AC 2012-4795: CLOSING THE ASSESSMENT LOOP: A FACULTY TRAINING PROTOCOL

Dr. Kenneth Reid, Ohio Northern University

Ken Reid is the Director of First-year Engineering, Director of Engineering Education, and an Associate Professor in electrical and computer engineering and computer science at Ohio Northern University. He was the seventh person in the U.S. to receive a Ph.D. in engineering education from Purdue University. He is active in engineering within K-12, serving on the TSA Board of Directors and 10 years on the IEEE-USA Precollege Education Committee. He was named the Herbert F. Alter Chair of Engineering in 2010. His research interests include success in first-year engineering, introducing entrepreneurship into engineering, and engineering in K-12.

Dr. Robert E. Kleine III, Ohio Northern University

Closing the Assessment Loop: A Faculty Training Protocol

Faculty members desiring to integrate activities that cultivate in students elements of the entrepreneurial mindset into their courses – such as effective collaboration in a team setting or critical & creative thinking applied to ambiguous problems – benefit from criteria to guide development of those activities[1,2]. Faculty members also need criteria for assessing the effectiveness of the activities they created; we need to know to what degree a specific learning activity accomplished the objective(s) intended. The need for guiding criteria is especially acute when faculty members are integrating new learning outcomes into their courses.

"Closing the loop," or leveraging assessment data to identify deficiencies in class activities, courses, or programs, and as a guide on how to address those identified deficiencies, is a common weakness of assessment programs. Rubrics provide a powerful tool for guiding the development of learning activities that cultivate specific elements of the entrepreneurial mindset. Rubrics are equally powerful tools for assessing the effectiveness of class activities designed to advance specific student learning outcomes. This paper describes a faculty training protocol designed to demonstrate (a) how to assess (score) student artifacts with a rubric; in other words, effective use of rubrics, and (b) how insights gained from the assessment can guide program improvement by identifying weaknesses and suggesting solution paths. For example, effective assessment can be used to determine if a new assignment is needed or if an existing assignment needs to be modified. The protocol is also an effective means for training faculty into the nuances of a particular learning outcome (and its associated rubric) and for gaining insights into possible deficiencies in the rubric that should be addressed.

This paper will describe the training protocol. An application of the protocol is then reported to illustrate the value of the technique.

Appropriate design and use of rubrics

Direct measures of student learning do not rely on students' opinions of what they know or qualitative assessment from an instructor: i.e., "This looks like a B to me." Direct measures observe and quantify students' ability to perform an objective. A standardized test is a classic example of a direct measure of student learning, and, if available, are excellent tools in assessment. Some student work, such as writing or team work, does not lend itself to quantification. Rubrics provide a method to assess student work objectively and repeatedly and yield quantifiable data, even when the student work can have more than one "right" answer.

A rubric is a scaled set of standards that defines criteria to be assessed and offers descriptions of levels of exemplary to unacceptable performance, specifying descriptions of each level of performance in terms of what students are able to do [3,4]. Rubrics can be used in assessment of individual student assignments and as a method to assess entire programs. Rubrics may be used to assign grades, but their primary value is in quantifying performance and offering feedback to students.

Care should be taken in the development of rubrics. Effective rubrics should be neither too specific nor overly general. It isn't necessary to evaluate every conceivable aspect of each assignment; rather, a well-designed rubric should be devised in such a way as to highlight parts of the work that the instructor regards as especially important [5,6]. Some characteristics of effective rubrics include:

- Language that is understandable to the learner and teacher
- Terms which are clearly defined and measurable
- Descriptors that encourage a "continuous improvement" mindset (indicate what can be done to improve)
- Avoiding double-barrel criteria (criteria that ask the rater to assess multiple characteristics at one time)
- Avoiding duplication of criteria

A faculty training protocol for rubric-based assessment

Introducing the use of rubrics for the first time is best accomplished in conjunction with training. This faculty training protocol can be administered with individual faculty members or even self-administered. However, the greatest value is extracted if the protocol is conducted with a group of faculty, especially if the use of rubrics in assessment is a relatively new concept for some of the group. Conducting the protocol in a group setting creates the opportunity for discussion in which faculty can compare and contrast their ratings and experience with the task. These discussions can be enlightening for all involved.

