WSU MSE Program Level Assessment Report for 2012-2013

PROGRAM NAME, DEGREE NAME (e.g. Organizational Leadership, B.S.): Materials Engineering, B.S.

COLLEGE in which PROGRAM is housed: College of Engineering and Computer Science

REPORT PREPARED by: Dan Young

A. ACTIONS TAKEN TO IMPROVE STUDENT LEARNING

The 2012-2013 academic year represented a transition year for this program assessment. At the start of 2013, the MSE program attained ABET accreditation for a full period of 6 years. The changes as a result of this accreditation process were discussed in the previous Program Level assessment document. The changes are summarized below.

- The ABET committee undertook a modified survey of the program constituents according to suggestions from the visiting ABET evaluation team.
- The ABET committee performed a program assessment using the AssessMyProgram (AMP) platform, for evaluation as a long-term solution for quantitative assessment of student outcomes. Based on this evaluation, the ABET committee and program faculty decided to design a process based around prerequisite quizzes and collected student work. The Fall 2013 semester was used as a test rollout for the modified assessment procedures.
- The program updated some of their experimental equipment, including a major purchase of a scanning electron microscope.

B. STUDENT LEARNING OUTCOMES ASSESSED AND EXAMINED

During the 2012-2013 academic year, the re-designed assessment process focused on a subset the ABET A-K student outcome list. Subsequent years will assess other student outcomes, and all outcomes will be assessed repeatedly over a 3-year cycle. During 2012-2013, the following ABET Student Outcomes were assessed:

- An ability to apply knowledge of mathematics, science, and engineering (ABET A)
- An ability to design and conduct experiments, as well as to analyze and interpret data (ABET B)
- An ability to identify, formulate, and solve engineering problems (ABET E)
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (ABET K)
C. METHODS FOR COLLECTING DATA

For the Fall 2013 semester, all students in the following courses were assessed – ME 2700, ME 3610 and ME 4770. These three courses were chosen specifically to allow assessment of a key course sequence within the MSE curriculum that all students are required to take. ME 2700 is a basic introduction to materials science and engineering. After taking 2700, students are required to take ME 3610 (Mechanical and Materials Testing) and ME 4770 (Mechanical Behavior of Metals).

D. ASSESSMENT MEASURES

In order to provide a framework for the direct assessment, the syllabi of all three courses were examined, and meetings were conducted with the course coordinators. The topical content of ME 2700 was established in a significant amount of detail, allowing a numerical assignment of the number of classes that are devoted to each technical topic. Then, this information was used to numerically determine which ME 2700 topics are required for the following ME 3610 and ME 4770 courses, and how much treatment of each topic was required. The results of this analysis is presented in section H of this document. Based on this analysis, it was determined that the following technical topics were to be assessed in all three courses, in order to assess both the coverage in ME 2700 and the resulting levels of student mastery in the following ME 3610 and ME 47770 courses:

- Crystallography, structures and indices
- Defects in crystal structures
- Mechanical properties
- Dislocations and strengthening mechanisms
- Failure in solids
- Phase transformations
- Composites

For direct assessment, all instructors of these courses were asked to submit all prerequisite quizzes, homeworks, lab reports and exams for assessment. All materials were either submitted electronically or scanned. At the end of the semester, a comprehensive analysis was performed. The collected material was examined and specific homework assignments, lab reports or exam questions were selected in order to allow assessment of the technical topics discussed previously. Each question or assignment was mapped to the ABET A-K criteria, and statistics based on student scores were compiled. The prerequisite quizzes in ME 3610 and ME 4770 were heavily analyzed, since those quizzes are specifically designed to assess the linkage between prerequisites and follow-on courses. However, each technical topic was assessed through a homework question, exam question or lab report in addition to the a prerequisite quiz question, as much as possible. These results are presented in section H of this document.
E. SIGNIFICANT FINDINGS

The purpose of the Fall 2013 MSE program assessment was to directly assess key student outcomes, but also to serve as a test of our re-designed assessment process. This activity revealed several bottlenecks in the assessment process itself.

First, the high volume of scanning homeworks proved cumbersome on staff, and data entry was time-consuming. Furthermore, it was determined that most homeworks in these 3 classes generally focused on a single technical topic. The ABET committee concluded that assessing individual homework questions is unnecessary, and homework score statistics would be sufficient for effective assessment. Second, assessment of individual exam questions tended to reveal the largest spread in scores and standard deviations in scoring. While some homework assignments appeared to have a large standard deviation, inspection of the data revealed that the data was highly bimodal, with many scores being “100%” and a smaller number being “0%”. ME 3610 labs also had a very low standard deviation. Finally, the scoring of individual exam questions is sufficient for assessments. The ABET committee concluded that the scanning of all student exams in unnecessary if the instructors can provide the per-question-scoring for all exams and final exams.

This activity also revealed several findings about student outcomes in the three courses in question. If a cutoff of 70% is taken as an acceptable performance level for an entire class, then students scored “acceptable” for 17 out of 28 assessments. Several scores were only slightly below 70%. These were individually examined by the ABET committee and it was determined that they were probably not a cause for concern. Based on the data, the committee determined that two areas may need further examination.

First, in ME 3610 the students scored low (on average) on the materials-related questions on the prerequisite exam. This suggests that they might not be retaining sufficient materials information for subsequent courses. However, students in ME 4770 scored acceptably on most materials-related prerequisite questions. Also, students scored below 70% on an assessment of “dislocations and strengthening mechanisms”. This data suggests that ME and MSE students may need separate consideration when assessing mastery of materials-related topics.

Second, it appears that students in ME 2700 do not receive an introduction to composites, whereas the ME 4770 requires 1 class of treatment of composite materials. However, it appears that composites topics were not covered in class-work.
F. DISCUSSION OF RESULTS

The results of this analysis were disseminated to the ABET committee and all course coordinators of the involved courses in January 2013.

G. ACTIONS PLANNED TO IMPROVE STUDENT LEARNING

Several actions are planned in order to improve student learning, and improve the assessment process itself. The following actions are planned:

- Future assessments will be designed to achieve a full ABET A-K assessment over a 3-year cycle, and courses will be carefully selected to provide a broad analysis of the success of students as the progress through the program. For example, in Spring 2014 the following courses will be assessed: ME 2700, ME 3610 and ME 4740. This sequence will allow a second assessment of ME 2700 since the class is very pivotal to the MSE major. However, senior-level follow-on courses will be the focus of Spring 2013. After this assessment, the thermodynamics sequence will be assessed.
- The composites content of ME 4770 will be assessed, in order to match the content of ME 2700 to the needs of ME 4770. Course content will be adjusted as necessary.
- Certain classes that have large numbers of combined ME and MSE majors will need to be analyzed in more detail.
## H. SUPPORTING DOCUMENTS

<table>
<thead>
<tr>
<th>2700 Technical Topics</th>
<th>CLASSES COVERED</th>
<th>3610 CLASSES REQUIRED</th>
<th>4770 CLASSES REQUIRED</th>
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