Integration of Learning Management System into University-level Teaching and Learning

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ABSTRACT
With rapid development of science and technology, introduction of the ICT different methodologies into the learning environment today becomes one of the most important factors. Application of IT tools in classroom learning and methodology for teaching and learning processes creates number of issues, which could be solved with the help of online Learning Management System (LMS).
This paper presents experiment results using of Moodle, at the course of Linear algebra and analytic geometry (LAAG) in the first semester of 2010-2011 and 2011-2012 study year. The paper presents quantitative and qualitative rationale interdependence analysis and experiment conclusion based on midterm and final exam results of the freshman students of the National University of Mongolia

Keywords
Learning Management System, Multimedia Learning, Mathematical Software, Training tools
Current situation in using of ICT in higher education of Mongolia

Today Information and Communication Technology (ICT) is becoming main issue for world development roadmap, acceleration drive for society and economy growth, protection and provision tool for human development and freedom security. ICT objective in the educational sector of Mongolia is “... to support with ICT transformation of educational organizations towards trainee-centered learning process, to create electronic version of textbooks and learning materials, to widely use web-based learning, to increase number of teachers who use computer system in the class towards 50 percent in 2012, 70 percent in 2016, 90 percent in 2020 by organizing trainings for teachers interested in ICT teaching …” (Ganbold, 2005).

For the Mongolian University of Science and Technology (MUST), which objective is to become E-school, “ICT-aided faculty number reached 94 percent, using total of 1560 e-files, in 2008-2010, total of 9 students studied Master degree online, 244+144 students chose online classes and 12 students studied undergraduate degree online. With the establishment of the multimedia studio in June 2009 MUST created environment for preparation of e-lessons on professional level and organization of continuous trainings for faculty on preparation of e-lessons. 262 faculty members participated in these trainings” (MUST, 2010).

National University of Mongolia (NUM) has goal to develop learning environment based on the latest technologies making electronic learning as core learning form and to establish its schools’ distance learning network. Towards this, NUM operates system for developing open learning curriculum OpenCourseWare (OCW), and currently it contains 67 lessons of 12 schools (NUM, 2012).

Faculty and management of Mongolian universities is paying high attention towards improving traditional training methods by applying electronic materials and utilizing ICT with specifics of each profession (Navchaa, 2011). But deployment of ICT faces some challenges, such as lack of theory and methodology, with uncertain experiment results and learning process. Thus, it could be said that, “research in this field until now is inadequate, no official body is to certify and control that the product is methodologically proven” (Tsedsuvsuren, 2008), “no policy and legal environment for e-learning, HR policy, program and standards development is slow” (Alimaa, 2011).

Introduction

This research demonstrates possibility of applying ICT towards supporting learning process. The term ‘Learning process’ includes faculty’s teaching and supervision and aspects connected with all-around support for students learning and abilities evaluation. The research presents results of continuous work of developing, experimenting, analyzing, observing and improving training tools for applying ICT in mathematics teaching.

- **Lecture teaching tools**
  Multimedia presentation helps students learn theory in depth and review at his own pace

- **Seminar and self learning tools**
  Development of teaching and learning aid tools to strengthen students’ knowledge, deployment of web-based open interactive examples.

- **Students evaluation tools**
  Development of tools to actually evaluate student’s knowledge and abilities, when and how to use, to refine mid-term exams

How to create virtual learning environment that consists of optimally organized multiple training
tools and establishes flexible relationship between teacher and student no matter of time and space?

**Background**

**Towards a new paradigm of teaching mathematics at University level**

Claudi Alsina (2001) distinguished three levels of innovative teaching, corresponding to tools to be used, new pedagogical strategies and the issue of assessment:

- Innovative technological tools
- Innovative pedagogical strategies

These are consistent with our trend mathematical training (Navchaa, 2010).

**The Cognitive Theory of Multimedia Learning**

*Dual channels:* Pavio (1986) & Baddeley (1986, 1999) tell us that humans possess separate channels for processing visual and auditory information.