The faculty training protocol requires these preparatory steps:

- Select a student learning outcome of interest;
- Select (or develop, if necessary) a rubric appropriate for the selected student learning outcome;
- Identify a student activity that generates student work (artifacts) relevant to the learning outcome, and
- Select at least two examples of student work generated by the assignment. Select one example of student work that exemplifies high proficiency related to the learning outcome. Select a second example of student work that illustrates low proficiency relative to the learning outcome. The objective is to select artifacts that evidence considerable variance in student proficiency. The samples of student work should be assessed (using the rubrics) by a set of instructors familiar with both the rubrics and the assignment prior to the training exercise.

The following materials should be prepared and distributed to each participant:

- The rubric that will be applied (see Table 1 for an example).
- Details about the activity or assignment that generated the student work. The illustrative activity (see Figure 1) is a reflection paper intended to afford evidence of students' effectiveness in a team setting. This activity was completed by students in a freshmen engineering course.

- Student work examples (artifacts) that illustrate high and low proficiency (each on a separate page; see Figure 2 and Figure 3 for examples),
- A score sheet for each artifact to be evaluated (see Table 2 for an example).

Table 1: Rubric for the Effectively Collaborate in a Team Setting Learning Outcome

Learning Outcome: Effectively collaborate in a team setting

Student is able to contribute to team meetings in ways that advances the group's work, facilitates the contributions of other team members, contributes to the project effort outside of team meetings, fosters a constructive team climate and responds effectively to conflict that may arise within the team effort.

<table>
<tr><th></th><th>Does Not Meet Expectations</th><th>Developing</th><th>Meets Expectations</th><th>Proficient</th></tr>
<tr><td rowspan="3">Contributes to Team Meetings</td><td rowspan="3">Does not share ideas or solutions that advance the work of the group.</td><td colspan="3">Offers new ideas or solutions to advance the work of the group.</td></tr>
<tr><td></td><td colspan="2">Offers alternative ideas or solutions or courses of action that build on the ideas of others.</td></tr>
<tr><td></td><td></td><td>Helps the team move forward by articulating the merits of alternative ideas or solutions.</td></tr>
<tr><td rowspan="4">Facilitates the Contributions of Team Members</td><td rowspan="4">Does not engage team members by taking turns and listening to others without interrupting.</td><td colspan="3">Engages team members by taking turns and listening to others without interrupting.</td></tr>
<tr><td colspan="3">Engages team members in ways that facilitate their contributions to meetings by restating the views of other team members and/or asking questions for clarification.</td></tr>
<tr><td></td><td colspan="2">Engages team members in ways that facilitate their contributions to meetings by constructively building upon or synthesizing the contributions of others.</td></tr>
<tr><td></td><td></td><td>Notices when someone is not participating and invites them to engage.</td></tr>
<tr><td rowspan="2">Contributions Outside of Team</td><td rowspan="2">Does not complete all assigned tasks by deadline.</td><td colspan="3">Completes all assigned tasks by deadline</td></tr>
<tr><td colspan="3">Work accomplished advances the project.</td></tr>
</table>

			Work accomplished is thorough and comprehensive.	
				Proactively helps other team members complete their assigned tasks to a similar level of excellence.
Fosters Constructive Team Climate	Does not support a constructive team climate; does none of the following:	Supports a constructive team climate by doing any two of the following:	Supports a constructive team climate by doing any three of the following:	Supports a constructive team climate by doing all of the following:
	Treats team members respectfully by being polite and constructive in communication.			
	Uses positive vocal or written tone, facial expressions, and/or body language to convey a positive attitude about the team and its work.			
	Motivates teammates by expressing confidence about the importance of the task and the team's ability to accomplish it.			
	Provides assistance and/or encouragement to team members.			
Responds to Conflict	Passively accepts alternate viewpoints/ideas/ opinions; fosters conflict.	Identifies and acknowledges conflict.		
		Redirects focus toward common ground, toward task at hand (away from conflict).		
			Stays engaged with conflict until it is resolved.	
				Directly and constructively helps to manage/resolve conflict in a way that strengthens overall team cohesiveness and future effectiveness.
Derived from the AAC&U Teamwork Value rubric (http://www.aacu.org/value/rubrics/Teamwork.cfm)				

A one-page (using 1.5 line spacing) "Team reflection" should be written to describe the results of your "Team evaluation" rubric. This memo should allow you to reflect on whether your team has been effective, especially considering qualities of effective teams we have discussed. You may also include any concerns about team dynamics (these concerns will not be shared with your teammates without your consent).

