Development and Evaluation of the Blended Learning Courses at Sam Ratulangi University in Indonesia.

Sary. D. E. Paturusi, Yoshifumi Chisaki, and Tsuyoshi Usagawa

***Abstract*—The advancement in educational technology precipitated by the dissemination of Internet in recent years has a potential to improve the quality of education by encouraging participation and collaboration between instructors and students. Educational institutions use information and communication technology (ICT) as a tool for teaching and learning in a number of ways including but not limited to Internet-based content delivery and visualization.**

This research involves the development and evaluation of blended learning courses at University of Sam Ratulangi (UNSRAT), Manado, North Sulawesi, Indonesia. The current work was aimed to redesign two courses of the existing curriculum based on the ADDIE instructional design model to support student-centered learning and develop e-learning materials. One of the courses was then delivered as two separate classes, the first class was delivered through conventional learning and the second class was delivered by blended learning. These were done to obtain a comprehensive view of students' preferences for learning model. Whereas the other course was entirely delivered by blended learning to acquire an evaluation of students' experience in this learning model.

In this paper, the development of the courses based on the instructional design are described. From the questionnaire and examination results, students' achievements both for conventional learning and blended learning are evaluated. The outcome of the research can be seen as a description of students' experience and can offer recommendation on how to design e-learning based courses under the circumstances at UNSRAT.

***Index Terms*—Blended learning, conventional learning, development, evaluation, Indonesia.**

I. Introduction

Over the past decade, the rapid development and growth of information and communication technology (ICT) has enriched teaching and learning experiences and provided a chance to involve learners more, as well as improving the quality of education [1], especially in developing countries. Conventional learning refers to the traditional method of instruction where an instructor and students convene to the same physical location to hold a class meeting, usually with the instructor positioned at the center of the class circle [2]. It sets restrictions on the place and time of learning as well as the subjects to be learned and the teaching / learning assessment methodology. Students' achievement is usually assessed by written and, in some occasions, oral examinations given at specified dates and times. On the other hand, electronic learning (e-learning) refers to the emergent phenomenon in which teaching and learning occur via the Internet. Blended learning is the learning paradigm that attempts to optimize both traditional learning and distance learning advantages, potentials and benefits while eliminating both learning paradigms shortages and challenges [2]. One notable difference in this new approach toward learning is that an instructor acts as a facilitator or a guide to the students. E-learning has the potential to maximize chance of a students to interact with instructors and other students by online via the Internet, regardless of time and place. The effective integration of the Internet to higher education could maximize opportunities for students to become more involved actively in self-directional learning [3].

Although the number of studies on the application of e-learning at higher education institutions has increased rapidly in the last decade, little is known about e-learning experience of Indonesian students and their preferred method of e-learning. University of Sam Ratulangi (UNSRAT), Manado, North Sulawesi, Indonesia is searching for the most effective method to integrate e-learning into their curriculum. “Logic Circuit and Digital Technique” and “Discrete Mathematics” are the core of the second-term courses currently offered to undergraduate students at Electrical Engineering Department, Faculty of Engineering in UNSRAT. In the past, those courses were implemented through teacher-centered learning, in which an instructor took an active role in instruction and students passively received the information. However, we would like to design the course with a student-centered approach [4] [5] using Modular Object-Oriented Dynamic Learning Environment (Moodle) software platform which allows development of interaction and collaborative construction of content [6].

This study aims to build the basis for developing student-centered e-learning materials with the Moodle platform and the Analysis, Design, Development, Implementation and Evaluation (ADDIE) instructional design model. To gain a comprehensive understanding of students’ experience and their preferred method of e-learning, the learning outcome was evaluated in two conditions: (1) conventional condition, and (2) blended learning condition which combined conventional method with e-learning. First, we will review the theoretical background regarding ADDIE instructional design model, conventional and blended method of learning and give a description of the refined version of the curriculum. Second, we will discuss the development of e-learning materials with the Moodle platform. Finally, we will conclude our paper by presenting the results of our study about the learning

Manuscript received April 20, 2012; revised June 20, 2012. This work was supported in part by Graduate School of Science and Technology, Kumamoto University, Japan.

