Using a Course Management System in K-12 Education

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Abstract: We report on the recent activities of PRISM, an electronic hub to support integration of digital resources into 6^{th} – 12^{th}-grade STEM classrooms for Indiana teachers. Specifically, this presentation gives a description and a preliminary assessment of the efficacy of integrating a course management system (Moodle) into a range of 6^{th} – 12^{th} grade content courses.

1. THE PRISM PROJECT

Funded by the Lilly Endowment, PRISM's goal is to help Indiana teachers (primarily of STEM) take advantage of digital learning tools in meeting the state academic standards. PRISM (http://www.rose-prism.org) is a test-bed for Indiana K-12 educators to try out web-based resources to which they might not otherwise have convenient access. Moving toward 6,000 registered members, the user community has grown dramatically since its inception in September 2003. On peak days, the site receives close to 1,200 unique visits. Assessment of PRISM's effectiveness has been reported elsewhere [1, 2].

At its core, PRISM's mission is to help teachers embrace digital learning tools as extensions of their own dynamic presence in the classroom. The objective is to move beyond mere surface appeal in order to integrate computer-mediated resources into traditional STEM curricula. To this end, we provide two complementary services:

(1) *A library of over 2,300 online teaching resources* (e.g. simulations, scientific visualizations, virtual labs, collaborative skills builders, process modelers, serious gaming, access to live data) that mirror the digital tools available in the modern workplace. All resources are reviewed and indexed to the Indiana Academic Standards.

(2) *Access to a full-featured, course management system (Moodle).* This platform provides tools for tracking student participation, homework/quizzes, and grades. In addition to these rather standard functions, the learning platform supports exciting new ways to engage students beyond traditional "talk and chalk" delivery methods. For example, Moodle uses many elements of "social networking" to motivate young people and to incorporate 21^{st} century technology literacy.

2. COURSE MANAGEMENT SYSTEMS AND EDUCATIONAL TRANSFORMATIONS

Course Management Systems (sometimes called learning management systems or virtual learning environments) evolved out of software to support virtual groups in business and

industry. These systems then migrated to higher education, where they had a natural fit with distance education because they (1) organized and sequenced course content, (2) promoted communication among class members, and (3) mediated various forms of collaborative work. These systems help make possible new roles for teachers, learners, and interactive content in a dynamic environment [6].

In general, the emerging literature examining CMS development clusters around three central research concerns:

- System Design and Technical Issues: Initially, CMSs integrated services that were already available as part of the Internet. As the notion of a CMS was enriched, more features were added (e.g. drop boxes, blogs, wikis, journals). Each of these enhancements warrants discussion on system performance and educational effectiveness (e.g., does any CMS contain a satisfactory version of a white board?).

- Learning Delivery Environment: CMS development paralleled the growing market for e-learning. Distance education is the best known of three patterns for incorporating web-delivered instruction into a course. The second, blended (or hybrid) courses receive much attention today because instructors can use "the web for what it does best and class time for it does best" [7, p. 227]. However, the third category – technology-enhanced traditional courses – proves to be the most prevalent venue for CMS because integration requires less training on technical tools and less adjustment of current teaching methods.

- Adaptation and Utility: Issues influencing faculty adoption include both pragmatic concerns (technical support and campus IT robustness), attitudinal barriers (resistance to change), and motivational incentives (adequate training and recognition) [8].

Our study falls into this last category – a look at how a group of K-12 instructors makes use of a CMS. We did not query these faculty on motives or attitudes, but acknowledge that these dimensions are critical to technology transfer in education. Rather, we devised 20 questions (clustered into four themes) that focus on whether Moodle mediates new teaching / learning behaviors within our sample population. The following segments highlight results from this survey of Indiana teachers considered as Moodle power-users within the PRISM system.

3. Self-Report Study of CMS Use Among K-12 Teachers

In the K-12 venue, course management systems usually appear as supplements to traditional classroom instructional methods. Using a CMS offers convenience as a labor-saving device for tracking attendance, recording grades, making announcements, disseminating assignments, reaching parents. Beyond this, a CMS **might** encourage instructors to create dynamic learning communities consistent with social constructivist pedagogy.

Moodle (http://moodle.org/) is an Open Source product that requires no licensing fee and has a number of leading-edge learning mediators. Integrating Moodle into PRISM gave our user community the features and functionality of other, similar commercial products (e.g. ANGEL, WebCT/Blackboard). Registered users of PRISM can set up a lesson or an entire course) by creating or importing content, establishing a roster, sequencing activities (including online

quizzes and other forms of assessment), and enable a peer-review feature so that students can electronically critique each other's work.

