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Assessing collaborative and experiential learning

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ABSTRACT

Collaborative and experiential learning has many proven merits. Team projects with real clients motivate students to put in the time for successfully completing demanding projects. However, assessing student performance where individual student contributions are separated from the collective contribution of the team as a whole is not a straightforward, simple task. Assessment data from multiple sources, including students as assessors of their own work and peers' work, is critical to measuring certain student learning outcomes, such as responsible team work and timely communication. In this paper we present our experience with assessing collaborative and experiential learning in five Computer Information Systems courses. The courses were scheduled over three semesters and enrolled 57 students. Student performance and student feedback data were used to evaluate and refine our assessment methodology. We argue that assessment data analysis improved our understanding of (1) the assessment measures that support more closely targeted learning outcomes and (2) how those measures should be implemented.

1. INTRODUCTION

Student direct experience with real-world team projects and discovery and inquiry-based pedagogical methods are well researched approaches to effective learning. Computing education research extensively supports collaborative and experiential learning, as demonstrated by studies presented at the SIGCSE, SIGITE, and the Consortium for Computing Sciences in Colleges' conferences. Team projects further improve student learning if they are developed with the participation of industry partners [1, 3, 4, 5] or non-profit organizations [7, 8]. Integrating projects with external clients into course curriculum, however, has its challenges. One challenge in particular, assessment, is the focus of this paper.

When team projects are a major course requirement, assessing student performance raises specific problems: (1) individual student credit should be derived from credit that is earned by the entire team and is based on the overall quality of project deliverables; (2) there are other assessors, besides the instructor, who are directly involved with the project development process and, consequently, assessment data should be collected from those sources, too. Assessment models that address these problems have been proposed in the computing education community [2, 6, 9].

In this paper we describe our experience with the evaluation of an assessment methodology that we designed for three courses in our Computer Information Systems program. The courses, Database Design and Development, System Analysis and Design, and System Implementation with DBMS, implement a collaborative and experiential learning model in which students work on teams to develop real-world projects for community partners. The learning model implementation has progressed in two stages based on our evaluation of student feedback and assessment data of student performance. In the rest of the paper we present the

proposed assessment methodology; discuss findings from analyzing the assessment data we collected; introduce some assessment revisions; and show a preliminary evaluation of the redesigned assessment methodology.

2. ASSESSMENT METHODOLOGY

2.1 Curricular Framework

In spring 2008, two Computer Information Systems (CIS) upper level courses at the University of New Hampshire (UNH) pioneered a collaborative and experiential learning model that involved three non-profit local organizations. The courses enrolled 23 students, who formed seven teams. Student teams conducted site visits and interacted with the users of the proposed projects. Students assumed different roles pertaining to the team tasks, presented team work products in class, offered feedback to the other teams, and made public presentations and demonstrations, including participation in the poster session of the UNH Undergraduate Research conference.

Team project requirements had three areas of interest: 1) the product, what teams delivered; (2) the process, how teams worked; and (3) presentations and demonstrations, what and how teams told their clients, peers, and outside world about their work. Students learned in the course by working on project assignments: project releases, public poster preparation and presentation, project report and demonstration; and by participating in team work, such as interaction and communication within the team and with the client. Students were responsible for holding weekly team meetings and making three client site visits.

2.2 Assessment Instruments

In an effective instructional model, course requirements are mapped to learning outcomes through adequate measures of student achievement of those outcomes [10]. The courses in our study shared the goals of preparing students to: identify and analyze user needs; design and implement a computer-based system that meets those needs; use and apply concepts and practices in core information technologies; function effectively on teams to accomplish a common goal; communicate effectively with a range of audiences; and allocate and manage effectively time on task. The team project requirements were reflective of these goals, and student achievement was measured through a variety of assessment instruments used by three different categories of assessors: students, the instructor, and external evaluators, such as clients, other CIS faculty, or IT professionals involved with our program. Assessment provided by students took two forms: self-assessment and assessment of their peers. Student grade in the course was entirely based on project-related work.