They are with Kumamoto University, Japan (e-mail: sary@hicc.cs.kumamoto-u.ac.jp, chisaki@cs.kumamoto-u.ac.jp, tuie@cs.kumamoto-u.ac.jp).

outcomes of Indonesian students.

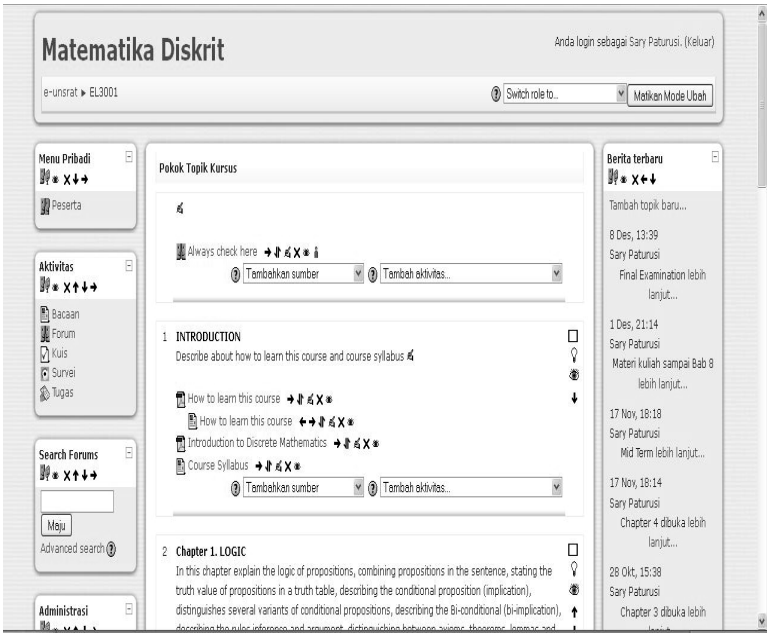

Fig. 1. Top page of the developed course. In the center column, learning content and corresponding quiz for each week are shown

II. Method

A. Course Development Based on ADDIE Model

The curriculum of "Logic Circuit and Digital Technique" and "Discrete Mathematics" courses were developed according to the key elements of a curriculum based on ADDIE model: Analysis, Design, Development, Implementation and Evaluation [7] [8].

During the analysis phase, the learning material resources for these courses were identified from some reference books. Students can earn 3 credits in the "Logic Circuit and Digital Technique" course, and the course constitutes a total of 42 hours of lectures divided into 14 meetings, and covers 7 chapters in a textbook. Whereas in the "Discrete Mathematics" course, students can obtain 2 credits with a total of 28 hours of lecture divided into 10 meetings, and covers 8 chapters in a textbook.

Through the design phase, learning objectives for each meeting, content, lesson planning and media selection were decided and the course structure were defined. "Logic Circuit and Digital Technique" course consists of 7 chapters. As the core of the second-term curriculum, upon completion of this course, students were expected to be able to analyze and create some simple design both for "Combinational and Sequential Logic." On the other hand, "Discrete Mathematics" course consists of 8 chapters and in this course, students learned the essential mathematics concepts and ideas in discrete mathematics, required for rigorous studies in most areas in computer science.

In the development phase, we adopted the Moodle platform, an open source learning management system, web application for producing modular Internet-based courses. Moodle is divided into courses and within these courses, instructors can share resources and set up activities, while students can read those resources and take part in the activities. Both instructors and students can communicate with each other all within their course [6].

The Moodle contains lecturer information, course syllabus, week-by-week program, materials, assignments and quizzes for each chapter as conceived in Fig. 1. After completion of learning in each chapter for both courses, an assignment and quiz were given to assess students' understanding about the material. The quiz uses a format in which answers were automatically evaluated and the feedback were given immediately to students. Other tabs provide access to a general forum which were instructors can post class information, assignment reminders and quiz deadlines, every week. Through this forum, we expected to have interaction between students and instructors as well as within students themselves.

