PRACTICES FOR QUALITY IMPLEMENTATION OF THE TIDEE "DESIGN TEAM READINESS ASSESSMENT"

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ABSTRACT

This paper outlines practices that ensure quality in administering, interpreting, reporting, and maintaining the 'Design Team Readiness Assessment' developed by the Transferable Integrated Design Engineering Education (TIDEE) consortium in the Pacific Northwest. A copy of the instrument can be downloaded from *www.cea.wsu.edu/tidee*. The instrument assesses design process, teamwork, and design communication skills in three different contexts. Previous work has demonstrated how to achieve high inter-rater reliability through explicit scoring criteria and decision rules. For this reason, the 'Design Team Readiness Assessment' can be used to evaluate the preparation of beginning and mid-level engineering and engineering technology students across institutions and degree programs. Faculty who have implemented the instrument have found it to be a valuable classroom tool, promoting self-awareness of life-long learning skills in a variety of course settings and supporting action research on lower-division design experiences. Their discoveries are summarized here using a framework for assessment literacy that is widely used in the K-12 education community.

ROLE OF EARLY-PROGRAM ASSESSMENT

Representatives of both industry and academia rank design process, teamwork, and communication among the top five capabilities that emerging engineers need to possess[1]. In response to such expectations, ABET Engineering Criteria 2000 now requires programs seeking accreditation to not only develop key competency areas such as these, but also to devise methods for assessing achievement and stimulating improvement in supporting skill sets[2]. Because these skill sets are multi-faceted and span developmental levels, they are ideally addressed and assessed at multiple points in the curriculum[3,4]. A special challenge occurs in assessing capabilities of students who transfer among institutions and degree programs during their academic career. This situation, along with a passion for improving the quality of design education, was the challenge that inspired the formation of the Transferable Integrated Design Engineering Education (TIDEE) consortium[5].

Three goals were established for development of a mid-program assessment instrument that focused on engineering design:

(a) To create a tool for assessing the effectiveness of design learning accomplished via different instructional approaches found in community colleges, four-year colleges, and research universities,

(b) To communicate a set of design education outcomes for lower-division courses, and

(c) To provide a learning experience that heightens student awareness of the knowledge and skills necessary for effective design team performance.

Based on faculty workshops and focus groups involving 2- and 4-year institutions across the Pacific Northwest, TIDEE identified three types of learning outcomes related to engineering design: (a) design team knowledge, (b) design team processes, and (c) design products. Design team knowledge includes students' understanding of design team terminology, concepts, and relationships among design team actions and results. Design team processes are the steps engineers utilize to create desired design products. Design team processes also include professional attitudes, self-awareness when design steps are executed, and self-control of transition between design steps. Design products are the items created as a result of a design activity—new materials, objects, components, systems, documents, or processes to meet specified needs.

Figure 1 illustrates a shifting balance among design team knowledge, process, and product that frequently occurs at different stages of an engineering degree program.

