DESIGN OF E-LEARNING INFRASTRUCTURE TECHNOLOGY TO SUPPORT LEARNING WITH COMPETENCY-BASED CURRICULUM

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Abstract
E-learning has been widely applied in many colleges. To support distance learning requires a reliable information technology infrastructure, so that the learning process can take place properly and competence is expected to be achieved. The use of Moodle that is now in favor of learning has not been fully able to support the learning system with a competency-based curriculum (CBC). To support the CBC still needed a system that could not only emphasizes the mastery of the material, but also on the activity, the characters and the learning process of students who continuously. The method used in this study is action research aimed at finding an effective way that produces a deliberate change in an environment that is partially controlled, with the stages of analysis, design, prototype manufacture, testing and evaluation of this writing only reached the design stage. The resulting design is a model DLMS which is a merger of two DMS and LMS applications to meet the needs of the implementation of curriculum-based teaching and learning process.

Keywords: e-learning, competency-based curriculum, Moodle, LMS, DMS

INTRODUCTION
Learning with e-learning using technology as a means of learning should not be expensive and difficult. In the application of the technology used applications that can be directly applied easily and does not require a lot of expenses (nearly free). In the use of technology or application that is not paid, would approach common functions that many people use. It represents the excess once the application deficiencies. To customize the application with the required need to be modified by adding or subtracting the application content or combine several applications to fulfill the needs of the organization.

E-learning has been widely applied in many colleges. The Indonesian government has given the green light for the implementation of this system with the issuance of Regulation of the Minister of Education and Culture No.24 Year 2012 on the delivery of Distance Education in Higher Education. As stated in the Ministerial Regulation, Distance Learning is education that their students apart from educators and learning using a variety of learning resources through information technology and communications and other media.

To support distance learning requires a reliable information technology infrastructure, so that the learning process can take place properly and competence is expected to be achieved. Many factors key to success of e-learning based on the Quality Standard ISO/IEC 19796-1, one of which is "ICT tools should support management (measures and indicators)" (Pawlowski, 2007).

Virtual Learning Environment (VLE) or often called as Learning Management System (LMS) that is widely used today are using Moodle LMS. "Moodle is a learning platform designed to provide educators, administrators and
learners with a single robust, secure and integrated system to create personalized learning environments” (‘About Moodle’, 2015). With Moodle, e-learning can be done by using study materials, quizzes and evaluation. According to Aslam Moodle is not (yet) have supporting facilities Learning Model (*Student Center and Based on Process*) (Aslam, nd) and based on observation and experience of researchers over the years, there are facilities that are not available on the LMS as recording facility learning process learners the involvement of learners in existing learning.

The use of Moodle that is now in favor of learning has not been fully able to support the learning system with a curriculum based on competency. To support the CBC still needed a system that could not only emphasizes the mastery of the material, but also on the activity, the characters and the learning process of students who continuously.

This article contains the idea of a model that will be used (applied) to online learning tools that support competency-based curriculum that has the characteristics of student-centered (*Student Learning Center*). This article will be described and explained:

- Comparing learning system that uses a competency-based curriculum (KBK) with features and modules that exist in Moodle;
- Designing a learning model that can support the CBC using LMS and DMS.

This article is limited to the design model to be applied in Perbanas Institute, especially in Faculty of Information Technology. The model is the learning model that can support the CBC invitation Moodle learning (*Learning Management System/LMS*) and Document Management System (DMS), particularly in terms of the capability of recording the activity of learners in teaching and learning activities.

**METHODOLOGY**

The method used in this research is the *action research*. According Gurito et al., (2010), *Action research* is a form of applied research (applied research) which aims to find an effective way that produces a deliberate change in an environment that is partially controlled (controlled). The main objective *research action* is entering a situation, make changes, and monitor the results (Guritno & Rahardja, 2011). The data used in this research is the source of primary data and secondary data sources. The primary data source is the administrator of e-learning and document management, secondary data source is in the form of documents available related to e-learning, document management and teaching.

Stages of the research conducted as in Figure 1. In this research stages starting from requirements analysis, design a prototype that will be created, and then build a prototype. Once the prototype is made will be tested which will then be evaluated.
Analysis
Analysis was done by viewing and comparing models LMS and DMS that has been there look at the services provided, while also learning rules and standards, which must be observed by the providers of education, competency-based curriculum.

