

# Implementation of a Capstone Senior Design Program Using Open Source Course Management Software

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Effectively conveying information to a large number of students in a timely manner may be a daunting task. In addition, collection, evaluation and return of student assignments are demanding both logistically and practically. Add a budget driven, enforced migration away from proprietary course management software, and the challenges become even more intimidating. The College of Engineering two-semester capstone interdisciplinary senior design sequence is comprised of students from four departments and eight majors. Enrollment in this course has been steadily increasing and was in excess of 200 students in a combined lecture in the fall of 2009. To address the challenges inherent in a course of this size and to effectively serve a student population of such diverse backgrounds and experience, the instructional team has developed a comprehensive tool utilizing open source course management software. The software package adopted by the university provides a centralized virtual community for students, faculty and external participants. The implementation of this offering, along with the necessary innovations and lessons learned, will be discussed in this work.

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## **Introduction**

The course management implementation discussed in this work serves three different types of senior design courses. Two of the courses are discipline specific (Mechanical Engineering and Mechanical Engineering Technology) where students who have an independent idea for their projects are allowed to pursue those with faculty guidance. The third course features sponsored projects provided by industrial partners, university faculty and independent units on campus (e.g., facilities, athletics). This core course, serving Mechanical Engineering, Electrical Engineering, Computer Engineering, Mechanical Engineering Technology and Electrical Engineering Technology students, features some attractive, existing structure and procedures that could be used for all students. This fact, coupled with a desire by faculty for all students, regardless of their project choice, to have a similar senior design experience, led to the design of the course management implementation discussed here.

The core course discussed in this work has several characteristics that can be problematic when some or all populations are present. First, the course is multidisciplinary, so a technically diverse student population is involved. This also means that multiple departments are also involved with the same course. These difficulties are also exacerbated by the fact that the course sequence is offered at a large, public

university, where Fall 2009 enrollment in the course sequence has surpassed 200 students. Experience with this course over the 2008-2009 academic year led the faculty instructional team to move the management of this course from Blackboard Vista to Moodle<sup>1</sup>, the course management software chosen by university administration which will be fully implemented in 2011.

## **Electronic Assignment Submittals**

The first and foremost goal of implementing this course management system was to eliminate the huge amount of paper generated during the course of this design sequence. Over 200 students and 70 teams can produce prodigious amounts of hard copy for collection, distribution, grading and return to students, in addition to archival requirements and difficulty in obtaining meaningful assessment information.

Students are now required to submit all work as pdf documents, to the course Moodle site as an uploaded assignment. These assignments are available to grading faculty online with the associated rubrics. Completed rubrics are provided to students as feedback and electronically archived for evaluation and assessment purposes at the program, department and college level.

Response to this implementation has been very good, with those graders who prefer to read hardcopy able to print assignments, and those who prefer to reduce usage

of paper also accommodated through the electronic grading option.

Students have access to submitted materials for the entire two semester course sequence, including written documents, software code, drawing files, database files or any other project materials that the students choose to upload into the course management system. This information is segregated by group, and is password protected.

### Faculty and Mentor Access

This senior design sequence has faculty in two roles, grading instructor and faculty mentor. Each project is led by a faculty mentor who provides feedback via grades and regular group meetings. Grading instructors interact with the class at large, assist mentors with teams as needed, and have final grading responsibility for the course.

Moodle allows the mentors to access the grade book and associated rubrics as TA's might, streamlining and reducing the effort required from the external mentors.

### Data Archiving / Resource Retrieval

This implementation provides a single point of entry for all students to access course materials. Some typical resources are listed below.

### Course Syllabus and Schedule

The complex nature of the design sequence involved in this course requires a detailed schedule. A lengthy course syllabus has been constructed based on the practical professional experience of the faculty. This document is maintained and revised on a continual basis. Students are instructed that the official syllabus for the course resides on the Moodle site, and that print versions are uncontrolled, unofficial copies.

### Sample Assignments

Students are provided samples from past sequences of all course deliverables. Anonymous examples of excellent, good and average work are provided.

### Document Templates

Students in this course sequence are provided document templates, similar to those they may encounter in the workplace. These templates are available for student download through the course Moodle website.