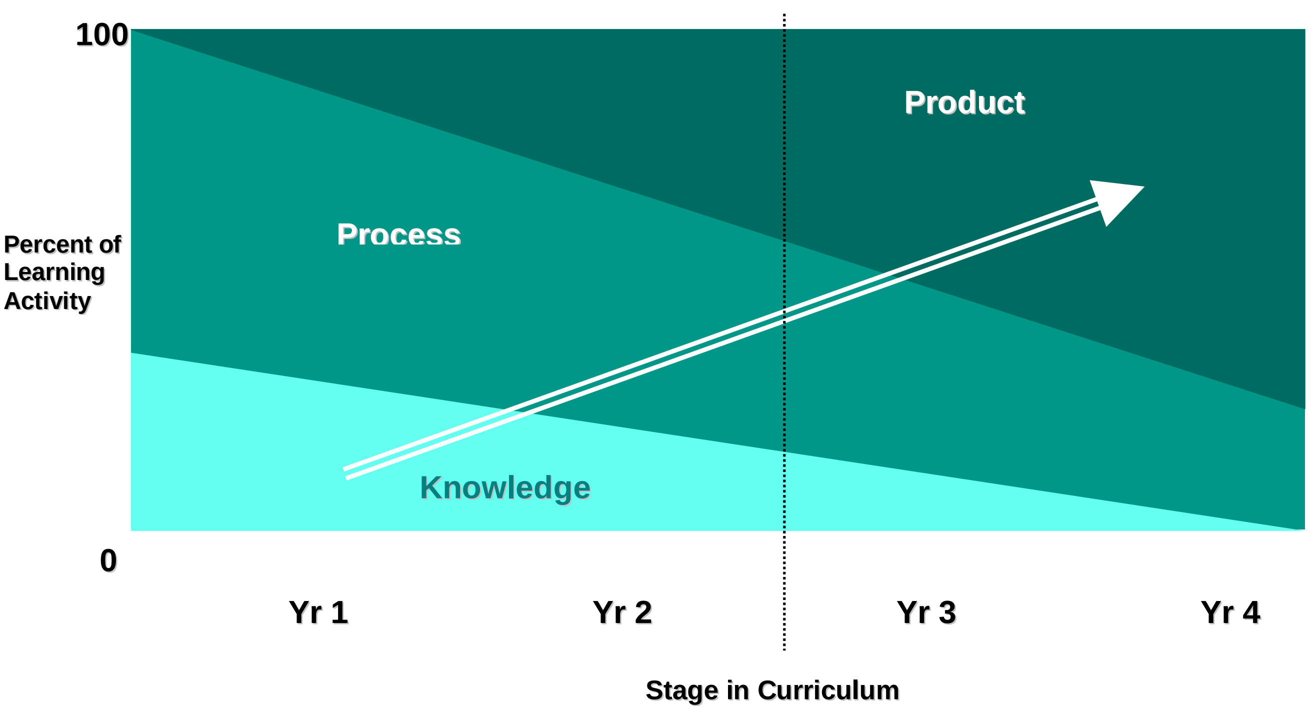

Figure 1. Changing Focus of Design Team Instruction

First-year students need to gain foundational understanding of design team terms/concepts and to participate in a guided-design process. Although first-year students also will produce design artifacts, these are of lesser concern at this point. Students in their mid-program years need to focus on refinement of design team processes with significantly less instructor prompting, while continuing to increase their design team knowledge and progressively giving more weight to design product quality. Students nearing completion of their engineering degrees should be self-motivated to improve their design team skills and they should be increasing their focus on creating products that meet client requirements. For the most effective development of students' design team capabilities, learning exercises at increasingly advanced points in the curriculum should exhibit this shift in emphasis from mastery of design team knowledge and process skills toward creating quality engineering products.

TIDEE participants concluded that mid-program assessments of design team capabilities should address the types of outcomes being developed during the first two years of engineering curricula. Specifically, mid-program assessments need to assess students' knowledge of design team concepts and their abilities to employ effective decision-making and self-awareness in the performance of design team activities. Mid-program assessments should peripherally address the quality of design products and design documentation.

DESIGN TEAM READINESS ASSESSMENT

Over the last five years, TIDEE has evolved a three-component instrument to monitor student design capabilities at the mid-program level[6]. A copy of the latest version of the Design Team Readiness Assessment (formerly called a mid-program assessment of team-based engineering design) can be downloaded from the TIDEE web site: www.cea.wsu.edu/tidee.

The first component of the instrument is a set of short-answer constructed response (SCR) tasks that assess students' foundational knowledge about the design process, teamwork, and design communication. Second, a performance assessment (PA) engages students in a team activity that seeks to identify customer requirements and to develop appropriate test procedures for a common hand tool. Teams produce written documentation that reports on team organization, design requirements, relevant test procedures, and actions taken at each stage in the design process. A reflective essay constitutes the third component and provides insights about design team decision-making, team performance, and individual contribution. Respondents are queried about key elements in the design process, teamwork, and design communication for evidence of thinking at the awareness, comprehension, and application levels in Bloom's taxonomy.