Design
At this stage designer for the manufacture of e-learning Instructional Model mapping function in the LMS with learning model CBC.

Manufacture Prototype
Make a model or prototype e-learning by using LMS and DMS.

Testing
The model will be tested at the Faculty of Information Technology Perbanas.

Evaluation
Evaluation/testing results of the test will be analyzed with a questionnaire.

DISCUSSION

E-Learning
Horton, William in his book entitled E-learning by Design define "E-learning is the use of electronic technologies to create learning experiences". Several variations of e-learning (Horton, 2012):

- Standalones courses;
- Learning games and simulations;
- Mobile learning;
- Social Learning;
- Virtual-classroom courses.

Competency-Based Curriculum (CBC)
According Kepmendiknas No. 232/U/2000 curriculum is defined as follows: "Higher education curriculum is a set of plans and arrangements regarding the content and study materials and lessons as well as the delivery and assessment used as guidelines for the organization of teaching and learning in higher education" (Sub Direktorat KPS (Kurikulum dan Program Studi), 2008).
In **MANUAL COMPETENCE-BASED CURRICULUM DEVELOPMENT OF HIGHER EDUCATION** (An alternative curriculum development) are arranged Sub Directorate of Curriculum and Program, Academic Directorate of the Directorate General of Higher Education states that the curriculum is a program developed and implemented to achieve a goal of education. In the form of program documents and implementation of programs.

**Learning in CBC**

CBC demand changes during the learning process that this has been done is *Teacher-Centered Content-Oriented* (TCCO) to *Student-Centered Learning* (SCL). Learning Process TCCO causing educator’s function as a facilitator or motivator.

![Student Centered Learning Schema](image)

**Figure 2**: Student Centered Learning Schema (Sub Direktorat KPS (Kurikulum dan Program Studi), 2008).

SCL learning method has the following characteristics: (Sub Directorate of KPS (Curriculum and Program Studies), 2008).

1. Students actively develop the knowledge and skills learned (SCL1);
2. Students are actively involved in managing knowledge (SCL2);
3. Not only emphasizes the mastery of the material but also in developing student character (life-long learning) (SCL3);
4. Utilizing many of the media (multimedia) (SCL4);
5. Functions as a facilitator and lecturer evaluations conducted together with students (SCL5);
6. The process of mutual learning and assessment conducted continuous and integrated (SCL6);
7. The emphasis on knowledge building. Error is considered to be a source of learning (SCL7);
8. According to the development of science by means of an interdisciplinary approach (SCL8);
9. Climate developed a more collaborative, supportive and cooperative (SCL9).
10. Students and professors learn together in developing the knowledge, concepts and skills. Students can learn not only from lectures but could also be used in various ways and activities (SCL10);
11. Emphasis on achieving competence of learners and not the completion of the material. The emphasis on how students can learn to use a variety of teaching
materials, methods, interdisciplinary emphasis on problem-based learning and skill competency (SCL1).

In the learning process of SCL, lecturers still have a role:

1. Acting as a facilitator and motivator in learning (DosenSCL1);
2. Assessing the competence of the subjects that need to be mastered at the end of the lesson students (DosenSCL2);
3. Designing strategies and learning environments by providing a variety of learning experiences necessary in order to achieve competence students charged in the course of teaching (DosenSCL3);
4. Helping students to access, organize and process information to be used in solving real problems (DosenSCL4);
5. Identify and determine the pattern of assessment of student learning outcomes that are relevant to its competence (DosenSCL5).

The role to be performed by students in learning SCL is: (Sub Directorate of KPS (Curriculum and Program Studies), 2008)

1. Assessing the competence of the subjects that presented lecturer (student of SCL1);
2. Assessing learning strategies that offered by lecturers (student of SCL2);
3. The lesson plan for the course that followed (student of SCL3);
4. Learn actively (by way of listening, reading, writing, discussions, and engage in problem solving and more importantly involved in high-level thinking activities such as analysis, synthesis and evaluation), both individually and collectively (student of SCL4);
5. Optimizing her abilities (student of SCL5).

Learning methods to support the SCL: (1) Small Group Discussion; (2) Role-Play & Simulation; (3) Case Study; (4) Discovery Learning (DL); (5) Self-Directed Learning (SDL); (6) Cooperative Learning (CL); (7) Collaborative Learning (CBL); (8) Contextual Instruction (CI); (9) Project Based Learning (PPA); and (10) Inquiry and Problem Based Learning (PBL) and many other learning model that can be used, as well as any teacher can develop their own learning models.

