Mini Workshop – Exploration of a Direct Method for Measuring ABET Professional Skills

Steve Beyerlein, Ashley Ater Kranov, Jay McCormack, Pat Pedrow, Edwin Schmeckpeper, Mo Zhang
sbeyer@uidaho.edu, akranov@abet.org, mccormack@uidaho.edu, pedrow@eecs.wsu.edu, edwins@norwich.edu, mo.zhang@mail.wsu.edu

Abstract – **Proficiency in professional skills related to teamwork, ethical responsibility, oral communication, impact of engineering solutions, life-long learning, and contemporary issues is critical for success in the multi-disciplinary, intercultural team interactions that characterize 21st century engineering careers. Yet, programs across the nation have struggled to define, teach, and measure professional skills since their introduction as ABET criteria for engineering programs in 2000. The Engineering Professional Skills Assessment (EPSA) is a direct assessment method centered on one of several inter-disciplinary scenarios that frame a contemporary societal problem, a generalized set of discussion questions intended to guide a meaningful, 45 minute discussion of multiple scenarios among 4-6 students, and the Engineering Professional Skills rubric that is broadly applicable for all scenarios. In this mini-workshop, participants will examine one scenario in detail along with self-scoring and peer-scoring of a scenario discussion among workshop participants. This experience will be structured to produce small-group and large-group insights about administering and scoring the EPSA in classroom situations. The intended audience for this workshop includes faculty who teach courses identified for collecting data on ABET professional skills, ABET coordinators from the entire spectrum of engineering programs, and ABET engineering program evaluators.**

Index Terms – ABET professional skills, inter-disciplinary scenarios, performance assessment, rubrics

PROFESSIONAL SKILLS IN ENGINEERING EDUCATION

To ensure continued competitiveness of American educated and trained engineers in the rapidly changing environment of the world economy and pressing global problems, engineering education must help students integrate professional and technical skills for more robust problem solving [1]. Although a variety of methods and instruments have been developed by engineering educators around the nation to teach and assess ABET professional skills (3d, 3f, 3g, 3h, 3i,and 3j), most of these instruments evaluate one skill at a time [2]-[5]. These are fairly cumbersome to implement and more frequently than not, they evaluate given skills indirectly through focus groups, interviews or surveys eliciting student opinions [6].

ENGINEERING PROFESSIONAL SKILLS ASSESSMENT

In fall 2006, the Washington State University College of Engineering and Architecture partnered with an assessment specialist to create an innovative, direct method to teach and measure the set of ABET professional skills. Major accomplishments since 2006 include an authentic performance task and measurement system described below, establishment of initial reliability and validity of the instrument, and a dedicated community of 40+ engineering faculty that used the assessment instrument to evaluate the efficacy of their own engineering programs. An ASEE paper on this initial implementation won the best paper award in 2008 [7].

Performance assessment typically has three components: (1) a task that elicits the performance; (2) the performance itself (which is the event or artifact to be assessed); and (3) a criterion-referenced instrument, such as a rubric, to measure the quality of the performance [8]. Correspondingly, the Engineering Professional Skills Assessment (EPSA) also has three components: (1) a performance task including a scenario and discussion prompts; (2) transcript of student discussion as a response to the task and; (3) an accompanying analytical rubric that is used to measure the quality of the students' performance in demonstrating the engineering professional skills.

First, in a 45-minute session, groups of five to seven students are presented with a complex, real-world scenario that includes current, multi-faceted, multidisciplinary engineering issues. Existing scenarios include lithium mining for electric vehicle batteries, Hanford superfund site clean-up, Tennessee Valley coal ash spill, offshore wind farm development, BP Deepwater Horizon oil spill, water projects for third world countries, vehicle retrofitting for disabled drivers, and placement of high voltage power lines. Second, students are asked to determine the most important problem/s and to discuss stakeholders, impacts, unknowns, and possible solutions. Finally, trained faculty raters use the analytical EPS rubric to measure student performance associated with the entire set of ABET professional skills. The EPSA method is flexible, easy to implement, and can be used at the course level for teaching and measuring engineering professional skills and at the end of a course sequence for evaluating a program component.

The authors are currently engaged in a three-year, multi-institution project to expand the set of scenarios as well as rigorously establish inter-rater reliability, content validity, construct validity, and criterion validity of the EPSA method and associated rubric. This effort is sponsored by the NSF Research in Evaluation of Engineering and Science Education (REESE) program [9].

PERFORMANCE TASK ANALYSIS

Participants will gain first-hand experience with a scenario, working in a small group with workshop colleagues. The role of recorder will be used to transcript of the discussion (e.g. a chronological outline of what was said). The group will spend up to 15 minutes pursuing the following goal:

Imagine that you are a team of engineers working together for a company or organization on the problem/s raised in the scenario. Discuss what your team would need to take into consideration to begin to address the problem/s. You do not need to suggest specific technical solutions—just agree on what factors are most important and identify one or more viable approaches to address the problem.

Additional prompts will also be considered. These include:

1. *Identify the primary and secondary problems raised in the scenario.*
2. *Who are the major stakeholders and what are their perspectives?*
3. *What are potential impacts of the problems and solutions raised in the scenario?*
4. *What would be the team's course of action to learn more about the primary and secondary problems?*
5. *What are some important unknowns that seem critical to properly address this problem?*

When working with students, a recording of discussion session is obtained and sent to a transcription service that identifies different speakers and captures their contributions to group discussion. Example transcripts will be available.

SCORING WITH AN ANALYTICAL RUBRIC

Student work is assigned a score of 1-6 using an analytical rubric that describes behaviors and actions for each of the ABET professional skills at three different levels of performance. A common scoring scale is used across all of the ABET professional skills: 1-absent, 2-emerging, 3-developing, 4–competent, 5–effective, and 6–mastering. Effective use of any rubric requires some rater training and calibration. Within the workshop, attention will be given to achieving small group consensus on the extent to which the recorder notes from the 15 minute discussion addressed different dimensions in the EPS rubric.

MINI-WORKSHOP AGENDA

This Mini-Workshop will consist of the following interactive activities among participants:

Introduction of facilitators/participants
Small group experience with a scenario/task kernel
Overview of EPSA components/methodology
Small group self-scoring of recorder's notes w/rubric
Peer group scoring of recorder's notes w/rubric
Large group reporting of findings/insights
Large group Q/A about general use of EPSA

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AUTHOR INFORMATION

Steven Beyerlein, FIE Mini-Workshop facilitator, Inter-Disciplinary Capstone Design Coordinator, Professor of Mechanical Engineering, University of Idaho, sbeyer@uidaho.edu.