*Limited capacity:* Baddeley (1986, 1999), Chandler & Sweller (1991) showed us that humans are limited in the amount of information that can be processed each channel at one time.

*Active processing:* Mayer (2001) & Wittrock (1989) propose that humans engage in active learning by attending to relevant incoming information, organizing selected information into coherent mental representations, and integrating mental representations with other knowledge (Jan Plass, 2010).

Mayer is concerned with how to present information in ways that help people understand, including how to use words and pictures to explain scientific and mathematical concepts. Mayer's research concerns the intersection of cognition, instruction, and technology. It is theoretical basis our research. If defines multimedia as the presentation of material using both words and pictures, then the rationale for multimedia presentations is that it takes advantage of the full capacity of humans for processing information.

*Figure 1. CTML: Cognitive Processes*
When material is presented only in the verbal mode, we are ignoring the potential contribution of our capacity to also process material in the visual mode. By building connections between words and pictures, learners are able to create a deeper understanding than from words or pictures alone. This idea is at the heart of the cognitive theory of multimedia learning. Learning involves adding information to one’s memory and is based on the following four assumptions. First, information – an objective item can be moved from place to place (such as from the computer screen to the human mind); Second, the learner’s job is to receive information; thus, the learner is a passive being who takes information form the outside and stores it in the memory; Third, the teacher’s job – or, in this case the multimedia designer’s job – is to present information; Fourth, the goal of multimedia presentations is to deliver information as efficiently as possible (Richard E. Mayer "Multimedia Learning", 2008).

**Principles of Multimedia Instruction**

These include

1. **Multimedia principle:** Students learn better from words and pictures than from words alone.
2. **Spatial contiguity principle:** Students learn better when corresponding words and pictures are presented near rather than far from each other on the page or screen.
3. **Temporal contiguity principle:** Students learn better when corresponding words and pictures are presented simultaneously rather than successively.
4. **Coherence principle:** Students learn better when extraneous words, pictures, and sounds are excluded rather than included.
5. **Modality principle:** Students learn better from animation and narration than from animation and onscreen text.
6. **Redundancy principle:** Students learn better from animation and narration than from onscreen text.
7. **Individual Differences Principles:** Design effects are stronger for low-knowledge learners than for high-knowledge learners and for high spatial learners rather than from low spatial learners.

(Mayer & Moreno, 2002)

**Learning Management System**

An LMS is a high-level, strategic solution for planning, delivering, and managing all learning events within an organization, including online, virtual classroom, and instructor-led courses. The focus of an LMS is to manage learners, keeping track of their progress and performance across all types of training activities. An LMS provides a single point of access to disparate learning sources. It automates learning program administration and offers unprecedented opportunities for human resource development. Once learners complete a course, the LMS can administer tests based on proficiency requirements, report test results, and recommend next steps.

Capabilities in an LMS:

- **Support for blended learning:** People learn in different ways. An LMS should offer a curriculum that mixes classroom and virtual courses easily. Combined, those features enable prescriptive and personalized training.
- **Administration tools:** The LMS must enable administrators to manage user registrations and profiles, define roles, set curricula, chart certification paths, assign tutors, author courses, manage content, and administer internal budgets, user payments, and chargebacks.
- **Content integration:** It's important for an LMS to provide native support to a wide range of third-party courseware
- **Adherence to standards**: An LMS should attempt to support standards, such as SCORM\(^1\) and AICC\(^2\). Support for standards means that the LMS can import and manage content and courseware that complies with standards regardless of the authoring system that produced it.

- **Assessment capabilities**: Evaluation, testing, and assessment engines help developers build a program that becomes more valuable over time. It's a good idea to have an assessment feature that enables authoring within the product and includes assessments as part of each course. (Greenberg, 2002).

**Moodle**\(^3\)

Moodle is a global development project designed to support a social constructionist framework of education. Moodle is provided freely as Open Source software. Moodle (noun) - acronym for Modular Object-Oriented Dynamic Learning Environment. An online learning management system (LMS), designed to create opportunities for rich interaction between teachers and learners.