Detailed reliability and validity studies of the Design Team Readiness Assessment have been discussed elsewhere[7,8]. Three raters participated in a multi-step procedure that included initial scoring of student work, reconciliation of differences among raters, revision of scoring criteria, and the development of decision rules to deal with student work that appears difficult to score within the scoring criteria. Intra-class correlation coefficients were computed before and after this process, showing marked improvement of inter-rater reliability.

While the Design Team Readiness Assessment was originally created to inform program level decision-making, pilot testing in a variety of different classes was observed to produce a recurring pattern of teachable/researchable moments during instrument administration, scoring interpretation, and results reporting. Formalizing these discoveries within the framework for quality assessment suggested by Stiggins has generated significant improvements to the instrument and has improved faculty preparation for conducting early- and mid-program assessment with the instrument[9]. Stiggins' guidelines for K-12 teachers and program evaluators consider the following five elements.

1. **Clearly communicated purposes**
2. **Clear and appropriate targets**
3. **Target and method matching**
4. **Appropriate sampling**
5. **Elimination of bias and distortion**

The remainder of the paper examines each of these five elements and discusses them as they relate to early- and mid-program assessment of design team skills.

CLEARLY COMMUNICATED PURPOSES

It is essential that all participants and users of an assessment understand why it is being conducted and how the results will be used. Educators at various levels assess for various reasons. In the context of engineering, professors may choose to focus on the needs of individual students, the needs of the class as a whole, or their own teaching skills. At the level of leadership, such as the department chair or associate dean, assessments may be used to allocate resources, assist new instructors, provide instructional support based on assessment results, or compare achievement across departments. Policy-level assessment requires a panoramic view of student achievement summarized across large numbers of students. These results can be used to fulfill accreditation criteria. Since no single assessment method can serve all of these purposes, assessments must be chosen to best respond to the intended purposes. For successful and sustained adoption, assessment designers must also be sensitive to the time required for faculty to prepare to use the assessment, the class time for students to complete the assessment, and the faculty time to analyze and report assessment findings[10].

The Design Team Readiness Assessment is an off-the-shelf instrument that can be used for pre- and/or post-assessment in early program courses (freshman level), mid-level courses (junior level), or capstone courses (senior level). The skill set it investigates is that expected of engineering students who assume summer or extended internships in the middle of their degree programs. An important design specification set by prospective faculty users was that the instrument requires no more than two class periods for a single instructor to administer and requires no more time to score each component of the instrument than a typical homework assignment (3-5 minutes per student) For this reason, TIDEE developers decided that mastery of mathematical methods and engineering science concepts should not be part of the instrument. This allowed for more thorough examination of individual and class-wide mastery of the non-technical skills necessary for efficient design team performance.

To prepare faculty adopters of the Design Team Readiness Assessment, TIDEE has held several half-day workshops prior to ASEE Pacific Northwest Regional meetings and statewide engineering educator meetings. These have served to orient faculty about accreditation requirements surrounding ABET learning outcomes, explore scripts for administering the instrument that connect it with important goals cited in the course syllabus, gain experience in scoring samples of student work, and discuss ways in which reporting can promote class-wide assessment literacy. Faculty adopters who have not attended a workshop have reported confusion about when and how to deploy the instrument in their course, as well as how to conduct scoring efficiently and accurately. Faculty adopters who have attended a workshop are more satisfied with the insights about student preparation that can be obtained and with the positive assessment culture that can be produced by using the instrument in their courses.

