Usability of BLESS-implemented class room: a case study of mixtio

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Abstract

Conventional learning system and e-learning have their own strengths and weaknesses. To combine both systems, blended learning is created. In Extention Program of Informatics Engineering Faculty at XYZ university most of the students already have jobs. As much 47.5 % of students who take this program have a job in daily office hours. Then, to facilitate the learning process the XYZ university develop learning management system (LMS) by Moodle. XYZ university want to make a learning process with blended learning concept. However, the Moodle sytem has limited function to adapt the blended learning system (BLS). In the aim to improve the class usability in BLS, then this study proposes to apply to Blended Learning System Structure (BLESS) into LMS design. BLESS is offered as a framework which matches to learning and uses a top-down approach. Then, the system design maed it "Mixtio". At the end of this study, it can be seen the analysis result of the use of BLESS can improve system usability of LMS.

Keywords: blended learning, BLESS, e-learning, usability

1. Introduction

The Learning System applied with conventional learning is delivered through face-to-face method. The limited learning time at class does not match to the material load that they have got to achieve [1]. The conventional learning system is actually can be improved by optimizing the face-to-face class so that the objectives can be attained as well as the target of learning credits.

Blended learning (BL) is offered to improve conventional learning. The term blended learning refers to combine between e-learning and face-to-face class. Numerous researchers define blended learning as "a training method that combines the benefits of in-class learning and e-learning" [2]. Both e-learning and face-to-face class can supplement each other and their benefits can be integrated [3]. In BL, online learning can be done through web, so that face-to-face interaction can be optimized. Even, appropriate method in every course section can be decided either using e-learning or having face-to-face class.

The term "blended learning" combines the elements of face-to-face teaching, including personalized learning, social interaction which allow greater variety and flexibility than traditional learning. Implementing blended learning in the classroom implies both online learning and integration of the content into the lesson [4]. The integration of face-to-face and online communication in education is the underlying principle of blended learning, which enables opportunities for collaborative and self-directing learning beyond the classroom setting [5, 6].

Nowadays, modern information technologies have become an integral part of the educational system in many countries all over the world. Blended learning is increasingly used in education [7, 8]. This idea is reflected in the works of many researchers whose scientific interests lie within the scope of information and communication technologies in education: the importance of computer technologies integration in the learning process [2], the use of information and communication technologies for developing adult learners' communicative foreign language competence [9] using blogs in creating special opportunities for language learning [10].

Information and communication technologies tend to dominate in teaching and learning processes at modern technical universities. They are widely used for teaching various subjects

as well as foreign languages. One of the forms of information and communication technologies is e-learning that is being implemented in the teaching process nowadays [11, 12]. However, e-learning cannot satisfy all the needs that the participants of the educational process have. Consequently, only the integration of traditional teaching methods and e-learning can lead to the desired results. Among various e-learning technologies blended learning is supposed to be the most effective and perspective one that should be implemented in the educational process at modern universities [4].

Potential benefits of blended learning include flexibility in learning, collaboration, and interaction among students and instructors [13]. Guangying [14] infers the increasing degree of attention paid to blended learning in the sphere of education via the contribution of blended learning approach to learning are flexibility, rapidity and accelerated power. There are some examples where blended learning succeed to optimize learning. Such as, in assessing its role in pharmacy education in Spain, Sancho [15] reported positive outcomes, time reduction, and student satisfaction when BL was applied in the instruction of complex competencies within microbiology. In Australia, pharmacy students in a practical pharmaceutics course with face-to-face and online teaching reported positive experiences and preference for partial online teaching [16].

Robinia [17] demonstrated improved satisfaction and attrition rates, with no significant difference in certification pass rates, after transitioning an undergraduate nursing certificate program to a blended format. Similarly, Houldson [18] compared the final examination scores, certifying exam scores of students graduating from traditional and blended nursing programs and found no significant differences. Blended learning is developed based on intuition. It has no special framework [1]. In general, e-learning focuses more on e-content development, and does not focus on learning process [19]. However, the e-learnig platform, Learning Management System (LMS) provided as learning platform is not flexible enough in order to match with the need of the system [20, 21].