To moodle (verb) - process of enjoyable tinkering that often leads to growing knowledge, insight and creativity. It applies both to the way Moodle was developed, and to the way we may use it to teach and learn.

Statistics by May, 2011: 54,000 registered verified sites in 212 countries, Registered sites contain 41 million users, 4.4 million courses and 1.1 million teachers, 97 language packs exist, 17 are complete. User’s 90% use Publish content (Pages, SCORM, Video, Audio), Assess via Quizzes and Assignments and Provide a passive Forum.

We used Moodle in teaching as it satisfies all above mentioned requirements. Hereby, we present experiment results of the using Moodle.

**The Experiment**

**Before the experiment**

After pilot study in 2010, LMS was placed on the university server and as experiment “Linear algebra and analytic geometry” course materials were placed, enabling study of LMS and official creation of experimental (2010) IT group registry. This stage was marked as pre-experimental stage and there was no significant difference between experimental (IT) and control (traditional) groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of students</th>
<th>Number of new students</th>
<th>Lecturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT group</td>
<td>Software Engineer-1A</td>
<td>25</td>
<td>31</td>
</tr>
<tr>
<td>Traditional</td>
<td>Software</td>
<td>24</td>
<td>31</td>
</tr>
</tbody>
</table>

\(^{1}\) Sharable Content Object Reference Model (SCORM) is a set of technical standards for e-learning software products. SCORM tells programmers how to write their code so that it can “play well” with other e-learning software. It is the de facto industry standard for e-learning interoperability.

\(^{2}\) The Aviation Industry CBT Committee is a nonprofit, membership-driven consortium dedicated to helping the training community get the most out of training technology. We do that by bringing together trainers, courseware developers, software vendors, simulator designers and airframe manufacturers to develop standards, technology recommendations and analysis of best practices.

\(^{3}\) Modular Object Oriented Dynamic Learning Environment
Table 1. Participation of experiment

<table>
<thead>
<tr>
<th>Group</th>
<th>IT group</th>
<th>Traditional group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Group SE-1A (31 students)</strong></td>
<td><strong>SE-1B (31 students)</strong></td>
</tr>
<tr>
<td>Lecture (3 hours/week)</td>
<td>Used board, chalk, computer and projector</td>
<td>Monday Used only board and chalk Wednesday</td>
</tr>
<tr>
<td>Seminar (2 hours/week)</td>
<td>All students obtained permission to access materials through internet (<em>Appendix 1</em>).</td>
<td></td>
</tr>
<tr>
<td>Moodle LMS</td>
<td>LMS enables students to submit practical works for assessment and view teachers marks online.</td>
<td>Students submit practical works written in papers.</td>
</tr>
<tr>
<td>Practical works</td>
<td>Tests were organized in the computer lab all tests given through internet.</td>
<td>Paper based tests were done.</td>
</tr>
<tr>
<td>Final exam</td>
<td>Theoretical knowledge is tested orally by 8 questions and evaluated by 40 marks.</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Different teaching and learning methodology between two groups

A questionnaire was taken with participation of 22 students from 25 IT group students and 27 from 30 traditional group students before experiment. It showed percentage of students with computer (IT group – 73%, Trad. group – 85%), access to internet (IT group – 41%, Trad. group – 53%), lecture sequence time, and displayed that conditions in the IT group were lower than in Traditional group. But other group specifications such as male students proportion (IT group – 80%, Trad. group – 77%), students ability to work on computer, showed no significant difference between groups.

Students grades were divided into 3 levels using cluster analysis according to their admission general test (AGT, with maximum of 800 marks) marks and achievement test result (ATR, with maximum of 50 marks) from SMCS office.