Table 1 summarizes the mapping of course requirements to assessment measures and their corresponding assessors. Points awarded to team members on an individual basis had two sources, the instructor (I) and self/peer (S/P) evaluations. Note that only 8 points (last entry in **Table 1**) of the final grade were based on student work that was done individually. The rest of the 32 points awarded to each student individually were based on student participation on the team as assessed by him/herself and peers. Based on methodologies proposed by [2, 9], we developed a self/peer evaluation form with a total of 20 criteria in five areas: communication, interaction, process, contribution, and responsibility. Students were asked to (1) score themselves and their peers using a 1 to 5 scale for each criterion; (2) comment on their individual responsibilities within the group and on team members' performance; and (3) quantify the

relative contribution of each team member (using percentage values totaling 100%). The formula proposed by Clark et al. [2] was used to calculate how student quantification of members' relative contributions (including self) translates into actual self/peer awarded points.

Table 1 Course requirements mapping to assessment measures and corresponding assessors

Requirement	# Points Awarded and by Whom	
	To all team members	To individual students
Four project releases	36 by instructor (I)	24 by self & peers (S/P)
Final project report	4 by peers (P)	2 by self and peers (S/P)
Project poster presentation and project demo	8 by peers and external evaluators (P/E)	6 by self and peers (S/P)
Client site visits	6 by external evaluators (E)	0
Project weekly reports	6 by instructor (I)	0
Individual student contribution	N/A	8 (I)
Total: 50 (I) + 50 (others)	**60 (I/P/E)**	**40 (S/P/I)**

2.3 Assessment Evaluation Results and Lessons Learned

2.3.1 Time on Task

Our collaborative and experiential learning model proved successful in making students spend the required time outside class. In a student survey administered at the end of the semester, students reported that they spent almost twice as much time outside class (5.52 hours/week on average) than in any other course with student team requirements (2.86 hours/week average). Even the individual portion of that time was 21% higher than the typical outside class time for any other course. Our college is a commuting school and 99% of the students work. The job time reported by students in our study averaged 29.3 hours/week, which was almost identical to 29.5 hours/week that students spent in and outside class for a CIS course.

A total time demand of almost 60 hours/week on average poses a very serious challenge. Student time outside a CIS class was divided among team meetings, client site visits, online collaboration to prepare project assignments, and presentation at public events. The student survey overwhelmingly indicated that finding time for team work outside class was the most critical problem they encountered in the course. To address this problem, we adjusted the implementation of our model by (1) scheduling student-client interactions during class time; (2) consolidating some of the project deliverables; and (3) having students include team work process reporting in the project release artifacts. We have also eliminated the formal client evaluation of team work processes. They were invariably a source of maximum scores and were confirming the merit of the partnership overall. Clients have very limited time for engaging in a more rigorous evaluation of student professional behavior.

2.3.2 Team Work and Communication

Student perceptions of team work showed the highest and strongest agreement on the essentiality of team work to the success of the course project (average score of 4.85 and standard deviation of 0.47). The highest and strongest disagreement was on the team members' equal contribution to the project completion (lowest average score of 3.64 and largest standard deviation of 1.33). Survey questions asked students to rate their own contribution as well as their team members' with respect to effective communication, significance of contributed work, and level of responsibility and dependability. In general, students scored higher their own

contribution and participation than those observed at their peers. Second to the lowest score was the team's ability to adequately mitigate internal conflicts without the instructor's intervention. The largest gap between how students perceived their own participation versus their team members' was noted on the question about effective and timely communication.

2.3.3 Student Performance

In **Figure 1** we show how the distribution of final grades compares with the distribution of performance results obtained from individually made contributions (assessed by the instructor solely) versus contributions made collectively through team work on project deliverables and process (with self, peers, instructor, and external evaluators as assessors).