Blended Learning Systems Structure (BLESS) offered a framework which tries to answer the need of establishing blended learning system (BLS). Derntl [22] explain that BLESS is a top-down approach which consists of 5 layers useful for designing blended learning system. In BLESS, technology has a role as enabler, not as driver of learning process so that BLESS technology can effectively support and suit the learning process. In BLESS, the complex blended learning can be separated into smaller and reusable units, because BLESS concentrates on course pattern and can be implemented on different LMS.

The extension program of Informatics Engineering Faculty offered by XYZ University to help Associate Degree pursue their study to achieve their bachelor's degree is conducted daily at 5 pm to 9 pm. The learning process is conducted at night because the information survey from faculty says that 47.5 % of students who take this program have a job in daily office hours. Then, to facilitate the learning process in this extension program, the XYZ university have been develop learning management system (LMS) by Modular Object-Oriented Dynamic Learning Enviroment (Moodle). Moodle is a Learning Platform. Hereafter, XYZ university want to make a learning process with blended learning concept. However, the Moodle system has limited function to adapt the blended learning system (BLS).

In the aim to improve the class usability in BLS, then this study proposes Blended Learning System Structure (BLESS) into LMS design. With the use of BLESS the LMS having been analyzed in top down way and focused on learning process, the system is reusable because it is not focused on one learning platform. But the system can be applied to any learning platform, considered good to be applied in extension program at XYZ University. The analysis result from BLESS will implemented into Moodle as additional features. Therefore, in this study, a BLS that adopts principles of BLESS is developed, to be used in extension program of Informatics Engineering Faculty at XYZ University. This BLS is named "Mixtio".

The question addressed in the study is how to design Mixtio with use BLESS, to optimize learning process. Therefore, the purposes of this study are as follows: Designing blended learning which applies BLESS model, and Testing the level of usability of created system. Therefore, this study is using usability to measure the implementation of BLESS in Mixtio, comparing it with the conventional learning conducted before. The rest of the paper is organized as follows: section 1 section 2 give the overview of the LMS, BL, and BLESS. Section 3, briefly discusses Analysis and Results. Section 4, highlights several conclusions.

2.   Research Method
2.1. Modular Object-Oriented Dynamic Learning Enviroment (Moodle)

Moodles one of the most used LMS. It is a well-known, user friendly and verified open source software LMS.It can provide a learning interface as well as a source of communication. Management of Moodel contain: Site management, User Management, and Course Management [23].

2.2. Blended Learning System Structure (BLESS)

BLESS is a framework whose function is to guide the development of blended learning Systems by putting complex process of blended learning into smaller, more real and reusable units. The result can be used to guide blended learning teaching and to use of technology [24]. As a framework for blended learning system development, BLESS enables the existence of conceptual modeling and layer architecture to describe blended learning scripts and allows the patterns of blended learning to be reused. BLESS puts emphasis on creating technology as an enabler not a driver in a meaningful learning process.

BLESS is a framework with top-down approach consisted of 5 layers as seen in Figure 1. The layers are aimed to clarify and reengineer teaching system of blended learning. The higher the layer the more abstract the layer is. The structure of layer comes from the needs to clarify the complex transitions of conventional teaching to the implementation of web-based teaching [22].
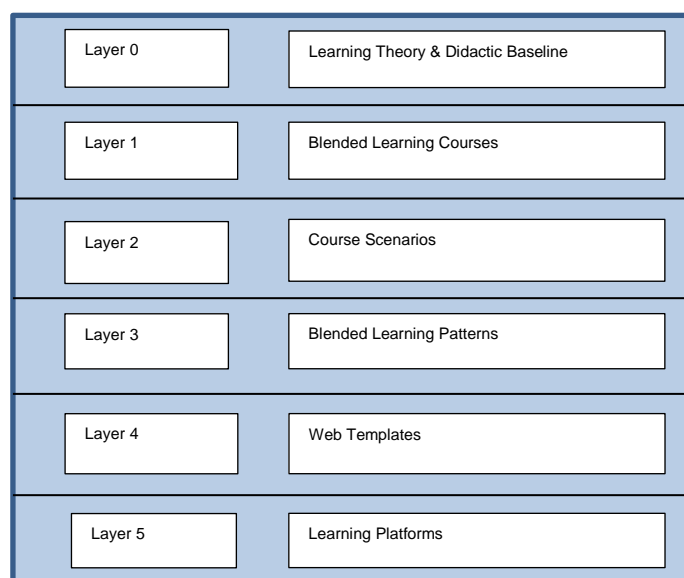
Layer 0	Learning Theory & Didactic Baseline
Layer 1	Blended Learning Courses
Layer 2	Course Scenarios
Layer 3	Blended Learning Patterns
Layer 4	Web Templates
Layer 5	Learning Platforms