During the implementation phase, actual instructions and delivery of learning experiences was done in the first semester of the academic year 2011 for the "Logic Circuit and Digital Technique" course, on the other hand, for the "Discrete Mathematics" course was done in the second semester of the academic year 2011.

In the evaluation phase, we provide an assessment of learning outcomes through students' results and recommend improvements in e-learning support as well as collecting feedback for continuous refinement in both courses.

B. Comparison Study of Two Learning Styles

Comparison study was carried out to obtain a comprehensive view of students' experiences and preferences for the learning model. In the present study, the course, "Logic Circuit and Digital Technique", was delivered in two separate classes; one class (Electrical Engineering concentration), through the conventional learning method and another (Information Technology concentration) by the blended learning method. In the both classes, this subject was a compulsory credits for the students. Whereas "Discrete Mathematics" course was solely delivered in one class through the blended learning method via Moodle.

At the end of the semester, a survey was conducted to assess students' experiences and preferences for both

learning models and the questionnaire based survey was selected as the method of assessment due to the easiness of student's participation. The questionnaires were administered during a class break when most of students were still in the classroom. No incentives were offered for completing the questionnaire. Students were given the choice of not completing the questionnaire, but most students participated because they considered that the survey was not long. The questionnaire consists of 10 items assessing students' experiences in the learning process, to obtain a comprehensive view of students' preferences for learning model. Sample items include: "Increase my motivation in learning", and "Increase my enjoyment in learning". Another questionnaire elaborated for this study especially for blended learning classes, with five items about e-learning system quality and 10 items about information content quality. Sample items include: "The e-learning system is user friendly", and "The course itself and the learning material are clear and well structured".

A total of 130 anonymous survey questionnaires were distributed to students, but only 126 questionnaires were returned, with a response rate of 97%. Of these participants 38% (n=48) were women, 62% (n=78) were men. Items on the questionnaires were used to measure students' achievement and satisfaction in the course as well as students' feedback in evaluating and revising a blended learning course. All variables are objectively measured with a five-point Likert Scale. Response options ranged from 1 (Strongly disagree) to 5 (Strongly agree). Student's t-test was used to compare academic achievement of students in both classes and a p value < 0.05 was considered statistically significant.

III. Results and Discussion

A. Students' Preferences for learning Model

For the "Logic Circuit and Digital Technique" course, students in both conventional learning (n1=38) and blended learning class (n2=65) completed the questionnaire to investigate their preferences in learning model (compare Table I). Table I indicates that in the blended learning process, 76.9% (n2=50) of respondents conclude that the system can increase their flexibility of learning, 75.4% (n2=49) of them found the experience enjoyable and 72.3% (n2=47) of respondents agreed that the system can increase their learning motivation. This finding is in agreement with El-Deghaidy and Nouby (2008) [9] who reported that the blended learning group students were more satisfied with the method of learning and stated that the technique was enjoyable and more interesting and provided sufficient feedback. However, just 60% (n2=39) of students acquire skills in the self-regulation of learning.

Whereas in conventional learning process, just 31.6% (n1=12) of respondents perceive that the system can increase their flexibility of learning, 23.7% (n1=9) of them conclude that the experience was enjoyable and 21% (n1=8) of respondents feel that the system can increase their learning motivation. Even though, more than 50% of students can acquire conceptual knowledge especially in the Logic Design (n1=21) and can identify their weaknesses and strengths in that course (n1=20).

We compare the questionnaire results of both class, for choices N (Neutral), D (Disagree), and SD (Strongly Disagree). If the percentage of responses decreases, it indicates a positive response, which is what occurred. While for choices A (Agree) and SA (Strongly Agree), the increasing number of responses indicates positive response, which also occurred as illustrated in Fig 2. In this figure, the black bars represent percentage of A and SA responses by the conventional learning class while the gray bars depict ones by the blended learning class. Horizontal items correspond to the items described in Table I, and Vertical axis presents percentages of positive response (A and SA) to the corresponding items of questionnaire.

