Work in Progress - Direct Assessment of Course Outcomes in a Computer Modeling and Simulation Class

Keith Garfield
Embry-Riddle Aeronautical University, garfielk@erau.edu

Abstract - This paper presents experiences with implementing a grading technique to closely couple student performance on specific course outcomes with student grades. The course selected for this technique is an undergraduate computer modeling and simulation course, which required an individual research component in addition to assignments and in-class tests. This class tested a technique whereby assignment of aggregated numerical scores for homework or tests was replaced by pass/fail feedback on individual course outcomes. Each assignment or test enumerated which specific course outcomes potentially satisfied within the assignment. Outcomes loosely correlate to Bloom’s taxonomy levels of recognition, understanding, application, and creation. Student feedback reported that the technique enhanced learning, though an increased tendency towards procrastination was also reported. Instructor experiences were positive, with the assessment technique integrating easily with course design and delivery.

Index Terms – Assessment, Criteria Based Assessment, Learning Outcomes

INTRODUCTION

This paper presents experiences with implementing a grading technique that closely coupled student performance on specific course outcomes with student grades. While instructors have access to a wide range of assessment techniques, effective techniques should strive to be formative, learner centered, ongoing, and align closely with course syllabus [1][2]. Additionally, the technique should measurably support an institution’s goals and be an integral part of the planning and teaching processes [3][4]. This class tested a technique whereby student performance was assessed using pass/fail feedback on individual course outcomes.

The course selected for this technique is an undergraduate computer modeling and simulation (M&S) survey course. Course material covered a wide range of M&S concepts, followed by in-depth presentation of the critical challenges currently confronting the M&S community. In addition to assignments and in-class tests, students were required to design, implement, and document a unique simulation experiment that investigated a topic of their choice. The project provides students with opportunities to display mastery of course topics, and affords an opportunity to reinforce technical writing skills ancillary to the core course topics.

Traditional assessment techniques do not necessarily tie mastery of course topics to a final grade, and potentially encourages students to focus on the letter grade outcome while losing sight of course learning objectives. Some educators advocate techniques that employ criteria based assessment of outcomes as indicators of learning [2]. Learning outcomes are a set of distinct and well defined set of skills or knowledge [5]. The outcomes utilized in this study loosely correlate to Bloom’s taxonomy levels of recognition, understanding, application, and creation. The inclusion of higher levels, such as synthesis, was not deemed appropriate for this undergraduate survey course. Students demonstrate recognition by simply providing a working definition of a glossary term. Understanding is demonstrated through correct usage of a term, or identification of the principle, while providing feedback on reading material. The student must justify the usage by referencing the key attributes that make the reference appropriate. Application level outcomes were satisfied by using a concept or analytical technique to solve a problem provided on test or assignments. The highest level of mastery assessed was the ability of students to create their own working examples, which was accomplished via the course project. For example, dynamic verification refers to any technique in which the correctness of a simulation model is assessed by running the simulation. The student demonstrates completion of the outcomes for dynamic verification by supplying a definition for the term (Level 1), justifying why a described verification technique is or is not dynamic (Level 2), describing how a dynamic verification technique could be applied to an example problem (Level 3), and creating a dynamic verification plan for their course project (Level 4).

A detailed list of course outcomes were provided to students as part of the introductory course materials. Explanatory material as to how each outcome level may be satisfied was also provided. Each assignment, test, and project deliverable enumerated which specific course...
outcomes were potentially satisfied within the assignment. Students received feedback via a tracking sheet noting all outcomes demonstrated thus far. This feedback acted as a formative assessment, as students were allowed to re-visit missed outcomes in order to gain credit for them later in the semester. The ability to repeatedly attempt the same outcome was viewed by the author as in keeping with the goal of outcomes being an ongoing part of learning [1][4].

**IMPACT ON COURSE PREPARATION AND PRESENTATION**

The use of this grading scheme presented several benefits and challenges. Overall course preparation time was not significantly affected from previous semesters offering the same course. The organization of topics, lecture schedule, and lecture content were assisted by the unity of the process. The instructor was cognizant of the need to provide opportunities to obtain credit for specific outcomes, which drove the design of assignments and tests. Since outcomes were equally weighted, the issues of how much weight to assign to a specific skill, or aspect of problem solution, were avoided. Grading student work on a pass/fail criterion resulted in a reduction in time to grade student work.

The percentage of course outcomes achieved in each of the outcome levels was used as the basis for computing overall course letter grades (Table I). Thus, the goal of removing the potentially arbitrary assignment of traditional 0 – 100% grading schemes was not fully achieved. However, the grading scheme did result in a concise record of attainment of specific outcomes at all levels to serve as grade justification if needed. Therefore, student performance was tied to course grade in this fashion.

<table>
<thead>
<tr>
<th>Level</th>
<th>Available</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>76</td>
<td>36</td>
<td>32</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>76</td>
<td>32</td>
<td>28</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>68</td>
<td>28</td>
<td>24</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>64</td>
<td>24</td>
<td>16</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

**IMPACT ON STUDENT EXPERIENCES**

Feedback for this grading technique was solicited from the students via informal classroom discussion, hallway talk, a mid-semester proctored feedback discussion, and end of course survey. Students identified the focus on outcomes as an enhancement to learning. Since learning objectives were clearly identified, effort applied to learning was consistent with effort applied to obtain a grade. This was consistent with assessment intent and good practices [1][2][4]. Students reported less test anxiety, citing two reasons. First, students knew that outcomes not achieved on a specific test may be achieved later. This contrasts with a traditional setting where each test serves as the only opportunity to capture a fixed percentage of total points available in a course. Second, since students were made aware of what outcomes they had not yet achieved in the course, they were able to target parts of the test that would potentially yield the highest results.

The most prominent negative aspect of this grading scheme was that students demonstrated an increased tendency to procrastinate. Two mechanisms were identified to encourage students to perform timely work in the future. The first is to enforce due dates after which certain outcomes would no longer be accepted. The second is to require students to obtain permission from the course instructor to proceed from one project phase to the next. Since the project represents the only opportunity to obtain level 4 outcomes, this would encourage timely completion of project goals.

**SUMMARY AND FUTURE WORK**

This class tested a technique whereby student performance was assessed using pass/fail feedback on individual course outcomes. This technique was seen as consistent with current trends in assessment techniques [1][2][3][4], and arguably tied student performance more directly to assignment of course letter grades. The instructor viewed the experience favorably, and experienced no additional workload while reporting a deeper alignment of assessment with other course activities. Student feedback was positive for the most part. Student’s identified the focus on outcomes as an enhancement to the learning process, while reporting an increased tendency to procrastinate. Mechanisms to discourage this tendency in the future were identified.

The author intends to implement this assessment technique with slight modifications to an additional course in the Fall 2011 semester.