Figure 1: Prompt used to generate student reflections related to the learning outcome of effective collaboration in a team setting

FROM: JJ
SUBJECT: Team Reflection

Team LL has had a rough start. After having six team meetings the group has failed to have a hundred percent attendance to a single meeting (AA has missed 4, DD 3, RR 1, and JJ 0.) Without the whole group present, our decision making and brainstorming has been continuously pushed back. When we do have meetings they are somewhat productive, however, for the following meeting we must repeat what was said previously to ensure everyone is on the same page. Our team meetings usually last one hour, during which I do most of the talking while everyone else just agrees with me. Being the team leader I understand that it is my job to run the meetings and to keep everyone on track, but it becomes a nuisance when no one else has any suggestions and must be told to help.

The poor attendance is a result of poor communication skills. Now that email addresses and phone numbers were exchanged I hope that communicating will no longer be a problem.

The dynamic of the "team" is not a team but a group. Nothing gets accomplished unless I assign jobs; even then not all the work gets done. With the unreliability of the team I get stuck doing all the work, which makes the distribution of the workload unequal. I have asked RR, DD, and AA to research LL to have an understanding of LL's problems. Out of the three of them, AA and DD were the only ones to accomplish the task. After having this assignment for weeks now, Robert has still not researched the country. Without the knowledge of LL's problems, it is impossible to have an opinion on how to fix the problems; which then leads to "group think." I have done the cultural exploration, letter of intent, and the layout of the brochure on my own. With three other teammates I should not have to do all the work.

Our last meeting was the most productive; we were able to start brainstorming. Even though AA and I were the only ones participating in the brainstorming process we were able to come up with some good ideas. Our ideas include the following: a water filtration/ collection system, improved farming tools, new cooking/ heating devices, and erosion walls.

Figure 2: Student artifact demonstrating limited proficiency at team collaboration

FROM: MM
SUBJECT: Team Reflection

PW Inc. is made up of four members: NN, KK, MM, and SS. The team has worked well together and all the members get along with each other very well. All the individuals on the Team have contributed to the project equally so far. This is very beneficial for the team because all the assignments are getting done in a reasonable amount of time. The culture identity was divided up so that each person had to research certain information. As a team everything has been evaluated and everyone has come to a consensus on team assignments so that no individual's opinion is less important than another. Each person has pulled his or her weight on assignments and/or a task assigned to them, which shows that everyone has respect for each other and wants to succeed. The key characteristic of the PW Inc. team is our ability to effectively communicate. The team has a lot of meetings to insure that everything can get done in a timely manner, so communication is key and so far it has been excellent. In addition to communication, attendance at each team meeting is valuable to getting things accomplished in a timely manner which the group has done a great job of so far. The team doesn't waste time on unimportant things, but rather focuses on the duties that need to get done, such as deciding the company name, working on the cultural identity, and creating the company.

One aspect I feel like the team has not done well is in group dynamics. I believe that some group members don't always participate in discussions because he or she doesn't want to be wrong or cause a distraction. My feeling is we are mature enough to not get offended if someone else has a better idea or an opinion that we don't necessarily agree with at the time.

Working together and communication are the two main keys to a successful team and so far I believe that PW Inc. is building for success. We have followed these two keys and have accomplished all the tasks assigned to the group.

Figure 3: Student artifact demonstrating effective team collaboration

Table 2: Artifact score sheet used by participating faculty to record ratings on student artifacts

Artifact Score Sheet (Please Refer to the Effective Collaboration Rubric)					
	Does Not Meet Expectations (1)	Developing (2)	Meets Expectations (3)	Proficient (4)	Not Applicable
Contributes to Team Meetings					
Facilitates the Contributions of Team Members					
Fosters Constructive Team Climate					
Responds to Conflict					

The procedure for the faculty training session began with the distribution of the rubric to participating faculty, and asking them to spend a few moments to familiarize themselves with the rubric. Any questions that arise about the rubric and how it should be applied are addressed within the group. At this time provide appropriate instruction for any participating faculty who are unfamiliar with rubrics.

The examples of student work (artifacts) and score sheets are then distributed to the participating faculty. Faculty are tasked to apply the rubric to score each of the student artifacts using each of rows of the rubric. Faculty record their ratings on the provided score sheet.