To prepare students to use the Design Team Readiness Assessment, it is valuable to remind them about the difference between assessment and evaluation. Assessment is a process of measuring and analyzing a performance, work product, or learning skill to provide quality, timely feedback, which provides meaningful directives and insights on how to improve future performance[10,11]. Alternatively, evaluation is a process of measuring a quality of a performance, work product, or use of a process against a set of standards to make a judgment if, or to what level, the standards have been met[11,12]. The goal of assessment is self-improvement. The goal of evaluation is often to assign a grade that is part of a permanent record. All students have experienced negativity associated with evaluation in their academic careers. Not all students have experienced the uplifting nature of assessment. Explaining this difference and emphasizing that the Design Team Readiness Assessment is an assessment, not an evaluation, goes a long way toward developing shared commitment to continuous improvement between students and faculty. It is helpful to point out that the purpose of the assessment is to provide feedback to the instructor on how to best address student needs, so that the goals of the course can be efficiently achieved. It is also helpful to frame the workplace importance of the skill sets investigated by the Design Team Readiness Assessment. Most students are fascinated to hear that more employees are terminated due to poor decision-making and interpersonal skills than due to deficiencies in technical skills. They also are curious to learn how their skills match up against other students' in the TIDEE assessment database.

CLEAR AND APPROPRIATE TARGETS

Soon after TIDEE received initial NSF funding for developing its mid-program assessment instrument, a faculty task force was convened to identify key competencies associated with design activities and to establish consensus on appropriate mid-program proficiency in supporting knowledge, skills, and attitudes. Figure 2 illustrates seven key attributes of quality design teams in each of three areas: effective design process, effective teamwork, and effective communication. These design attributes are consistent with the creative problem-solving model described by Lumsdaine[13] and the project based introduction to design by Dym and Little[14]. The teamwork attributes are consistent with the cooperative learning model by Johnson, Johnson, and Smith[15]. The communication attributes are consistent with the recommendations by the writing across the curriculum movement summarized by Bean[16]. These attribute lists have evolved somewhat over time and have been integrated with profiles of expected performance at the novice, intern, and entry-level to produce the performance measures used by the instrument.

Knowledge of the Engineering Design Process

- information gathering/understand problem/customer needs
- problem definition/goals or requirements defined
- idea generation/brainstorming/creativity
- evaluation/analyzing ideas/testing/design modeling
- decision making/selection/planning
- implementation/produce/deliver design to customer
- process review & improvement/iteration

Knowledge of Effective Teamwork

- purpose/goals/focus
- team leader or shared leadership
- assigned responsibilities/accountability
- team attitude/support/commitment
- time management/task orientation
- team member skills/resources/knowledge
- communication/listening

Knowledge of Effective Communication

- clarity of ideas/word use
- organization/logical order
- presentation/format/style/speech
- thoroughness/examples/visual aids
- relevant to audience background/needs
- accuracy/reliability/credibility
- listening/responsive/eye contact

Figure 2. Key Attributes of Quality Design Teams

Engineering novices have completed all requirements for beginning their engineering programs and are able to execute simple engineering tasks under constant direction from a supervisor. Engineering interns have completed pre-engineering coursework along with selected courses in their discipline and are able to perform routine engineering tasks if accompanied by frequent supervision and detailed instructions. Entry-level engineers have completed course requirements for an engineering degree and are competent, self-motivated team members capable of independently performing complex engineering tasks with minimal supervision. Figure 3 outlines the expected progression of design team skills at each level. At the junior level, students should be well on their way to demonstrating capabilities of an engineering intern. This is the target performance level measured by the Design Team Readiness Assessment.

	ENGINEERING NOVICE	ENGINEERING INTERN	ENTRY LEVEL ENGINEER
Design Team Knowledge	Many key attributes neither recognized nor appreciated, not able to formulate linkages between attributes, discussion shows no sense of context to specific design problems.	Most key attributes recognized but with little valuation, some linkages intimated between attributes, discussion loosely connected to specific design problems.	All key attributes recognized and highly valued, thoughtful linkages articulated between a number of attributes, discussion insightfully connected to specific design problems.
Design Team Process Skills	Minimal roles may be identifiable with little effort to manage process for timely task completion, no use of iteration to improve quality, minimal self-awareness of individual or team performance.	Useful roles assigned but executed with limited effectiveness, some effort to achieve cooperation toward task completion, limited iteration to improve product quality, some self-awareness of actions and consequences.	Role assignments made with clear accountability and effectively carried out, resources applied to achieve timely process completion with appropriate iteration that improves product quality, able to accurately explain several strengths and areas for improvement in future design performances.
Design Team Products	Often not operational, unmindful of client needs, accompanied by minimal design documentation, no features justified by engineering analysis.	Operational within limited context, meets some client needs, accompanied by incomplete design documentation, some features justified with engineering analysis.	Fully operational, meets all client needs, delivered with complete and user-friendly design documentation, many features justified with engineering analysis.