3.1 Survey Design and Demographics

A cohort of the 100 most active users of PRISM's Moodle platform were invited (both by mail and by email) to participate in a short survey. The questionnaire was available online from 10 December 2008 through 6 January 2009. This 25-item instrument asked for self-report in six specific areas:

1.	Demographics	3 items
2.	Intensity of use expressed as frequency and number of students	2 items
3.	Theme: Return on Investment for Teachers	5 items
4.	Theme: Enable Authentic Assessment	5 items
5.	Theme: Students and 2st Century Skills	5 items
6.	Theme: Active Learning and Inquiry-Based Pedagogy	5 items

Survey responses for the last 20 items were entered on a standard five-degree Likert scale:

- Strongly Agree (SA)
- Agree (A)
- Disagree (D)
- Strongly Disagree (SD)
- Not Enough Experience to Answer (NE)

After each cluster, respondents were given an opportunity to comment or give further explanation. A copy of these narratives may be obtained by contacting the author.

All respondents were anonymous, and each agreed to our Informed Consent document prior to starting the survey. The study was approved by the Rose-Hulman Institute of Technology Internal Review Board (IRB). After cleaning the data for incomplete responses, we ended with a total of 58 surveys, or 58% of the identified sample. This is considered a reasonable response rate for polling of this type.

Characteristics of our responding population are reasonably varied (see Table 1). 62% are in STEM disciplines. 50% of our Moodle power users teach in a high school; 43% characterize themselves as teaching 6^{th} – 9^{th} grade – which is the PRISM target audience.

The sample contained a preponderance of seasoned veterans, with 79 % reporting at least five years teaching experience. A surprising 48 % indicate that they use PRISM's Moodle daily. Combining this number with the 36% who use the system at least once per-week, over three-fourths (84%) of our population make substantive use of Moodle. Over 46 % of our respondents

report using the system with over one hundred students. 9 % have taught 500 or more students (cumulative) using PRISM's Moodle.

Table 1
Demographics and Usage Intensity for PRISM Moodle Users

Primary Area of Expertise	**Math**	**Science**	**Tech & IT**	**Other**
% of PRISM Users	7%	26%	29%	38%

Grade Level Typically Taught	**K – 5th**	**6th – 8th**	**9th**	**10th – 12th**
% of PRISM Users	7%	31%	12%	50%

Number of Years Teaching	**< 1 year**	**1 – 5 years**	**6 – 10 years**	**> 10 years**
% of PRISM Users	0%	21%	19%	60%

Frequency of Moodle Use in Classes	**Daily**	**1x/week**	**1x/month**	**1x/year**	**Never**
% of PRISM Users	48%	36%	12%	4%	0%

Cumulative Number of Students	**< 50**	**51 – 100**	**101 – 500**	**> 500**
% of PRISM Users	26%	28%	37%	9%

3.2 Descriptive Analysis of Results

Preliminary analyses of these survey results were completed in early January of 2009 and are reported here for the first time. Based on client self-report, we found strong support for two major claims:

- Teachers find great utility in the various convenience aspects of a CMS. More importantly, teachers feel that these features result in instructional benefits for students.

- Moodle helps teachers to motivate students through active learning. Our indicators suggest that teachers engage students in problem solving, scientific visualization, and socio-cognitive behaviors valuable to the workplace.

The four segments below present and comment on results from the central themes of the survey. All 58 respondents answered all questions. Results are presented in tables, using percentages of the population for each of the items on the Likert scale. To establish a perspective on feature usage, we report – in the far right hand column of each table – the percentage of teachers who felt that they did not have enough experience to respond to the specific question. This number gives us insights into Moodle areas that are under-utilized.

3.2.1 Return on Investment for Teachers -- CMSs – such as Moodle – include a number of time-saving features that offer convenience to teachers. Teachers were asked to estimate how

features (such as electronic grade book, time-stamped submissions, and computer-aided grading) have helped them to better serve their students.

Responses in this cluster are very strong (see Table 2). Note that nearly all respondents agreed that the structured environment of Moodle improves their planning process. As for the last item, comments hinted that the lack of sharing might stem from the scarcity of computer resources. In other words – as one teacher said: "it may be selfish on my part, but the more people who know about this, the harder it will be for me to book the computer lab."