When all participating faculty have completed scoring each of the provided student artifacts, the facilitator then aggregates their ratings. This can be accomplished quickly by a simple show of hands. For example, survey the faculty and ask how many faculty scored artifact #1 as "does not meet expectations," and repeat for each level, beginning with the first row of the rubric. Repeat the process for each row of the rubric, then repeat for artifact #2. Repeat the process until all rows and columns of the rubric score sheet have been populated. To facilitate this data capture, it is helpful to prepare a pre-formatted spreadsheet in advance. It is also helpful to have one person counting hands while a second individual handles data entry.

A visual summary of the resulting score distributions provides a powerful tool for stimulating discussion. A visual summary such as a frequency table or bar chart prove to be effective. Results of one implementation of this procedure illustrate the success of the protocol.

Results

The training protocol was administered to a sample of 23 faculty members during an assessment seminar. The faculty were primarily from smaller, private universities in the Midwest. Figure 4 displays rating data obtained from this sample of faculty rating two artifacts on the "fosters a constructive team climate" row of the effective collaboration in a team setting rubric. Discussion prompts such as: "What do you notice about the distribution of scores / What do you notice about student artifact X / What do you notice about student artifact Y?" opened the door to a meaningful discussion period.

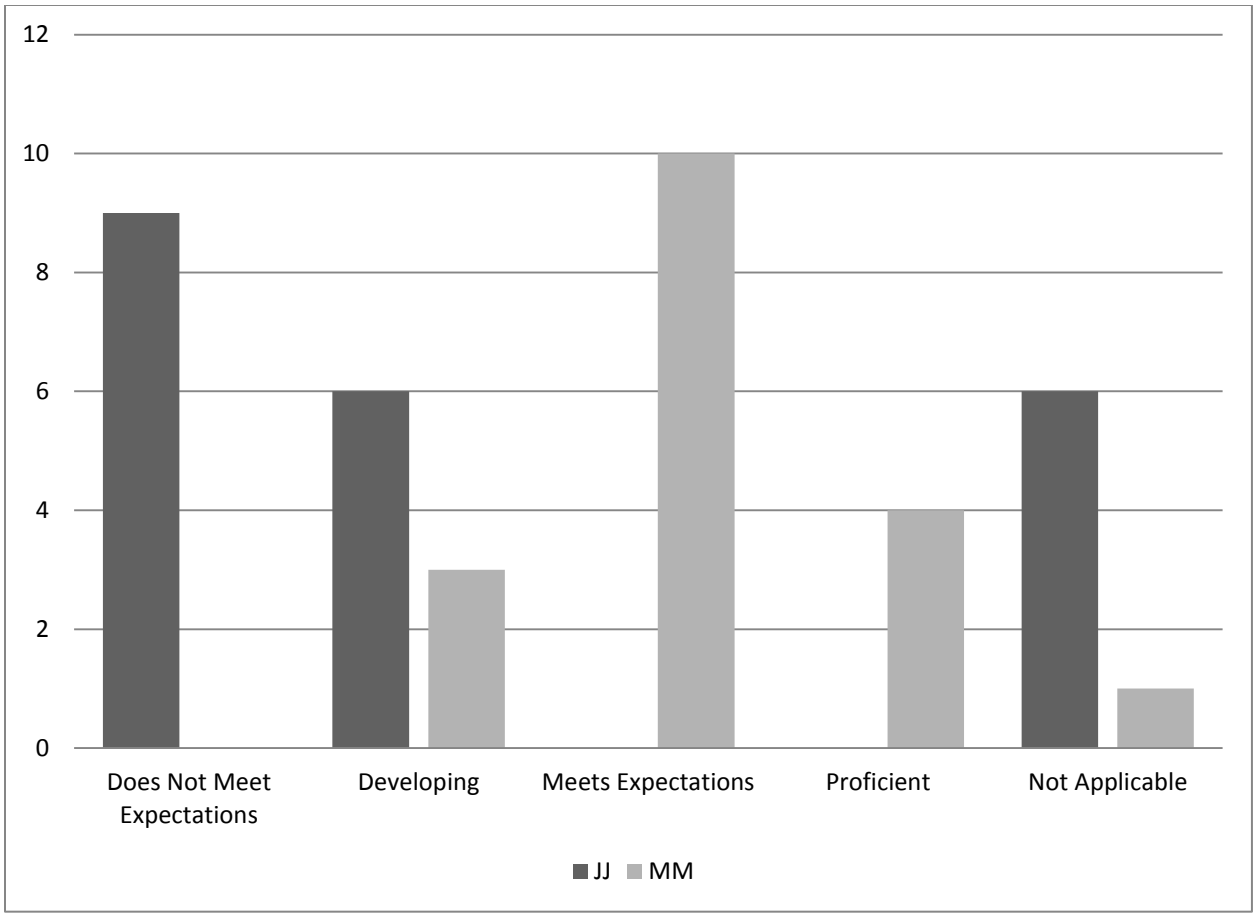

Figure 4: Faculty ratings for the two sample student artifacts on the "Fosters Constructive Team Climate" row of the "Effective Collaboration in a Team Setting" rubric (n=23)
NOTE: The distributions are statistically distinct (Chi-squared=27.5, df=4, p<.001).

