Online Learning Design At Higher Education: An Example From Mathematics Classroom

A Lubis*, A Ritonga, Y Hia, A A Nasution
Department of Mathematics, Universitas Negeri Medan, Jl. Willem Iskandar, Pasar V, Medan, 20221, North Sumatera, Indonesia

* asrinlubis@gmail.com

Abstract. The rapid increase of technological consumption in many aspects has left educational institutions a great demand to apply it, including higher education. At higher education, the lecturers generally undertake the teaching and learning process out of class. In this case, one possible approach to facilitate this distant learning is through virtual classroom (online learning). The potential use of online learning rises the needs towards how it should be designed. Thus, this paper attempts to discuss about designing online learning that can help enhance student learning and make them engage with the content. An example of classroom implementation was depicted from Mathematics course. The data were collected through an analysis of developmental study conducted at two Indonesian universities. The results of this study indicate that there are four main concerns in designing constructive online learning (1) course arrangement; (2) content appearance; (3) collaborative and interactive; and (4) well-timed response.

1. Introduction

The internet has a great potential in learning, both as a source of learning media and supporting the management of teaching and learning process [3]. Effective learning activities require a media that supports the absorption of various informations as much as possible, along with the development, information technology plays an important role as a means to obtain information sources related to the subject matter being taught [4]. This technology has emerged as a multi media function. In this case, the communication can be conducted personally, such as e-mail and chat or known as one-to-many communications such as mailing lists. The internet is also able to be present in real time like the conventional method with the teleconference application.

Based on this phenomenon, the internet can be assumed as a teaching media since it has unique characteristics, such as interpersonal and mass media, interactive, and enables synchronous or asynchronous or delayed communication, and with these characteristics allows students to be able to communicate with wider sources of knowledge, when compared using conventional media [2].Utilizing communication and information technology in the world of education, namely in schools, is an effort to improve the quality of education in Indonesia, by utilizing teaching materials that are packaged in the form of media based on Information and Communication Technology, such as e-learning. E-learning is a learning media based on Information and Communication Technology and its use has not been widely developed and utilized in Indonesia.

Therefore, the aim of this paper is to identify important components to be included in the design e-learning or online courses to enhance a student learning. Efforts to develop and utilize the internet are always carried out, including implementing e-learning, where with e-learning a teacher can create and
implement an interactive learning, and e-learning implementation can be used in the form of online learning or with blended learning.

2. Theoretical Framework

2.1. What is online learning?
Basically, online learning has a wide scope of meaning. E-Learning is short for electronic learning, which has the meaning of learning by using electronics, while the understanding of electronics is computer or internet. According to [3], online learning refers to the courses delivered partially or fully online, in a synchronous or asynchronous manner. Meanwhile, [7] stated that e-learning refers to the use of internet technology to deliver a series of solutions that can enhance knowledge and skills. In short, the meaning of online is a learning media that can be used to deliver solutions, to provide information, assess and facilitate a teaching and learning process where students as a center of learning and carried out interactively.

In this case, the situation of online learning is distinctive from the regular classrooms in which teaching process is mostly conducted through classroom interaction. However, students and lecturers may never meet in online learning environment. It is important to notify that online learning offers effective delivery that traditional method.

2.2. The use of online learning in teaching process
Although advances in technology have had a major impact, including the world of education, but the use of electronic learning resources or e-learning modules still needs attention. This is due to the still not optimal use of ICT / IT in the learning process and also the lack of discrete Mathematics e-learning books in Indonesian. This also relates to differences in student characteristics such as intelligence, talent, learning ability, and so forth. For this reason, an interactive module is needed that can be used by all students to reach and master study material according to the time provided, for example per semester.

The interactive module in this study is defined as a learning module that is equipped with a controller that can be operated by the user, so that the user can choose what he wants for the next process. The focus of this paper is on the development of interactive modules for Mathematics courses. In terms of designing and producing interactive modules, there are things that must be considered in the module as criteria for assessing the interactive module program [9] which is described as follows:
1. Ease of navigation - A program must be designed as simple as possible.
2. Cognition content - The content of the program content must provide the cognitive experience (knowledge) needed by students.
3. Media integration - Media must integrate several aspects and other skills that must be learned. Such as language skills, listening, speaking, writing and reading.
4. Aesthetics - To attract media learners must have an artistic appearance.
5. Overall function - The program developed must provide learning to students so that when a student finishes running a program he will feel that he has learned something.

2.3. Multimedia as Interactive Learning
Interactive multimedia is a multimedia that is equipped with a controller that can be operated by the user, so users can choose what they want for the next process. Example: interactive multimedia is interactive learning, game applications. Whereas learning is defined as the process of creating an environment that enables the learning process. The use of computers for learning activities, lately more and more utilized by the world of education. This shows the computer media is very possible for a more effective teaching and learning process. This happens because nature and characteristics of the computer are quite typical.