Learning Management System (LMS)

"A Learning Management System is the "great enable" of many current and future education initiatives, such as personalized learning, learner-centered decision making, staff productivity and curriculum development in support of the Common Core State Standards." (Phillipo & Kongrad, 2012)

Learning organizations require a LMS that is easy to access, easy to use and supports the primary mission of the organization by:

- Generate accurate, reliable and timely information about student performance to realize the process of education and personalized learning;
- Increase the involvement of parents by increasing access to relevant information and updates on the educational experience of students;
- Empower students with the resources needed to assume an active role in, and accept responsibility for their educational experience;
- Provide staff with the opportunity to work together and are interdependent to
improve communication cross curricular, improve productivity, and increase accountability;

- Linking staff development programs and evaluation/supervision of student learning and achievement in a comprehensive, nuanced attitude;
- Connect a standard for learning programs and assessment strategies through virtual alignment tool;
- Identify gaps and misalignment in learning programs, such as the adequacy of instructional resources, assessment items, and/or proficiency of staff, with the test program;
- Allow community members of all ages to participate more fully in the learning process through the use of online tools.

![Figure 3: LMS Conceptual Model](image)

A lot of LMS or VLE has been used by various organizations or personal with advantages and disadvantages. Figure 4 shows a comparison of some of them. Based on research Ajlan, 2012, which compares 10 sorts VLE basis of the features and capabilities as well as technical aspects of the system, Moodle VLE is the best.
Moodle

Moodle is a Virtual Learning Environment (VLE) which is widely used around the world by schools, institutes, universities, companies, freelance teachers and parents "home schooling". Moodle also has great potential to draw on the experiences of e-learning success by providing many excellent tool that can be used to enhance learning conventional classes in the system VLE that has scaled up from one site teacher for more than 50-thousand-student (O’Donnell, Hmelo-Silver, & Erkens, 2013). Moodle, is free applications (open source software) licensed under the GNU (General Public License) is an online Learning Management system that can help teachers create a personal website that can be filled with material that dynamic(dynamic courses) which enables learning anytime and anywhere.

Everyone can adapt, develop or modify Moodle either for commercial or non-commercial. MOODLE provide a complete software package (MOODLE + Apache + MySQL + PHP) which can be downloaded at http://download.moodle.org/ The Moodle features is:

1) General Features: Modern, easy to use interface, Personalized Dashboard, Collaborative tools and activities, All-in-one calendar, file management Convenient, Simple and intuitive text editor, Notifications, Track progress,
2) Administrative Features: Customizable site design and layout, Secure authentication and mass enrollment, Multilingual capability, Bulk course creation and easy backup, Manage user roles and permissions, Supports open standards, high interoperability, Simple add-ons and plug-in management, Regular security updates, Detailed reporting and logs, detailed reporting and logs
3) Course Development and Management Features: Direct learning paths, Encourage collaboration, Embed external resources, Multimedia Integration, Group management, workflow Marking, In-line marking, Peer and self assessment, Integrated Badges, Outcomes and rubrics, Security and privacy

User or Moodle users can be divided into multiple roles (roles), as in Table 1. Activities of learning to or facilitated by Moodle are as varied as in Table 2 that support the learning process.
Table 1: Standard Roles

<table>
<thead>
<tr>
<th>Role name</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>site administrator</td>
<td>Can do &quot;anything&quot; at LMS</td>
</tr>
<tr>
<td>Manager</td>
<td>More bit of the site administrator</td>
</tr>
<tr>
<td>Course Creator</td>
<td>Creating classes (courses)</td>
</tr>
<tr>
<td>Teacher</td>
<td>Manage and add the contents of the class</td>
</tr>
<tr>
<td>Non-editing teacher</td>
<td>Scoring but can not edit</td>
</tr>
<tr>
<td>Student</td>
<td>Can view and participate in classroom</td>
</tr>
<tr>
<td>guest</td>
<td>Can be viewed but not can participate in classroom</td>
</tr>
<tr>
<td>authenticated user</td>
<td>All users who log on and see the front page</td>
</tr>
</tbody>
</table>

Document Management System (DMS)

Alfresco is a hybrid cloud enterprise content management platform that manages and synchronize content in the cloud and on-premises repository. Mobile platform and application integration allows users to collaborate anywhere. Alfresco provides the ability to search in customized that connect users to files, websites and relevant people. Integrated analytical search by looking for content and interactions and help identify assets. Average build more than 100 million documents and serve thousands of users (Brooks, 24, & EST, 2016).