### Grading Rubrics

Due to the team approach used in the teaching of this course, along with the many project mentors involved,

the deliverables for the course sequence are assessed using rubrics. These rubrics are published for the students to review at the time the syllabus for the course is released<sup>2</sup>. Rubrics for this course are designed to apply in general to cross functional team projects, with the assessment of technical quality of individual projects addressed in a way that accommodates wide variation in project content. Readers who are interested in more detailed descriptions of the course rubrics are directed to Reference [2]. Completed grading rubrics are also available for student review for each assignment.

### Lecture Materials

Slides, videos and other program materials presented in lecture are available for review on the course website.

### Design Review Presentations

Students are required to do group presentations at the midpoints of each semester, in the form of a conceptual design review, and final design presentation. Student presentations are recorded using PanOpto<sup>3</sup> software, and made available, after editing, to each individual group for review, along with the rubrics used to evaluate those presentations. These presentations are also archived for ABET review.

### Course Announcements

Listing the courses under a common Moodle framework facilitates announcement to a broad audience in a way not available without extensive work by individual faculty. Room changes, guest speakers, syllabus revisions and assignment modifications have been communicated effectively. Moodle provides the capability for email and announcements to be sent directly to students' university email accounts, so students do not have to be logged in to Moodle to obtain current and important information.

<b>Element</b> 4	Design and Documentation	Weight: 1.50
<b>Select</b>	<b>Criterion</b>	
<input type="radio"/>	<ul style="list-style-type: none"> <li>The design as documented may not work.</li> <li>Implementation plan is lacking.</li> <li>Appendices were not utilized when appropriate.</li> </ul>	
<input type="radio"/>	<ul style="list-style-type: none"> <li>Not enough design documentation to carry forth the design without significant investigation.</li> <li>Difficult to implement</li> <li>While appendices are present, material in appendix is not referred</li> </ul>	
<input checked="" type="radio"/>	<ul style="list-style-type: none"> <li>Drawings and design details are present but a description of the theory is insufficient.</li> <li>Can be implemented</li> <li>Appendices are used when appropriate.</li> </ul>	
<input type="radio"/>	<ul style="list-style-type: none"> <li>There is a good theory of operation, design details (Drawings, Schematics, Pseudocode or/flow charts)</li> <li>Ready to implement</li> <li>Information is placed appropriately in either the main text or an appendix.</li> </ul>	
<b>Feedback:</b>	<p>Make it clear - is netmetering offered for CATS? Later you talk about sell-back, etc.</p> <p>All spec sheets, etc., must be provided in an appendix. I am giving you a break on the appendices this time, but you absolutely must provide this information in the future.</p>	

Figure 1.  
Sample Rubric Interface in Moodle Workshop  
Technical Content

## Custom Workshop / Rubric Interface

Two of the authors are handling the Moodle custom programming. Institutional resistance to full implementation of Moodle led the authors to write code for a special workshop interface that gives grading faculty a simple rubric for assessing assignments. The radio button interface utilizes the common Novice, Apprentice, Practitioner, Expert evaluation levels, with a 3 point scale. An example of this interface is shown in Figure 1.

The completed rubric is made available to students as feedback for their individual assignment submissions. Figure 2 shows another aspect of the evaluation rubric. The Workshop tool allows the rubric to feature different evaluation topics, with different grading weights. The drawback of this approach is that the Workshop tool does not directly populate the grade book, necessitating an external spreadsheet for grade input and subsequent upload. An Excel spreadsheet has been created with a linked list of students in each group. Although this approach is not ideal and does require an initial set-up, it has worked well and requires minimal instructor interface.