The forms of utilizing interactive computer-based multimedia models in learning can be in the form of drills, tutorials, simulations, and games. Basically, one of the objectives of learning with interactive multimedia is as far as possible and or complementing and supporting the elements: objectives,
materials, methods and assessment tools that exist in the teaching and learning process in conventional education systems that are commonly done [5].

3. Methodology

3.1. Research Sample
This study was conducted at two different universities, which is Unimed and UMSU. About 35 mathematics students from these universities were involved during conducting this study.

3.2. Data Collection
Important use of online course has potentially raised in digital circumstances. By the increasing demands of online learning application, many researchers question about “what we should consider in order to design online courses?”. In order to answer the research question, we collected two types of data. The data were collected from discrete mathematics classroom and some data were gathered from literature study. About 17 articles from peer-reviewed journals were studied. In this case, the literature study was aimed to acquire information about the use of online learning in classroom experience. The results of theoretical discussions were adjusted with the actual online-learning interface whether the design meets the requirements or there may be some parts of the media needs to be fixed. The actual online learning was designed to cope with the demands in teaching mathematics at university. The results of this study are expected to give the contribution to the development of online learning at university.

4. Results and Discussions

4.1. Results
In order to answer the main question of this study, we conducted literature study in the first place. The analysis was made through reviewing recent studies in the field of designing online learning in teaching process. In this case, about 18 articles from peer-reviewed journals were studied in the domain of designing e-learning and online learning. Based on the literatures, four main components emerged from the discussion [8], such as:

4.1.1. Structure and security
In designing e-learning, a lecturer needs to consider carefully the design of the online learning system [1]. The look of an online learning should include important elements, such as course announcement or reminders from the lecturer, course information which include the syllabus, timetables, outlines, grading and assignments. Some experts (such as [6]; [10] argued that an online learning also should have clear rubrics and several instances of instructions to finish them.

In relation to this study, we have built an electronic learning by considering the above conditions. The interface looks like figure 1 below.
Figure 1. Interface of E-Learning

Based on Figure 1, it can be seen that the e-learning has different menus, such as course contract, announcement, Assignments and Scoring. Course contract contains the information about the syllabus, scoring system and what the students must do during the teaching and learning process. Announcement menu was designed in order to make the students easy contact the instructor. In this case, they can post questions towards the teaching and learning process. Assignment contains the tasks that must be discussed by the students. The students can see their score assignments in the scoring menu.

Based on this explanation, the features can support lecturers to conduct online learning, especially in discrete mathematics classroom. The contents were designed such as there are interactions between the lecturer and the students and among the students. This e-learning also has security to keep the content safe. Thus, in order to enter the e-learning system, they need to register themselves before entering the e-learning.

4.1.2. Content Presentation

Online learning that can be implemented in classroom experience must contain clear contents that can support the students in their learning process. Providing the students with choice of contents and activities allow them explore and play with the learning media. In this study, we also consider about providing contents and problems for each of it. The content includes discrete mathematics topics, such as:

1. Mathematical proof methods
2. Basic structure of discrete objects
3. Basic principals of counting
4. The principal of inclusion-exclusion
5. Recursion
6. Recurrence relation
7. Generating function

The above description used in designing e-learning of this study. In this case, it can be explicitly seen in Figure 2 below.
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Figure 2. Content Presentation in e-learning

Based on Figure 2, the e-learning was designed with contents which are integrated in the discrete topics. Each sub-menu of the mathematics topics consist of contents and descriptions of the contents. The presentation of contents is intended to support the students in the learning process and let them explore the learning media such that they get use to operate features provided in the e-learning.

4.1.3. Collaboration and interaction
These two keywords are the core elements in designing e-learning in classroom activities. The online learning features must be able to allow interactions among the students. This interaction can be possible facilitated through the special menus, such as: discussion forum, chat and email. In designing e-learning an instructor should consider about how the students can connect with the lecturer and their friends. Thus, the e-learning should include some features, such as chat, comment or virtual classroom, that can facilitate these issues. In designing the e-learning, we fully consider about this condition in such a way the students can build communications with the lecturer and friends. The outlook of the feature can be obviously seen in Figure 3 below.

Figure 3. Discussion Forum
4.1.4. Well-time response
Based on the literature, the last part of the conversation lies on the presentation of well-timed response provided in e-learning. This feature will allow the students reflect on their works during the teaching and learning process. In this case, they can see the work reviewed by the lecturer. These features also possibly includes how the lecturer grade the students' work and also scoring rubrics for the students' works.

In relation to our study, we fully consider about including this issue in our online learning. In our online learning, the students can see how the lecturer grades their works. In this case, the lecturer puts the scoring in the system so that the students can reflect on the rubric in finishing the assignments.

5. Conclusion
After conducting this study, we do believe that it takes time to design online learning (e-learning based on the students' need, including discrete mathematics. The online learning aims to support students to learn and to develop their thinking. In this case, we are attempting to discover what should be concerned in designing online learning and we also provide some examples of online learning that we had created.

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6. References
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