Figure 3. Expected development of design team knowledge, skills, and product capabilities

TARGET AND METHOD MATCHING

Several assessment methods are available to educators. These include selected response exams (multiple choice, true/false, matching, and fill in the blanks), essays, performance assessments (real-time observation and product evaluation), and personal communication (question and answer sessions, oral reports, and interviews). Selected response exams are only capable of measuring thinking at the lowest levels of Bloom's taxonomy[10]. The other methods are much better at eliciting higher-level thinking[9]. On the other hand, personal communication is likely to generate the greatest variety and depth of assessment data, but it is extremely time consuming. Essays are nearly as insightful because they challenge respondents to create original text in which they can introduce, analyze, and synthesize ideas. Essay assessment can be greatly facilitated by interpreting what is written against predetermined scoring criteria. Similarly, performance assessment can be simplified by comparing skills applied and products created against predetermined performance criteria.

Because of the advanced skills expected of an engineering intern and the limited time available for implementing the Design Team Readiness Assessment, essay assessments were selected for the first and third components of the instrument. The first component provides a basis of assessing student's knowledge of design, teamwork, and communication processes without being limited to a specific set of vocabulary terms. The third component assesses the level of critical thinking exhibited by students as they reflect on a design-team exercise. Each student receives a separate score corresponding to their design process, teamwork, and communication knowledge and skills when taking the first and third components of the instrument.

While it would be very insightful to conduct an observational performance assessment during the team design activity prescribed by the second component of the instrument, this type of assessment would require a separate assessor for each team and is not practical for routine use. For this reason, the second component investigates the quality of documentation produced during a design team activity. The entire team receives a single score for this product and this is admittedly less meaningful than the individualized scores on the other components. However, the challenge of producing a team product to meet a specific need in a limited amount of time provides an excellent context for reflection on individual, team, and process strengths as well as areas of improvement, which is the focus of the third component of the instrument.

APPROPRIATE SAMPLING

Sufficient tasks or exercises are needed to confidently generalize on how students might perform if assessors could administer all possible exercises. Naturally, the chosen assessment method can limit the ability to do this with confidence. Each of the components of the Design Team Readiness Assessment requires open-ended responses for which there is no single correct answer. Sufficient time appears to be available for students to share what they know, in that most students are willing to turn in their papers before the allotted time has elapsed. Appropriate sampling is further assured by giving the instrument 'cold' without prior class preparation. In this way, the instrument better measures latent understanding and long-term behavior that can be expected outside the temporal and spatial boundaries of a single course.

Many adopters choose to invest a significant portion of a class period to debrief students on their performance on each component of the instrument. Assessment literacy can be promoted by sharing and then explaining the scoring criteria used to rate their work. It is also very effective to have students analyze and critique exemplary responses by other students.

At Washington State University, seniors in Biological Systems Engineering take the instrument as a pre-assessment at the beginning of their capstone design course. The lively discussion that follows raises issues prospective team members are likely to encounter in their capstone projects and reinforces high expectations for design team performance.

At the University of Idaho, sophomores in Mechanical Engineering take the instrument during the first week of class. They are asked to relate skills examined by the instrument to skills displayed by graduating seniors at the annual college-wide design show where they show off their capstone design projects. Furthermore, they are asked to make a journal entry analyzing their individual performance with the rubric suggested by Figure 3 and outlining a personal plan of action for elevating their skills to the next level. They are also asked to speculate why engineering students typically score much lower on the teamwork and communication sections than the design process sections and are asked to suggest actions that could be taken across the curriculum to improve performance in these areas.