Figure 1. BLESS framework [22]

2.3. Person Centered E-Learning (PCeL)

Person-Centered e-Learning (PceL) is a theoretical foundation of BLESS framework for developing blended learning. PceL is based on Person Centered Approach theory of [25] Carl Roger. The main hypothesis of PceL is that information transferred is carried out by computer (e-content), meanwhile time and other resources can be located to enrich face-to-face meeting.

By basing on the considerations, blended learning system in BLESS that is intended for PcEL should be based on:

a. Using ICT as much as possible to provide resource, teaching material, and other information.
b. Using ICT proportionally to conduct online activities (feedback, evaluation, announcement, forum) and to reduce overhead organization and administration.

Using face-to-face meeting for holding activities which enrich social skills, personality, and social interaction (goal sharing, presentation, discussion, problem solving) and for activities

which can't be carry out online. The activities are designed to allow the learners to learn independently [26].

2.4. Usability

The most intuitive definition of usability is the property of the system that defines its degree of simplicity of use in terms of learning, storage and efficiency. The ISO 9241 standard, on "Ergonomics of Human System Interaction", defines usability as "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" [27]. Though the construct of usability emerged from the field of Human Computer Interaction, it does not solely apply to cognitive and sensorial usage issues. The concept of usability helps to define and operationalize the quality of the interaction and experience, and can be applied to physical or digital products alike. In addition, the definition of the satisfaction component of usability includes 'freedom from discomfort', which also includes physical interactions. The ISO definition of usability contains two user performance measurements (effectiveness and efficiency) and one user experience measurement (user satisfaction) [28]. This aligns with the definition of ergonomics by the IEA in which the goals of the profession are described as optimizing human well-being and system performance [29]. Therefore, this study is using usability refer the ISO 9241 standard to measure the implementation of BLESS in Mixtio.

2.5. Subjects and Setting

This study is conducted among students of informatics engineering extension program which consists of 40 students. This class will implement Mixtio that starts face-to-face meeting with the lecturer from 5 pm to 9 pm every weekday, while using the LMS for online activities both scheduled (test, quiz) and unscheduled (forum, announcement, etc).

2.6. Procedure

To finally measure the level of usability in Mixtio, this research is conducted as follows:
1) Analysing and designing layers of BLESS to be implemented
   a. Layer 1: determining courses
   b. Layer 2: determining study scenario
   c. Layer 3: determining blended learning patterns
   d. Layer 4: developing web template for each pattern
   e. Layer 5: integrating web template in LMS
2) System testing in a forementioned classroom
3) Measuring usability level by handing out questionnaire. There are 3 parameters to measure usability as follows:
   a. Effectiveness
   b. Efficiency
   c. Satisfaction
4) Using wilcoxon signed rank test to test the hypotheses

3. Analysis and Results

3.1. Analysis and System Design

In this part, Mixtio is designed based on principles and layers of BLESS, which adopts principles of PCeL. Each layer of BLESS will be analyzed in accordance with real situation and requirement in extension class. The analysis is used to design Mixtio. The 5 layers are:

3.1.1. Layer 1: Blended Learning Courses

The analysis of layer 1 is carried out based on the school subjects. Characteristically the school subjects can be classified into 3 types:

a). Analytical type

General characteristics: the subjects for analytical type focus on concept internalization, basic principle, and analyzing things based on the theory which has been introduced before. Subjects included in this type are Database System, Software Engineering: Object Oriented technique, Information Technology Project, Management, Information Retrieval, E-Learning, Web Engineering. The subjects in this type are delivered by explaining concept and basic

principle based on the target theory. Then, the theory is used to analyze real-life example and design a project.