The distribution in Figure 4 is striking for at least two reasons. First, the score distributions clearly distinguish the two student artifacts. The score distributions do not overlap: JJ is clearly rated as less proficient than MM on this specific criterion. Why some faculty scored JJ's artifact as "does not meet expectations" vs. "developing" generated interesting discussion. Second, the disparity in the number of faculty that scored student JJ's artifact "not applicable" (6 faculty) relative to student MM (1 faculty) again provided fodder for enlightening discussion among the participating faculty. The discussion revealed that the faculty that rated the row as "not applicable" to JJ's artifact explained that they believed the artifact provided no evidence of fostering a constructive team climate. From this, they inferred the row was not applicable, clearly illustrating an opportunity for faculty training. Faculty that scored the artifact as "does not meet expectations" offered that they interpreted the absence of evidence in the artifact of fostering an effective team climate as evidence of ineffectiveness. At the conclusion of this discussion, the faculty that initially scored the artifact on this row as "not applicable" offered that, in retrospect, they would score the artifact as "does not meet expectations." Through this discussion, the faculty enhanced their understanding of the rubric and its application. This could reasonably be expected to result in more consistent results from the use of rubrics as an assessment tool.

Figure 5 provides a visual summary of the rating data aggregated across the rubric's four rows. This summary thus provides a holistic picture of how the artifacts were rated.

These summaries provide the basis for additional discussion questions. For example, it is useful to ask the group: "What have we learned about the effectiveness of this activity for furthering the target student learning outcome?" and "What might we change in the activity; i.e., how might we "close the loop," as a result?" Faculty discussion of these questions revealed different perspectives on the relevance of projective reflection papers, such as the prompt used to generate the artifacts used for the demonstration (Figure 1) for gaining insights into team collaboration. Some faculty were adamant that team collaboration, as assessed by the applied rubric, should only be determined via direct observation of each student in a team setting; that the provided artifacts were not relevant. These faculty members tended to use the rubric's "not applicable" column. Other faculty expressed their belief that reflection papers are a valid way to gain data relevant to collaboration. This discussion reveals the value of the activity in that faculty became aware of differing conceptions of what constitutes an acceptable artifact and proceeded to discuss their alternate points of view so as to work toward agreement.