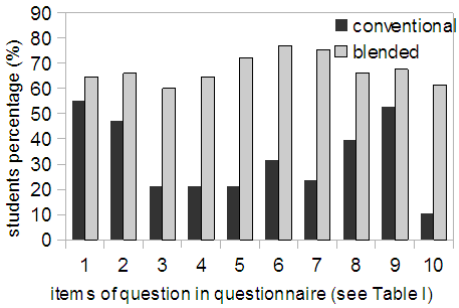

Fig. 2. Comparison between the percentages of positive response (A and SA) of the two classes

From Fig. 2, it could be concluded that students' experience in the blended learning class indicates positive results than their experience in the conventional learning class. This finding is in agreement with Saleh, El-Bakry, and Asfour (2010) [1], who reported that the adaptive e-learning materials can improve the learning process and affect the students in a positive way.

TABLE I: Percentage of Positive Response for Both Classes

No	Question	Percentage of positive response	
		Conventional	Blended
	In this learning process, I can		
1	Acquire knowledge	55.26	64.62
2	Decide pace of learning	47.37	66.15
3	Acquire skills	21.05	60
4	Control enhancement	21.05	64.62
5	Increase motivation	21.05	72.31
6	Increase flexibility	31.58	76.92
7	Increase enjoyment	23.68	75.38
8	More convenient	39.47	66.15
9	Identify weakness	52.63	67.69
10	Found mark given fair	10.53	61.54

Moreover, all students in both classes were given the final examination with the same questions in the same day and time. From their results, the conventional class just had 4 students from a total of 38 students who obtained the highest grade (M1=6.84). On the other hand, there are almost 50% (n2=30) of students in the blended class who gained the highest grade (M2=8.03). The study revealed that there was a highly significant difference in academic achievement of students between conventional learning class and blended

learning class ($p<0.01$) as conceived in Fig 3.

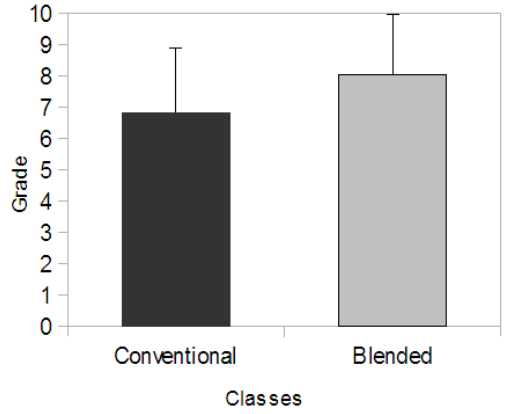

Fig. 3. Results of students in final examination for both classes

These results are in contrast with Shen et al (2007) [10], who found that traditional-mode students have achieved a slightly better performance in examinations in comparison with online-mode students.

B. Students' Evaluation of Their E-learning Experiences

For the blended learning classes, students in both "Logic Circuit and Digital Technique" course (n=65) and "Discrete Mathematics" course (n=23), were given another questionnaire to examine their learning experiences as well as to evaluate e-learning performance in those courses as shown in Table II. One-way t-tests were carried out to investigate the hypothesis that students' evaluation deviate significantly from the mean of the scale (3 indicating neither agreement nor disagreement) (compare Table II). Thus, it was analyzed whether students give distinct favorable or unfavorable evaluation.

In all fields, students gave positive evaluation of their course (all comparisons were significant; compare Table II). Table II shows, especially regarding system quality, that 69.3% (n=61) of respondents conclude that the e-learning system is user friendly, and 63.6% (n=56) of them thought that the system is easy to handle. However, just 38.6% (n=34) of students agreed that the e-learning system has provided interactive features.