b) Algorithm type

The general description of algorithm is it is the subject which focuses on basic concept of algorithm, efficient algorithm, kinds of algorithm strategy and other things related to algorithm. Algorithm puts emphasis not on a mere writing program but it stresses on the right way of writing program in term of algorithm. The subjects included into this category are Basic Programming and Algorithm design analysis. The subject in this category is delivered by explaining the basic concept in a very beginning step by giving the learners examples, tracing to help the learners comprehend algorithm and its product and later provide opportunity to the learners to practice writing program match to the given basic concept.

c) Logic-Mathematics Type

General characteristic: the subjects in logic mathematics type focus on solving problem logically or mathematically. Many formula and logics are used to solve the problem. The subjects included into this category are Mathematics Logic, Numeric Analysis, Artificial Intelligence, Data Mining, Soft Computing, Graphic and image, Computational Engineering. The subjects under this category are delivered by describing basic theory and problem solving exercise. Layer 1 provides information about user characteristic globally. In the study, the learner characteristics; the students of informatics extension program of Faculty Informatics Engineering, XYZ University, are as follows [6]: The age is up to 21 years old, 47.5% are studying while working, limited meeting time and ineffective learning time since it is conducted at night, the students are more independent and more adult compare to the regular students.

3.1.2. Layer 2: Course Scenarios

The layer 2 analysis is carried out by taking three sample of learning subjects. Each one is taken from different types. The subjects taken for sample are Analytical Type: Object Oriented Technique (OOT) software engineering, Algorithm Type: Algorithm Design and Analysis, Logic-Mathematics Type: Data Mining. The learning scenario of every subject included into sample is created. The process of creating learning script is re-engineering process (modeling) of conventional learning process matched to blended learning concept which integrates traditional learning and online learning. Some of process which is in the reality is carried out face-to face are made online. The scenario resulted from layer 2 analysis will be used to analyze layer 3. Basic scenario taken from the three subjects can be seen in Figure 2. Specific difference of the three subjects is on the division of instructional material. The instructional material is divided into face-to-face lecture and online lecture. The scenario clarifies activities conducted in face-to-face lecture as well as activities in online lecture.

3.1.3. Layer 3: Blended Learning Patterns

The basic scenario patterns obtained from BLESS analysis in layer 1 and 2 steps are summarized in Table 1. There are 14 patterns with the description, motivation, and scenario for each pattern. Based on PceL principles which is the basic of BLESS, use of ICT should be optimized in providing resource and reducing organizational and administration overhead, meanwhile face- to-face session should be conducted for social activities. The above patterns in Table 1 can be implemented by using provided feature from widely used LMS such as Moodle and ATutor, except for final task management and interactive quiz. Therefore, the final task management and interactive quiz patterns are chosen to be developed into web templates. The patterns are:

1) Pattern 1: Final Task Management

This Pattern describes interactive learning process or incremental milestones. Final task (tubes) is a unique thing of learning at XYZ University. The management of it can be facilitated by this feature. The things that can carried out by the feature are:

a. Lecturer give his first instruction

b. Learner forms teams

c. The formed team make learning contract. In the learning contract, there are targets which are created by the team (milestones) and task distribution among team and team member. Every milestones is a phase that must be done in accordance with learning contract.

d. If a milestone has been done, the team publishes its result and mark the milestone. And they can carry out the next milestone.

e. Lecturer verifies the progress of each team.

By implementing the pattern, it is expected that some targets can be attained. They are:

a. Learner can be more independent by making their own team and deciding their own milestone
b. Lecturer can check the progress of each team and remind those who cannot keep the schedule they have created.
c. The final task can be more controllable, more centralize and more manageable

2) Pattern 2: Interactive Quiz

Evaluation is carried out interactively. In this case, the evaluation is in form of game. This kind of evaluation has some advantages. Learners can be more fun and relax while doing the quiz. Besides, the problem come up in the game is easier to memorize. The games used in interactive quiz pattern is hangman. In hangman games, learner is given question. He is given a chance to choose letter to form the answer to the question. He may make mistakes for 5 times and when he fails to find right answer after choosing wrong letter for 5 times, he loses the game.

By implementing this pattern, it is expected that some achievements can be gained. Games may attract users to use e-learning. Through interesting games, it is expected the user will be more motivated to use e-learning.