Table 2
Return on Investment for Teachers

	SA %[a]	A %[b]	D %[c]	SD %[d]	NE %[e]
The gains my students and I make in the classroom justify the amount of time I spend preparing my Moodle course(s).	44.8	57.1	1.7	0	1.7
The various class management tools (such as the gradebook, time-stamped submissions, and posting assignments) help me to stay organized.	29.3	58.6	1.7	0	10.3
Working to prepare and integrate content, classroom activities, and online assessment in a Moodle unit has improved my planning process.	36.2	60.3	3.5	0	0
I am more confident of the teaching advantages of Internet resources when I embed them within a Moodle learning unit.	39.7	51.7	3.5	0	5.2
Moodle helps me to share ideas or course materials with other teachers	24.1	39.7	17.2	3.5	15.5

[a] Strongly Agree (SA). [b]Agree (A). [c]Disagree (D). [d]Strongly Disagree (SD). [e]Not Enough Experience to Answer (NE)

3.2.2 Opportunities for Authentic Assessment – CMSs – such as Moodle – help teachers to use a wider range of assessment techniques to measure student learning. For example, instead of testing for discrete skills, teachers are able to monitor concept learning within a more contextualized process. In this segment teachers indicated to what extent they use several emerging forms of assessment in their classroom as a direct result of Moodle.

Results from this cluster will help the PRISM team to develop more persuasive training materials to demonstrate the value of alternative assessment forms (see Table 3). The socio-cognitive behaviors suggested in the five questions in this cluster are at the leading-edge of reform-driven teaching. Even modest gains in these areas are noteworthy.

While the agree-to-disagree ratios are all positive, we are disappointed in the high percentages of respondent who did not (or felt that they did not) have enough experience to give an answer. However, venturing beyond the standard forms of grading required in a traditional curriculum proves challenging even for the most experienced K-12 teachers. Furthermore, some of the embedded assessment we suggest here (such as e-portfolios and peer review) probably require more access to computer facilities than available to many Indiana teachers.

Table 3:
Authentic Assessment

	SA %[a]	A %[b]	D %[c]	SD %[d]	NE %[e]
Using such features as an electronic journal, my students engage in self-reflection (which may aid them in learning self-management skills).	20.7	34.5	6.9	1.7	36.2
Using paired, small group, or whole class input, my students have participated in giving and/or responding to peer feedback on their work.	20.7	31	1.7	1.7	44.8
Using an electronic portfolio approach, I am able to assess a wider range of learning artifacts from my students (for example, not just a final product but also materials from the various stages of development).	13.8	41.4	3.5	1.7	39.7
By using Moodle, I am able to understand my students' learning process so that assessment/evaluation takes on a mentoring dimension.	24.1	58.6	10.3	0	6.9
Moodle's electronic testing capabilities help me to return graded materials to my students more quickly than traditional paper-and-pencil methods.	44.8	36.2	3.5	0	15.5

[a] Strongly Agree (SA). [b]Agree (A). [c]Disagree (D). [d]Strongly Disagree (SD). [e]Not Enough Experience to Answer (NE)

3.2.3 Students and 21st Century Skills – Indiana is recognized for its commitment to education that prepares young people for success beyond high school, either in the workplace or in postsecondary education. A critical part of this commitment to 21st century education focuses on life and career skills. In this section, teachers indicated to what degree Moodle – with its emphasis on visualization, rich context, staged problem solving, and electronically enabled collaboration / communication – help students learn skills that mirror professional STEM

practices in a technology-based environment. The segment also contained items on skills foundational to group work – such as communication and collaboration.

This cluster contains encouraging results for a set of competencies that move beyond the three "Rs" in the traditional view of K-12 instruction (see Table 4). We note that these more nuanced skills are difficult to teach and require substantive preparation and monitoring from a classroom teacher. Our results indicate that teachers using Moodle observe growth in student proficiencies with information technology, social skills, and media literacy. We point out that approximately one-third of the teachers did not use Moodle to facilitate group work; however, those who used the collaboration features overwhelmingly agreed that it contributed to teaming skills.

Table 4:
Students and 21st Century Skills

	SA %[a]	A %[b]	D %[c]	SD %[d]	NE %[e]
Students learn valuable media literacy skills when they work with Moodle.	58.6	34.5	1.7	0	5.2
By participating in Moodle features such as chats or forums, my students learn to communicate in an effective and socially appropriate fashion.	37.9	43.1	1.7	0	17.2
By participating in electronic group work, my students develop skills that foster collaboration (for example, information sharing, adaptability, flexibility, and other behaviors appropriate for teaming).	29.3	36.2	1.7	0	32.8
The various features of Moodle help my students to develop skills for synthesizing information from a range of sources.	37.9	50	3.5	0	8.6
Since I started using Moodle, my students have had increased exposure to non-textual teaching resources that mirror the digital tools used in the modern workplace (for example, computer-mediated visualization, computation aids, and multi-modal materials).	29.3	48.3	8.6	0	13.8