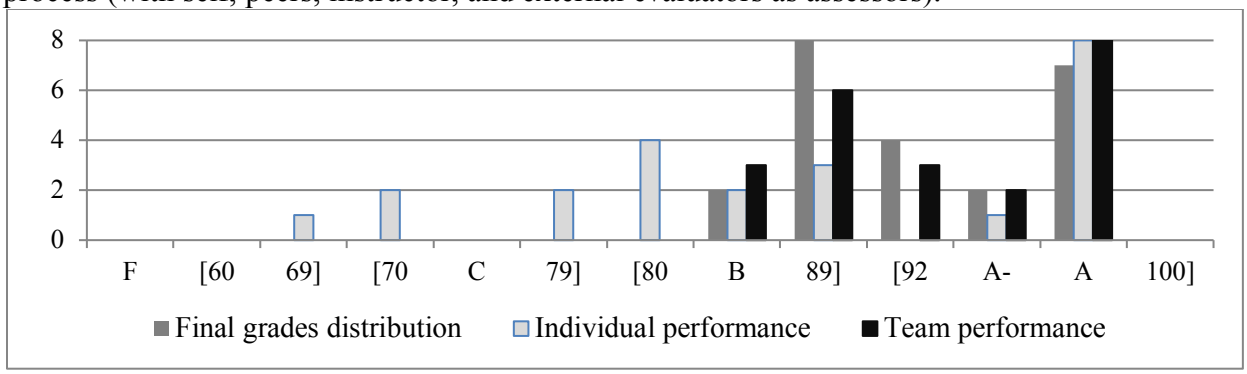


Figure 1 Distribution of grades (final grades and individual and team performance results contributing to the student final grade). Maximum 8 points of the final grade counted towards individual performance.

We notice that team performance (counting up to maximum 92 points of the final grade) dictated the student final grades, which ended up the B to A bracket. Individual performance, on the other hand, with the exception of A grades, lagged behind team performance and final grades in the C- to B bracket. The very small weight of 8 points awarded for individually submitted work and the lower grades students received for this type of work explain the discrepancy between individual performance and student final grades. To address the problem of slackers who were getting free rides, we redesigned the assessment scheme to include considerably higher weights for student individual performance. In the assessment redesign we present next, we introduced exams and homework assignments students were asked to do on their own.

3. ASSESSMENT REDESIGN AND PRELIMINARY FINDINGS

The revised assessment scheme was applied to three courses in Fall 2008 and Spring 2009. Four additional community partners sponsored the course real-world projects and 34 CIS majors in ten student teams carried out those projects.

Two main changes have been made to the assessment methods. First, we complemented the course project with an individual component that weighs half of the final grade and is primarily assessed by the instructor (**Table 2**). A small portion of the homework grade was obtained through student self-assessment of the drafts of their homework assignments.

Table 2 Assessment measures mapped to course requirements that include an individual student component in addition to the course project.

Individual Student Component	Pts to all team members	Pts. assigned individually
Exams	N/A	30 (I)
Homework Assignments	N/A	15 (I), 5 (S)
Project Component	Pts. to all team members	Pts. assigned individually
All team project deliverables	25 (I), 15 (P/E)	10 (S/P)
Total: 70 (I) + 30 (others)	**40 (I/P/E)**	**60 (S/P/I)**

Second, we simplified considerably the self/peer evaluation rubric, which now uses three criteria only: on time completion, effective and timely communication, and effective teamwork. The quantifier of relative contribution of each team member has been simplified, too, and lets students impose deductions on the project deliverable grade based on questionable or substandard team work observed of themselves and peers.

Complementing team projects with exams and homework assignments that assess student learning on an individual basis (60% of the final grade with 45% graded by the instructor) has the desirable effect of aligning individual performance with final grade and team performance pattern (**Figure 2**). Again, the highest concentration of A's is provided by team performance. However, the individual performance, ultimately, dictates the final grade.