About the content quality information, Table II shows that 59.1% (n=52) of respondents found that the learning objectives of the modules are stated clearly and lecture notes are the core of learning materials, whereas 57.9% (n=51) of them thought that the course itself and the learning material are clear and well structured. The previous finding was in accordance with Paechter and Maier (2010) [11] who found that there are five items which contributed positively to the satisfaction with a course one of them being clarity and structure. But, less than half of students, roughly 40.9% (n=36), felt that the course content and presentation are long enough to cover all content.

Furthermore, all students have personal access to computer device, 67.05% (n=59) of them from laptop device and the rest of them 32.95% (n=29) from desktop PC. Concerning access to e-learning materials, 45.5% (n=40) of students access the e-learning material using their home connection about half of the time as well as university connection. Regarding frequency to visit, 15.9% (n=14) of students nearly 1 hour, 52.2% (n=46) of them fairly until 3 hours, 20.5% (n=18) of students practically until 5 hours spent on using a computer/internet per day. Although 45.5% (n=40) of them just spend 1 hour and 42% (n=37) of students spent fairly until 3 hours on using a computer/internet for educational purposes per day as well as visiting e-learning module per week.

The findings of this study admitted that there was high availability of student's access to computer devices as well as possibility of internet connection. Even though students persistence both to using computer/internet per day for educational purposes and visiting e-learning module were slightly deficient.

TABLE II: STUDENTS EVALUATION OF THEIR E-LEARNING EXPERIENCE

Question	M	SD	Percentage of positive response
System quality			
provides high availability	3.3	1.4	45.5
easy to handle	3.6	1.3	63.6
user friendly	3.8	1.2	69.3
provides interactive features	3.2	1.6	38.6
attractive features	3.4	1.4	43.1
Information content quality			
clear and well structured	3.8	1.3	57.9
objective are stated clearly	3.7	1.2	59.1
Lecture notes are the core learning materials	3.6	1.6	59.1
Course content and presentation are long enough	3.5	1.6	40.9
easy to understand content	3.5	1.3	54.5
provided at an appropriate difficulty level with this course	3.5	1.5	47.7
Exam questions and assignments are clearly explained	3.6	1.2	55.7
Tasks given in appropriate number	3.7	1.2	53.4
provides sufficient information	3.5	1.2	56.8
provides up to date information	3.5	1.3	54.5

IV. CONCLUSION

The current research proposed the redesign of course curriculum based on ADDIE model and development of e-learning materials through Moodle. The overhaul represents a transition from a passive model of learning to an active model. This study compared students' learning performance under conventional and blended learning classes in the Electrical Engineering Department of UNSRAT, and showed that the implementation of blended learning has a positive effect on increasing students' performance and raising exam pass rates in the courses, both the "Logic Circuit and Digital Technique" and the "Discrete Mathematics" course.

From students' evaluation of their e-learning experiences, this model encourages active and collaborative learning and the development of a learning environment according to

learner needs. It can be concluded from students results that with their own pace of learning, they could plan their study and meet the assessment, which in turn increases their motivation and achievement. Moreover these findings could indicate endorsement for implementation of blended learning system for more courses in UNSRAT educational environment.

In future work, the detailed student feedback can be considered as a vital component to enhance the blended learning systems according to this evaluation. More performance in the experiments evaluation is also expected. Considering that chosen subjects may be applicable for blended learning while others may not, then different subjects mat be added in the next experiment.

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Sary Diane Ekawati Paturusi was born in Manado, North Sulawesi, Indonesia, on October 4th, 1977. She graduated from the Electrical Engineering Department, Faculty of Engineering, University of Sam Ratulangi, Manado, Indonesia with a Bachelor of Engineering. She works as a lecturer at University of Sam Ratulangi, and is currently a Masters student in the Graduate School of Science and Technology, Kumamoto University, Kumamoto, Japan. Her research interests include E-learning, Educational Technology and Computer Networking.