Table 2: Table learning activity in Moodle

<table>
<thead>
<tr>
<th>Activity</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignments</td>
<td>Enable teachers to grade and give comments on uploaded files and assignments created on and off line</td>
</tr>
<tr>
<td>chat</td>
<td>Allows of participants to have a real-time synchronous discussion</td>
</tr>
<tr>
<td>Choice</td>
<td>A teacher Asks a question and specifies a choice of multiple responses</td>
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<tr>
<td>database</td>
<td>Enables of participants to create, maintain and search a bank of record entries</td>
</tr>
<tr>
<td>external tool</td>
<td>Allows of participants to interaction with LTI compliant learning resources and activities on other web sites.</td>
</tr>
<tr>
<td>feedback</td>
<td>For creating and conducting surveys to collect feedback</td>
</tr>
<tr>
<td>Forum</td>
<td>Allows of participants to have asynchronous discussions</td>
</tr>
<tr>
<td>glossary</td>
<td>Enables of participants to create and maintain a list of definitions, like a dictionary</td>
</tr>
<tr>
<td>Lesson</td>
<td>For delivering content in flexible ways</td>
</tr>
<tr>
<td>Quiz</td>
<td>Allows the teacher to design and set quiz tests, the which may be automatically marked and feedback and/or to correct answers shown</td>
</tr>
<tr>
<td>SCORM</td>
<td>Enables SCORM packages to be included as course content</td>
</tr>
<tr>
<td>survey</td>
<td>For gathering the data from students to help teachers learn about Reviews their class and reflect on their own teaching</td>
</tr>
<tr>
<td>wiki</td>
<td>A collection of web pages that anyone can add to or edit</td>
</tr>
<tr>
<td>workshop</td>
<td>Enables peer assessment</td>
</tr>
</tbody>
</table>
Alfresco which has existed since 2005 helps the entire organization to share (share), set (manage) and maintain content for the entire organization with ease. Alfresco is being implemented in more than 180 countries can collaborating become more effectively, improve business processes become more efficient and ensure information governance.

Alfresco is one powerful enterprise content platform. Alfresco can fully manage all types of content from simple office documents to scan images, photographs, engineering drawings and video files are huge. One built-in Alfresco enables companies to automate document business processes, increase efficiency and accuracy. One collaboration of Alfresco enables secure collaboration, within or even outside the firewall

Research of James R. Bennett, James Lane, Ge Wang, gives an overview of the important functions that can be implemented using Alfresco (R. Bennett, Lane, & Ge, 2013):

1. Repositories on Alfresco facilitating
   - Upload, download, search, organize, update, comment, delete, move, or copy a file or folder on computer or mobile device, almost the same as the solutions provided by the product/similar commercial applications like DropBox or iCloud;
   - Can be accessed using several protocols: hypertext transfer protocol (HTTP), Web Distributed Authoring and Versioning (WebDAV), file transfer protocol (FTP), secure shell FTP (SFTP), content management interoperability services (CMIS) and many more, can be accessed with almost all web browser and display the attractive GUI in line with management tools and functionality searching;
   - All data and information sent via HTTP to be safe by adding TLS/SSL certificate for the Alfresco server to encrypt communications between the user as HTTPS (same security used by all retail/banking website);
   - WebDAV extension of the HTTP protocol has the same basic functions with the FTP with collaborative functions such as 'locking' and 'version control';
   - FTP, SFTP and all popular file protocols supported by Alfresco.
2. Index function seeking actively and extract all the text from a file including the compressed file (zip or rar). Indexing allows users to search for content from both internal and commercial search engines such as google or yahoo. A user can search and view content in accordance with the access that, it very useful for organizations that deal with content-sensitive/confidential.
3. Alfresco provides enterprise-class features user management is very increasing value and their role as the configuration of security rules specific user or using standard conditions recommended.
4. 'Knowledge management' tools, it is very important for the user to collaborate, share documents and knowledge.
5. Workflow management (WFM) is already in Alfresco, allowing content to be "progress" with a certain time and a combination of users and tasks, for example, "Review & Approve" workflow.
Alfresco have the open source applications to access content via mobile devices. (Android and iOS).