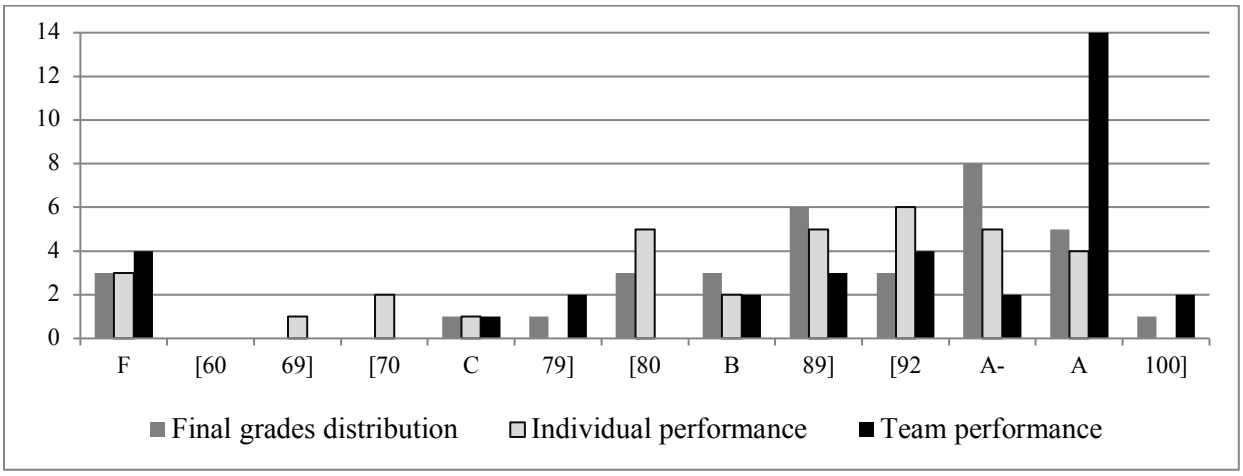
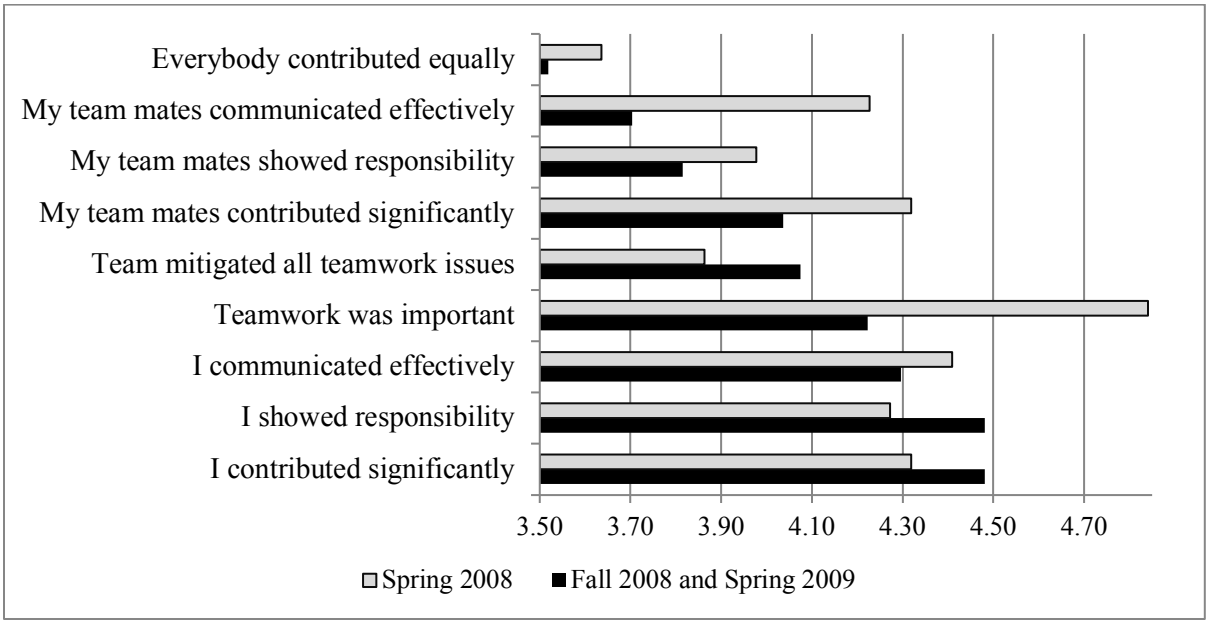


Figure 2 Distribution of grades (final grades and individual and team performance results contributing to the student final grade). Maximum 60 points of the final grade counted towards individual performance.

We conclude this paper with comparative results of the analysis of student feedback on team work and team communication for the two phases of our evaluation study (**Table 3)**. These results point to an even higher and stronger disagreement on "everybody contributed equally" question (average of 3.52 and standard deviation of 1.45). We also notice a larger gap between how students perceived their own level of responsibility and communication effectiveness versus what they observed about their team members. Further investigation of the assessment methodology is needed to understand how we can improve team work and communication and student satisfaction with a collaborative and experiential learning model.

Table 3 Student feedback on team work and communication



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