Assessment of CATS-Solar_FinalProjectReport.pdf	
Assessment by Deb Sharer Sunday, 13 December 2009, 02:01 PM	
The Grade is : 21.00 (Maximum grade 30)	
<b>Element 1:</b>	Visual Format and Organization Weight: 0.50
<b>Select</b>	<b>Criterion</b>
<input type="radio"/>	<ul style="list-style-type: none"> <li>The document is not visually appealing and there are few "cues" to help the reader navigate the document.</li> <li>There is no apparent ordering of paragraphs.</li> </ul>
<input type="radio"/>	<ul style="list-style-type: none"> <li>Errors in the Table of Contents are present.</li> <li>Within sections, the order in which ideas are presented is occasionally confusing.</li> </ul>
<input checked="" type="radio"/>	<ul style="list-style-type: none"> <li>The document is organized.</li> <li>Use of white space and typography help the reader navigate the document, although the layout could be more effective.</li> </ul>
<input type="radio"/>	<ul style="list-style-type: none"> <li>The document is visually appealing and easily navigated.</li> <li>Appropriate typography and usage of white space are used as appropriate to separate blocks of text and add emphasis.</li> </ul>
<b>Feedback:</b>	Separate and bold section headers - include in table of contents. Note, if there is no 2, 1 is not needed. Check section 4 - subsection numbering looks strange. Double space between paragraphs. Font changes?
<b>Element 2:</b>	Language (Word Choice, Grammar) Weight: 0.50
<b>Select</b>	<b>Criterion</b>
<input type="radio"/>	<ul style="list-style-type: none"> <li>Errors in sentence structure and grammar frequently distract the reader.</li> <li>There is unnecessary repetition of the same words and phrases.</li> <li>There is an overuse of jargon without definition.</li> <li>There are many misspelled words.</li> </ul>

Figure 2.

Sample Rubric Interface in Moodle Workshop Report Mechanics

## Group Work

All of the senior design sections are used in satisfying ABET program criteria, especially in the area of group work. The group functionality available in Moodle is used to facilitate communication with individual groups

and instructors or faculty mentors, as well as within the group itself. Some groups are as large as 10 members, so coordination/communication is of paramount importance.

Students have limited, secure access to their postings and documents for the course, via the group settings available in Moodle. While the current system implementation does not include revision control along the lines of a traditional Enterprise Resource Planning (ERP) system, a paper based system is in place. Planning is underway to implement a limited ERP ability by integration of Al Fresco<sup>4</sup> software within the existing Moodle framework<sup>5</sup>.

## Accreditation Documentation

The implementation of this course management system has made archiving for the next ABET accreditation visit more streamlined. Submitted documents in pdf format with associated rubrics save a significant amount of time in generating displays for evaluators, especially for the department in the college that has instituted fully electronic displays.

## Future Work

The open source code available with Moodle makes future development of this course management system attractive and cost effective. Some areas of anticipated future work are listed.

### Integrate a custom rubric interface into the standard Moodle rubric tool

The standard tool available in Moodle for generating rubrics does not have, in the authors' opinion, a desirable interface. Grades are available as dropdown boxes, not radio buttons as shown in Figures 1 and 2. There is also currently no provision for providing the criteria defined for each component in the rubric interface.

Student feedback is limited to numerical scores, with no comments or guidelines associated with a rubric score. Work is ongoing to integrate the look of Figure 1 with rubric automatic grade book population.

### Group Grading

Most of the assignments in this sequence are group efforts. Modules are being sought that can differentiate group assignments from individual student assignments, and populate the grade book accordingly to remove the necessity of the external linked Excel spreadsheet.

## **Peer Evaluation**

Students in this course sequence do peer evaluations twice per semester that account for a portion of the final grade. This evaluation is currently accomplished outside Moodle and manually entered into the grade book. An automated module for this activity is being investigated.

## **Summary**

An implementation of open source code course management software has been discussed. Use with a large cadre of capstone students and the associated lessons learned from a preliminary implementation are described. Areas for future work and course improvement are detailed.

## **References**

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1. <http://Moodle.org>
2. James Conrad, Nan BouSaba, William Heybruck, Daniel Hoch, Peter Schmidt and Deborah Sharer, "Assessing Senior Design Project Deliverables," Proceedings of the 2009 ASEE Conference, Austin, TX, June 2009.
3. <http://www.panopto.com/>
4. <http://www.alfresco.com/>
5. James Conrad, Nan BouSaba, Daniel Hoch, Steve Patterson, Peter Schmidt and Deborah Sharer, "A Simplified System of Document Control for a Capstone Senior Design Program," Proceedings of the 2010 ASEE Conference, Louisville, KY, June 2010. (In Press)