Table 3. Before experiment achievement of students, 2011

<table>
<thead>
<tr>
<th>Level</th>
<th>Advanced</th>
<th>Middle</th>
<th>Lower</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AGT</td>
<td>ATR</td>
<td>AGT</td>
</tr>
<tr>
<td></td>
<td>Number of students</td>
<td>Number of students</td>
<td>Number of students</td>
</tr>
<tr>
<td>Exam</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IT group</td>
<td>786</td>
<td>42</td>
<td>2</td>
</tr>
<tr>
<td>Traditional group</td>
<td>756</td>
<td>45</td>
<td>5</td>
</tr>
</tbody>
</table>
Experiment preparation and implementation process

**Lecture:** For the IT group, multimedia presentations using Flash and PowerPoint programs; interactive demonstrations (such as, Mathematica demonstrations\(^4\), GSP\(^5\) files) in the middle and at the end of the course; tools – notebook, projector, chalk and board.

**Seminar:** Problems with solutions prepared by Mathcad\(^6\); assignments evaluation by program with comprehensive report sheet.

It has advantage that all the students get equal opportunity, increasing teacher’s efficiency. This method was used in both groups. All tools and interactive presentations were used in connection with each other in the classroom as well as in LMS.

It was great advantage that Moodle test and evaluation tools give student and teacher opportunity to analyze their work, evaluate and make reports of exam results.

After the experiment and results

<table>
<thead>
<tr>
<th>Year</th>
<th>Group</th>
<th>Number of students</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Students who attended in final examination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Rate</td>
</tr>
<tr>
<td>2010</td>
<td>Pilot study</td>
<td>IT</td>
<td>25</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trad.</td>
<td>22</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>19</td>
</tr>
<tr>
<td>2011</td>
<td>Experiment</td>
<td>IT</td>
<td>25</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trad</td>
<td>30</td>
<td>6</td>
<td>5</td>
<td>3</td>
<td>16</td>
</tr>
</tbody>
</table>

number of students who …

A - … excluded from exam with attendance scores
B - … excluded from exam because of insufficient prerequisite scores
C - … didn’t participated in exam
D - … attended in final examination

*Table 4. Students achievement after experiment*

Total attendance average in 4 groups was 75%, in trad. group 53%, in IT group 84%, which shows that experimental group students whole-year participation in classes had tendency to increase (2011).

\(^4\) With its debut in 2007, the Wolfram Demonstrations Project introduced a new paradigm for exploring ideas, providing a universal platform for interactive electronic publishing. The power to easily create interactive visualizations, once the province of computing experts alone, is now in the hands of every Mathematica user. More importantly, anyone around the world can freely use these thousands of fully functional Demonstrations.

\(^5\) The Geometer's Sketchpad is a popular commercial interactive geometry software program for exploring Euclidean geometry, algebra, calculus, and other areas of mathematics.

\(^6\) Mathcad today includes some of the capabilities of a computer algebra system, but remains oriented towards ease of use and simultaneous documentation of numerical engineering applications.
In practical work I: students have to create their data and process given tasks. In practical work II: lecturer gives data and students have to process given tasks using given data. Area of blue triangle is greater than area of red triangle in all 3 data (Fig 2).

Pre-experimental stage grades average have no difference in 2 groups (table 4), and it is difficult to say which group is better (figure 3). After experiment, IT group students’ average grade is 13% higher (table 4) than traditional group, and it shows better results in all 3 levels than traditional group students (figure 3). This proves that experiment was successful and experiment methodology is good for students grades.

**Discussion and Conclusion**
- Moodle was successfully implemented, giving fruitful experience. There is possibility to study more and use opportunities.
- Application of LMS positively affects students learning
- Introduction of LMS at university level will help improving LMS usage among students
- LMS positively stimulates creativity and enthusiasm of students at all levels
- Teachers’ mechanical work is reduced, while enriching resources with reports and archives to be used in later works
- Teachers and students collaboration is more tightened
- Experience in creating different type of learning methods, such as indoor class combined with online learning, distance, online learning, etc
- To improve lecture tools and teaching methodology for theory study applying multimedia learning methods
- Depending on the sequence of the themes knowledge to be gained might be more stable when applying LMS

Reference
Acknowledgement
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Appendix 1.
LAAG course in the LMS

For example, 10th week of semester:

1. Lecture tools
2. Seminar and self-learning tools
3. Students evaluation tools
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