At Seattle University some freshman classes take the instrument as an ice-breaker in the beginning engineering course. This experience initiates fellowship among their peers and helps students see the big picture of what design skills can ultimately become. The assessment occurs early in the quarter and represents a "just-in-time" example for the first lectures on design, teamwork, and communication. Comparing freshman data against national averages gives students confidence and boost their enthusiasm for engineering design experiences.

At Tacoma Community College entering students take the assessment near the end of the introduction to engineering design class to assess and summarize their learning. It provides a focus for future classes where team projects are part of the curriculum.

On several occasions at multiple institutions, administration of the instrument has been enhanced by having an industry representative discuss the relationship between the skills measured by the instrument and success in the workplace. Anecdotes about star performers and non-performers make engineering education real and help to establish positive role models.

ELIMINATION OF BIAS AND DISTORTION

The reliability and validity of assessment instruments should be ascertained to ensure that scores represent real student achievement. Bias and distortion can result from underdeveloped language skills (both reading and writing), poor wording of task items, and deficiencies in rater training. Revisions to the Design Team Readiness Assessment are made once each year. Proposed wording and instruction changes are reviewed by TIDEE representatives from five engineering schools with different student populations.

Once changes are approved, TIDEE adopters look for unexplained changes in student performance connected with instrument revisions. If these are suspected, randomized administrations of new and old versions of the instrument are conducted in classes during the ensuing term. Since these assessments are given to the same student population, statistically significant differences in scoring are construed as a sign of potential invalidity. Results of validity studies and proposals for remedying suspected deficiencies are entertained at the next yearly TIDEE review of the instrument[8].

Training is a key factor in reducing scoring bias and distortion[9]. TIDEE maintains a database of more than one hundred samples of student work that have received consensus scores by three raters. A dozen test cases have been identified for use in faculty training. Clean copies of student work are supplied to participants in training workshops. Marked-up copies showing the rationale for consensus scoring are used to provide feedback.

After several iterations with the scoring criteria and decision rules, most participants are able to achieve inter-rater reliability comparable to that reported in the instrument reliability study[7]. Participants also discover the increased reliability of rating by pairs of faculty if they desire to use the results of the Design Team Readiness Assessment in pedagogical research. Faculty adopters are encouraged to score several of the test cases before they score work by a new class of students to verify that they have not lost their scoring acumen.

CONCLUSIONS

Reliable instruments for measuring and improving design team performance are in high demand because of the new ABET EC 2000 requirements. This paper outlines how TIDEE's Design Team Readiness Assessment has been designed and implemented to support efficient, high quality assessment of design process, teamwork, and design communication proficiencies at early and mid-program points in engineering curricula. Figure 4 summarizes actions taken by TIDEE to insure assessment quality. Highlights include:

- explicit scoring criteria and decision rules;
- a faculty development workshop to boost assessment literacy and scoring ability of potential adopters;
- tips for instrument administration and results reporting to boost assessment literacy of engineering students who take the instrument; and
- safeguards to ensure continued reliability and validity while maintaining the flexibility necessary for evolving the instrument.

Methodologies found in the K-12 assessment and evaluation literature are a valuable resource in planning, collecting, and analyzing programmatic data needed to support ABET accreditation under the new Engineering Criteria 2000. This paper illustrates how Stiggins' keys to quality assessment have been used to guide development of the Design Team Readiness Assessment. The authors are strengthening collaboration begun in this work between faculty in Engineering and Education as they prepare to develop end-of-program assessments for many of the learning and design project outcomes prescribed by Criteria 3 and 4. The focus for this effort will be capstone design projects.

