum, Laboratory Improvement (CCLI) projects. The database is a component of a larger collection of strategies and resources to help engineering educators effectively evaluate projects, maximize the benefits evaluation can offer for program improvement, document impact, and sustain this work over time.

The process of conducting this project included initial identification, categorization, evaluation, and dissemination of information about existing evaluation tools that could be used in the context of CCLI project evaluation. In addition, the project sought to identify gaps in evaluation tool resources in engineering education. A national panel of experts with diverse backgrounds provided recommendations in regard to the refinement, further development, and broad dissemination of the Evaluation Tools Database.

**Preliminary Database Development**

This project was funded by the NSF Division of Undergraduate Education (DUE) program for CCLI for a one-year period: October 2008 through September 2009. The project was led by a small research team working with a panel of diverse stakeholders that included experienced evaluation tool developers, users, research consultants, and industry representatives.

The initial search for evaluation tools represented a range of evaluation tool types and characteristics. The search spanned the period 1999 through 2008 to include tools that were: (a) well developed as well as those that were early in their development process, (b) appropriate for a range of engineering education CCLI and other educational development projects, (c) used in multiple levels within engineering programs (e.g., curricular, project, program, college), and (d) targeted toward the needs of different stakeholder groups in engineering programs (e.g., faculty, students, advisory board, alumni). The search was conducted through on-line databases with archived descriptions of evaluation projects. These databases included conference proceedings and funded NSF development project databases, including: (a) CCLI, (b) Department-Level Reform, (c) Assessment of Student Achievement, and (d) Graduate Teaching Fellows in K-12 Education. Archived assessment-related presentations and papers presented at the American Society for Engineering Education (ASEE) and Frontiers in Education (FIE) annual conferences were also queried.

The review process was conducted in multiple stages, using the keywords *engineering education*. Available publications and project technical reports were read to identify evaluation tools. Project leaders were contacted by email and telephone to obtain more recent information on evaluation tools used or developed. Relevant documents for each of the identified evaluation tools were assembled and categorized as a resource for an evaluation tools database.
Figure 1 illustrates the type of information contained in the Evaluation Tools Database for one of the evaluation tools. The Teamwork Achieved Assessment uses several open-ended questions and scoring criteria to evaluate student team practices and to facilitate extension of learning after a teamwork experience has been completed. This tool has been pilot tested and is supported by evidence for multiple types of validity and reliability. It appears to meet several utility and accuracy standards.

<table>
<thead>
<tr>
<th>Evaluation Tool Specifications</th>
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<tr>
<td>Name: Teamwork Achieved Assessment (code = 35h); purpose: to document and extend application of effective team practices; format: a mix of open-ended questions with scoring criteria; administered to students after finishing teamwork assignment</td>
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<th>Evaluation Tool Technical Characteristics</th>
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<tr>
<td>Pilot tested; validity evidence available for content, concurrent, construct and validity framework; evidence for reliability</td>
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<th>Utility and Accuracy Standards of Program Evaluation</th>
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<td>Stakeholder identification and values identification utility standards met; accuracy standards met include: context analysis, purposes and procedures, valid and reliable information, quantitative and qualitative analysis, and meta-evaluation.</td>
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<th>ABET Criteria</th>
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<td>The tool provides evidence for ABET teamwork and communication outcomes.</td>
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Figure 1: Abbreviated database content for the Teamwork Achieved Assessment evaluation tool.

The initial Evaluation Tools Database was populated with this type of data for each evaluation tool for which appropriate information was obtained. Nearly 100 tools were contained in the database at the time of the workshop with the panel of stakeholders. By the completion of this project (September, 2009), 150 tools were identified and characterized in the tools database.

**EXTERNAL REVIEW OF PROJECT**

Project leaders assembled a panel of external faculty members, practitioners, and consultants to obtain stakeholder input for the Evaluation Tools Database. Panel members engaged in pre-workshop reviews of database draft materials, face-to-face workshop discussions, and post-workshop follow-up activities.

A half-day workshop was conducted to engage panel members in discussions to advance development of the Evaluation Tools Database. In a variety of small and large group discussions, a distillation of recommendations was developed that focused on indicators of evaluation instrument quality and database interface.

The next workshop activity focused on identifying candidate evaluation tools for the database. Panel members were asked to identify candidate tools using a three-step process: (1) identify categories of tools needed to span all of engineering education, (2) identify known tools that need to be included, and (3) identify gaps where needed tools do not exist.

**PANEL RECOMMENDATIONS**

The following is a definitive set of recommendations that emerged from the pre-workshop and workshop activities:

**Recommendation 1. Understandable**

Participants emphasized the need for making the database understandable to the user.

**Recommendation 2. Quality**

Participants suggested early population of the database should focus on the evaluation tools that are of highest quality and that are broadly recognized in the field of engineering education and educational measurement.

**Recommendation 3. Dissemination**

Participants emphasized the need for credible information to guide people’s development and use of evaluation tools.

**Recommendation 4. Further Database Development**

Participants recommended further development of the Evaluation Tools Database with a high quality web interface.

**Recommendation 5. Broader Awareness**

Participants suggested increasing awareness of the Evaluation Tools Database through convention displays and short articles targeted at technical audiences.

**Recommendation 6. Closing Tool Gaps**

Participants suggested including in the database tools related to several aspects of student learning, such as: problem solving, creativity and innovation, decision making, social competency, communication, cultural competence, ethics, and leadership. Other tool needs included: effectiveness of departments and curricula, faculty learning and development, faculty advising and mentoring, and university infrastructure for engineering education. Future development of the evaluation tools database will take these recommendations into consideration.

**AUTHOR INFORMATION**

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