[a]Strongly Agree (SA). [b]Agree (A). [c]Disagree (D). [d]Strongly Disagree (SD). [e]Not Enough Experience to Answer (NE)

3.2.4 Active Learning and Inquiry-Based Pedagogy -- CMSs – such as Moodle – are sometimes credited with changing the roles of instructors and students within an educational environment. That is, the technology helps teachers modify their pedagogy so that learning is student-constructed as opposed to teacher transmitted. In this segment, teachers indicated to what degree Moodle helped their students engage in problem-solving activities that encourage discovery, insight, and critical thinking.

This cluster's results are very positive (see Table 5). At least 80% or more of our responding sample felt that they could provide an opinion on each of the five questions. Additionally, the ratios are compellingly in favor of observed gains – as self-reported – on dimensions foundational to pedagogical change.

Over the years, the PRISM team has stressed that "educating the mind's eye" will draw K-12 students toward engineering careers [3]. Thus, the solid agreement in this segment on Moodle's ability to engage students and to link the conceptual and the concrete is very encouraging. We also point out that teachers reported 4-to-1 that they believe the teaching methods enabled by PRISM engage female and minority students better than traditional instructional approaches.

Table 5
Active Learning and Inquiry-Based Pedagogy

	SA %[a]	A %[b]	D %[c]	SD %[d]	NE %[e]
By using the electronic resources delivered through Moodle, my students are able to link real-world applications with the more abstract concepts of the course.	37.9	50	3.5	0	8.6
Moodle lessons - with their emphasis on visualization, rich context, staged problem solving, and electronically enabled collaboration / communication - more strongly appeal to female and minority students than traditional chalk-and-talk" teaching methods."	20.7	43.1	17.2	0	19
Using Moodle, my students are better able to engage materials that help them to practice spatial, temporal, quantitative, and probabilistic thinking.	34.5	51.7	1.7	0	12.1
I use Moodle to help my students engage in problem-solving activities that encourage discovery, insight, and critical thinking.	43.1	48.3	1.7	0	6.9
Using Moodle has helped me to improve my pedagogy (for example, to construct engaging activities, to writing rubrics / scoring devices that reflect learning objectives, and to embed feedback that fosters better learning).	39.7	51.7	3.5	0	5.2

[a]Strongly Agree (SA). [b]Agree (A). [c]Disagree (D). [d]Strongly Disagree (SD). [e]Not Enough Experience to Answer (NE)

4. DISCUSSION

Much has been claimed for course management systems as a transformative agent for education, but relatively few studies have been published that examine the contributions of this web-delivered innovation. CMS is the fastest growing educational technology application today on

college and university campuses, with thousands of courses being supported and the number increasing at a "staggering rate" [4, p. 46].

Morgan (2003) studied faculty adoption of CMSs at all locations in the University of Wisconsin System. While the PRISM study did not replicate her methods, Morgan's findings give a framework for interpreting our results. Faculty, notes Morgan, begin using a CMS to address a specific need, yet this need seldom involves transformative pedagogy:

> When probing below the surface . . . it seems that most of these needs have less to do with pedagogy, per se, and more to do with class management. Faculty adopt course management systems principally to manage the more mundane tasks associated with teaching, especially teaching large classes. Faculty look to course management systems to help them communicate easily with students, to give students access to class documents, and for the convenience and transparency of the online gradebook. [5, p.2]

While we did not directly survey our teachers on reasons for using a CMS, their patterns of usage suggest that they – like their higher education colleagues – are slower to use the more complex and interactive tools of a CMS. For the K-12 teaching community, a lack of computer resources may be the simplest explanation for this lag. Additionally, not all students have access to the Internet outside of class, and teachers are unlikely to invest heavily in a pedagogy perceived to exacerbate the divide between the "haves" and the "have-nots."

Despite these limitations, we are encourages by our results. For the past year, PRISM has offered two distance education courses on Moodle (Basic and Intermediate), each 5-weeks in duration. 493 participants have successfully completed at least one of these offerings. Out of the top 60 PRISM Moodle users, 35 were trained through our e-learning facility. PRISM also hosts over 1,000 Moodle-enabled courses (developed by K-12 teachers), 75% of which have been active within the last six months. Insights gained from our study will guide us in developing workshops and sample lessons that focus on using a CMS to its best educational advantage.

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