3.1.4. Layer 4: Web Templates

Web templates is made in form of PHP file which represent pattern functionality implemented by that web templates. In this case, web template is made for pattern "Final Task Management" and "Interactive Quiz". These web template is made as generic as it can so that it can be used in other LMS. This emphasize the principles used in BLESS, so that the resources should be reusable. In this study, these web templates are treated as a new modul that can be installed in Mixtio's LMS.

3.1.5. Layer 5: Learning Platform
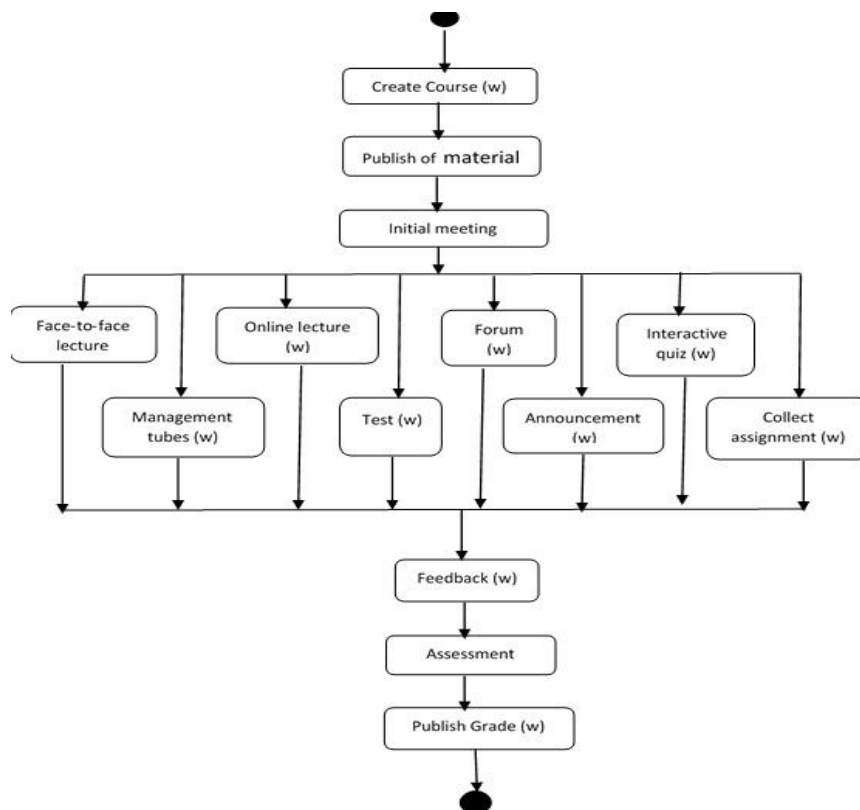
Web templates are implemented in Mixtio's LMS.