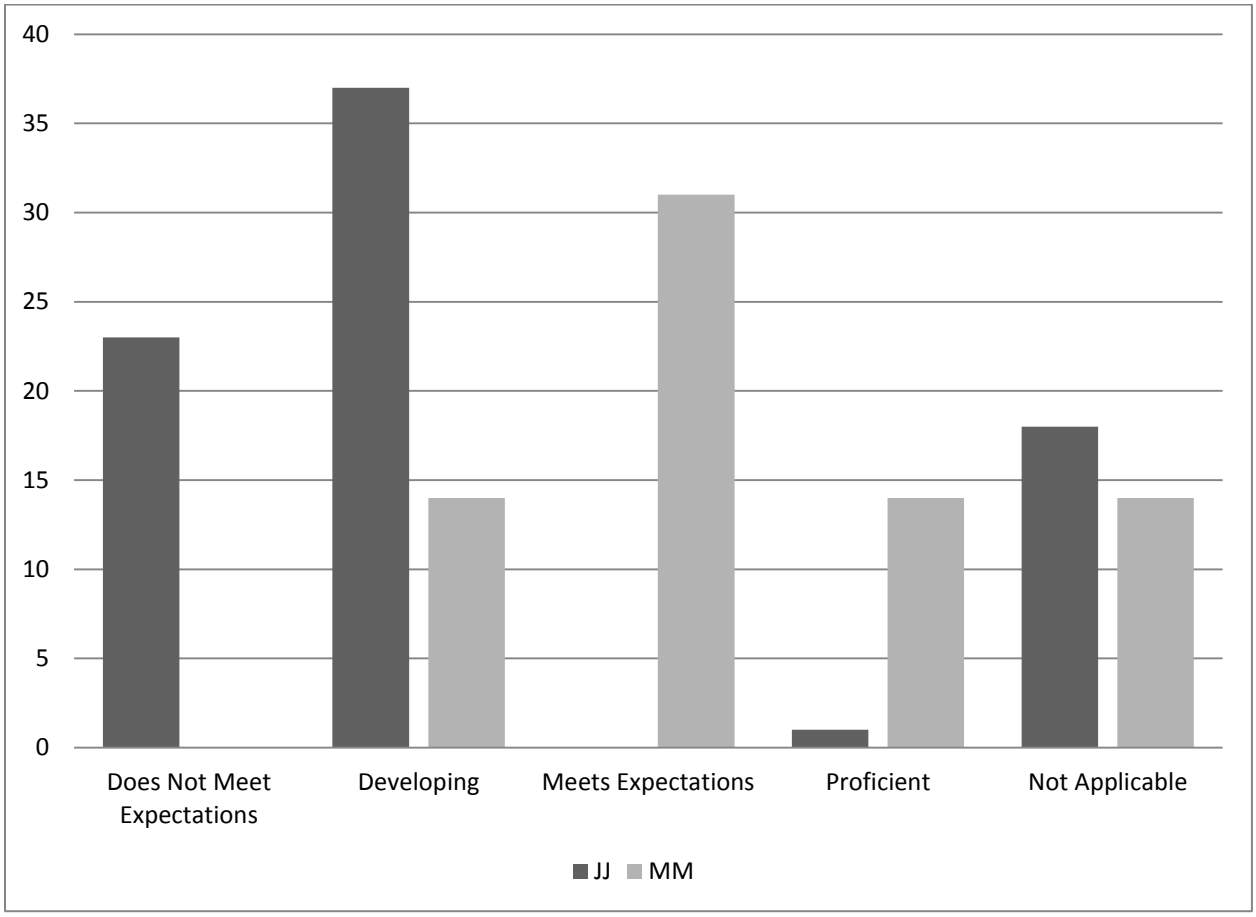

Figure 5: Ratings for the two student artifacts aggregated across the four rows of the "Effective Collaboration in a Team Setting" rubric (n=23)

Some faculty suggested that the prompt for the reflection be modified such that the resulting reflection would yield more clearly evidence of the individual student's role and functioning within the team setting. It was also suggested that the prompt be modified to align more closely with the rubric. For example the prompt might be modified to explicitly mention contributions to team meetings, how they facilitated the contributions of team members, how they fostered a constructive team climate, and how they responded to conflict the four rows that make up the effective collaboration.

Conclusion

By experiencing this protocol, participating faculty were able to engage in a process that builds their ability to appreciate the value of the use of rubrics as an effective assessment tool, thus "closing the loop" in their assessment protocols. Further, through discussion after the protocol, faculty were able to discuss discrepancies in ratings from the use of rubrics, which can lead to increased consistency in ratings generated by the use of rubrics. The protocol stimulates discussion among faculty members that reveals differing perspectives and affords an opportunity to discern and discuss differing perspectives faculty may have about artifacts appropriate for assessment. The protocol yields insights that are directly applicable to improving activities designed to cultivate student learning outcomes.

References

1. Kleine, III, Robert E. and John David Yoder (2011), "Operationalizing and Assessing the Entrepreneurial Mindset: A Rubric Based Approach," *Journal of Engineering Entrepreneurship*. Volume 2, Number 2.

2. Reid, Kenneth J. and Elaine Cooney (2008), "Implementing Rubrics as Part of an Assessment Plan," *International Journal of Engineering Education*, Volume 24, Issue 5.

3. Wenzlaff, Terri L., Jennifer J. Fager, and Marta J. Coleman (1999), "What is a Rubric? Do Practitioners and the Literature Agree?" *Contemporary Education*, Volume 70 (Summer), Issue 41.

4. Bresciani, Marilee J. (2002), "Development of a Rubric to Evaluate Academic Program Assessment Plans at North Carolina State University," *Assessment Update*; Volume 14, Issue 6, pp. 14-15.

5. Simkins, M. (1999), "Designing Great Rubrics," *Technology & Learning*, Volume 20, Issue 1, pp. 23-24, 28-30.

6. Briedis, Daina (2002), "Developing Effective Assessment of Student Professional Outcomes", *International Journal of Engineering Education*, Volume 18, Issue 2, pp. 208-216