Assessment Element	Actions Promoting Quality
CLEARLY COMMUNICATED PURPOSES	Instrument motivated by workplace and accreditation need for design team skills among engineering graduates. Instrument specifications solicited from prospective adopters in assessment planning. Orientation workshops conducted for faculty adopters. Orientation guidelines suggested for student participants.
CLEAR AND APPROPRIATE TARGETS	Key attributes of design process, teamwork, and communication identified through faculty focus group sessions and review of models in the pedagogy literature. Attributes and student profiles used to define performance measures for design team performance below, at, and above mid-program level.
TARGET AND METHOD MATCHING	Constructed response answers used to assess higher-order reasoning related to design team skills. Scoring criteria aligned with attributes identified by faculty focus groups and models in pedagogy literature. Group exercise assessed by analyzing work product.
ADEQUATE SAMPLING	The assessment instrument contains three components, (1) design knowledge, (2) ability to apply design knowledge, and (3) ability to critique and improve performance. The number, type, and mix of assessments are designed to provide program level feedback concerning student design competencies. Student work collected from multiple institutions, multiple disciplines, and course levels to validate scoring criteria.
ELIMINATION OF BIAS AND DISTORTION	Decision rules formulated to resolve confusion experienced by raters in scoring student work. Multiple raters used to establish instrument reliability. Classroom experiments organized to investigate suspected validity issues associated with version changes.

Figure 4. Application of Best Practices in Design Team Readiness Assessment

BIBLIOGRAPHY

1. M. Valenti, Teaching Tomorrow's Engineers, *ASME Magazine*, July 1996.

2. Engineering Accreditation Commission, *Engineering Criteria 2000*, Accreditation Board for Engineering and Technology, Inc., Baltimore, MD, 2001.

3. W. Duncan-Hewitt, D. Mount, S. Beyerlein, D. Elger, and J. Steciak, 'Creating Design Experiences for Beginning Engineering Students According to Developmental Principles', Proceedings of 2001 Frontiers in Education Conference.

4. M. Huba and J. Freed, *Learner-Centered Assessment on College Campuses, Shifting the Focus from Teaching to Learning*, Allyn and Bacon, 2000.

5. M. Trevisan, D. Davis, R. Crain, D. Calkins, and K. Gentili, 'Developing and Assessing Statewide Competencies for Engineering Design', Journal of Engineering Education, April 1998.

6. D. Davis, M. Trevisan, L. McKenzie, D. McLean, S. Beyerlein, C. Atman, R. Adams, K. Gentili, R. Christianson, J. McCauley, P. Daniels, T. Shuman, and P. Thompson, 'Design Team Readiness Assessment: A Multi-Component Instrument for Measuring and Improving Prerequisite Knowledge, Skills, and Attitudes – Version 6', TIDEE, 2002.

7. D. Davis, M. Trevisan, L. McKenzie, and S. Beyerlein, 'Enhancing Scoring Reliability in Mid-Program Assessment of Design', Proceedings of 2001 ASEE Annual Conference & Exposition.

8. L. McKenzie, D. Davis, M. Trevisan, and S. Beyerlein, 'Enhancing Scoring Reliability and Face Validity in Mid-Program Assessment of Design', Proceedings of the 2001 American Evaluation Associate Annual Conference.

9. R. Stiggins, *Student-Centered Classroom Assessment*, Prentice Hall, 1997.

10. T. Angelo and P. Cross, *Classroom Assessment Techniques, A Handbook for College Teachers*, Jossey-Bass Publishers, 1993.

11. P. Parker, P. Fleming, S. Beyerlein, D. Apple and K. Krumsieg, 'Differentiating Assessment from Evaluation as Continuous Improvement Tools', Proceedings of the 2001 Frontiers in Education Conference.

12. M. Scriven, *Evaluation Thesaurus (4th ed.)*, Sage Press, 1991.

13. E. Lumsdaine and M. Lumsdaine, *Creative Problem Solving: Thinking Skills for a Changing World*, McGraw-Hill, Inc., 1995.

14. C. Dym and P. Little, *Engineering Design, A Project-Based Introduction*, John Wiley, 2000.

15. D. Johnson, R. Johnson, and K. Smith, *Active Learning: Cooperation in the College Classroom*, Interaction Book Company, 1991.

16. J. Bean, *Engaging Ideas, The Professor's Guide to Integrating Writing, Critical Thinking, and Active Learning in the Classroom*, Jossey-Bass, 1996.

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