Figure 2. Basic scenario

Table 1. The Patterns of Blended Learnig System

		Description	Motivation	Scenario
1.	Create course	instructor creates a course in a learning platform,and manage the course necessities.	facilitating learning process by providing course	instructor create course in learning platform then arrange the parameters
2.	Material Publication	instructor provides material online	Facilitate learners to get resource and elaborated learning material	instructor uploads learning material file. Instructor provides links related to the teaching material.
3.	Initial meeting	first meeting at classroom between learner and instructor	to build first impression of the course	Course Introduction, rules and regulation of the course, initial information
4.	Face-to-face lecture	Face-to face meeting between learner and instructor at classroom	Utilizing face-to-face meeting for social skill, personality, and material exploration	instructor facilitates classroom activities
5.	Online lecture	learning through SCO (shareable content object) in learning platform	providing learners space for exploration and finding comprehensive basic information	instructor uploads SCO to learning platform, decides range of time, and notifies the time. Meanwhile Learners access learning platform and its SCO
6.	Forum	every course has its own forum	providing space for the learners and instructor to communicate one to another	instructor initiates forum. Instructor and learners together take parts in the forum.
7.	Test	Material assessment	assessing how far the learners understand the material	instructor uploads exercises in learning platform, notifies test time. Meanwhile the learners do the test.
8.	Announcement	announcing information related to the course in learning platform	centralizing information to allow the learners to access it easily	instructor puts in an announcement.
9.	Collecting assignment	learner can submit task files to learning platform	facilitating and centralizing task submission	
10.	Final Task Management	the form is Project-based learning. Learners can decide themselves, their own tubes work milestone, and instructor can control the steps of learner's work.	• Learner can be more independent by making their own team and deciding their own milestone • Lecturer can check the progress of each team and remind those who cannot keep the schedule they have created. • The final task can be more controllable, more centralize and more manageable.	• Lecturer give his first instruction • Learner forms teams • The formed team make learning contract. In the learning contract, there are targets which are created by the team (milestones) and task distribution among team and team member. Every milestones is a phase that must be done in accordance with learning contract. • If a milestone has been done, the team publishes its result and mark the milestone. And they can carry out the next milestone. • Lecturer verifies the progress of each team.
11.	Interactive quiz	interactive assessment form. Using games to ask question	making learners interested in the quiz	instructors upload the questions/ problems, learner plays the games
12.	Assessment	scoring process by an instructor	deciding learner achievement	Referring to scores of test and other components, an instructor can decide the score of each learner's achievement.
13.	Grade Publication	students' achievements published so that the students can see their own score.	making learners know their own score/ achievements	instructor publishes score, the learners access it.
14.	Feedback	collecting feedback to evaluate course.	creating input for evaluation and consideration for holding other courses	instructor uploads feedback questionnaires, learner answers.

3.2. Testing Plan

The planning in this system testing as follows:
a. Give a presentation in class about the Mixtio LMS and BLESS
b. Give a guidance about the system has been design
c. Run a system testing by repondents (students of informatics extension program)
d. Respondents answer the questionnaire

3.3. Analysis of Test Results

Mixtio has been tested by the students of Informatics extension program. Then, questionnaires are distributed to measure usability of Mixtio and to determine whether there are significant difference between usability of Mixtio and conventional learning. The data from questionnaires are analyzed by using Wilcoxon signed rank test. Wilcoxon Signed-rank is a non-parametric test that is useful for testing whether a significant difference exists between state one and the second. The cases are two related samples, or repeated measurements in the same sample. This test is also a refinement of the sign test (t-test) [30].The aim of this test is to measure whether there is a significant increase between the existing lecture system usability and blended learning system that used BLESS. The results are as follows:

From Table 2, it can be seen that all values of Z is more than critical value Z in α=0.05 (Z α=1.960). Therefore, all the hypotheses (H1, H2, H3) are rejected. It means that there are statistically significant difference between Mixtio and conventional learning. H1 rejected means there is significant difference between the effectiveness of Mixtio and conventional learning. The items with most enhancement are easy to get learning materials and freedom of learning. It is in line with BLESS principles to give students freedom in learning and to optimize use of IT.

Table 2. Hyphotesis Result

Hypothesis	Z	P	Result
H1: there is no significant changes on the effectiveness between the available learning system and blended learning system BLESS.	2.794	0.005	H1 rejected
H2: there is no significant changes on the efficiency between the available learning system and blended learning system BLESS.	2.486	0.013	H2 rejected
H3: there is no significant changes on the satisfaction between the available learning system and blended learning system BLESS.	3.169	0.002	H3 rejected

H2 rejected means there is significant difference between the efficiency of Mixtio and conventional learning. The item with most enhancement is time management. This is consistent with the objective of BLESS to optimize use of IT. H3 rejected means there is significant difference between the satisfaction of Mixtio and conventional learning. The item with most enhancement is satisfaction towards features provided. It means that the patterns designed is suitable for learning activities in extension program.

Because there are significant changes to the three usability parameters, it can be said that there is also a significant change in the usability of the BLESS blended learning system. In other words, the usability of BLESS's blended learning system is higher than the existing lecture system.

4. Conclusion

With refer to the study conducted on the implementation of BLESS on Mixtio, some conclusion can be withdrawn: a) The implementation of BLESS to optimize learning in extension program is carried out by adding pattern management tubes and interactive quiz to Mixtio; b) The implementation of BLESS on Mixtio can improve system usability; c) The students know the strength of Mixtio and feel that Mixtio is helping them study better.

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