**CBC Learning mapping system with the features of Moodle**

Based on the requirements demanded by the learning system with CBC and modules provided by Moodle, such mapping obtained in Table 4, Table 5 and Table 6. Based on the mapping, it can be concluded that Moodle can support learning by competence-based curriculum. However, there are limitations on Moodle so that learning includes:

1. Moodle provides facilities activities that can encourage activity, but teaching students in this faculty is hard to see the liveliness of the students.
2. Workflow students for the task group (task management) of each member of the group can not monitored by Moodle.
3. Document management of student work is not managed properly.
4. Moodle gives no direct notification (via e-mail) to students or faculty if there is activity both teachers and students.

**Table 4:** Learning Method SCL and Features Applications Moodle

<table>
<thead>
<tr>
<th>ACTIVITY LEARNING SCL</th>
<th>Assignments</th>
<th>Chat</th>
<th>CHoice</th>
<th>dBASE</th>
<th>extranal tool</th>
<th>feedback</th>
<th>Forum</th>
<th>Glossary</th>
<th>Lesson</th>
<th>Quiz</th>
<th>SCORM</th>
<th>Survey</th>
<th>Workshop</th>
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<tbody>
<tr>
<td>SCL1</td>
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### Table 5: Role in Learning SCL lecturers and Features Applications Moodle

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>Learning SCL</th>
<th>Assignments</th>
<th>Chat</th>
<th>Database</th>
<th>External Tool</th>
<th>Feedback</th>
<th>Forum</th>
<th>Glossary</th>
<th>Lesson</th>
<th>Quiz</th>
<th>SCORM</th>
<th>Survey</th>
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### Table 6: Role of Students in Learning SCL and Features Applications Moodle

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>Learning SCL</th>
<th>Assignments</th>
<th>Chat</th>
<th>Database</th>
<th>External Tool</th>
<th>Feedback</th>
<th>Forum</th>
<th>Glossary</th>
<th>Lesson</th>
<th>Quiz</th>
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<tr>
<td>students SCL1</td>
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**E-Learning Model Design**

Limitations contained in the Moodle must be overcome by using other applications, which can overcome the existing limitations. Merging these two applications are expected to support learning by competence-based curriculum. After doing the research literature, collecting data and interviews with experts or managers of e-learning using Moodle as LMS, the existing limitations can be overcome with a document management system application, one of which is Alfresco. The model offered is a model DLMS, which consists of two parts:

1. **LMS as learning tool includes** providing material, evaluation, assessment, feedback, discussion, consultation
2. **DMS as a tool that function recording process and teaching activities**

   DMS on the exterior of the model, then the LMS application placed in. DMS has governance capabilities to its own function as well as other applications that are placed inside it, so with this model implementation process management that is in DMS easier. With this model, the purpose of "Learning Process Management" can be obtained on the basis of DMS applications more readily as do multi governance process. Part in the wake DMS, can be integrated in it with other applications in university, e.g. website, academic applications, courses and more.
DLMS developed to be implemented in terms of managerial (governance) as a means of technology used in the learning process focuses on "Student Center Learning".

Governance of operational e-Learning can be done via DMS as control centers, then the learning process can be run as expected with a focus on active learning (Student Learning Center). E-Learning Model in terms of managerial can be seen as a figure 5.

With this model, learning interaction between learner and teacher is not limited by the space in which it means that the learning process can be done anywhere, anytime by an individual or a group of students. Lecturer plays a role as a facilitator (and monitored) by the students' activities. Students do not continuous interaction. While the faculty has the ability to monitor student activity by receiving the information at any time about whom the students are accessed e-Learning. This monitoring is obtained from the recording and response systems owned DMS applications. These recordings in the form of a track record of student activities that supported the system response in the form of a notification email to the lecturer.

![Figure 5: Model of the e-Learning Process Governance](image)

**CONCLUSION**

Based on the above discussion it can be concluded that the LMS Moodle can not fully support the learning process that uses a competency-based curriculum (CBC), so it needs the additional support of other applications.

DLMS models developed is the result of combining two DMS and LMS applications to meet the needs of the implementation of curriculum-based teaching and learning process CBC. This compliance is obtained from e-Learning assessment where all participants receive notifications about activity that is happening on this model. The ability to do (send) this notification is an important part that is needed especially for the person in charge of the learning that educators in order to exercise control (monitoring) activities of students. By utilizing this model which will see students who are already running their own learning both reading, doing tasks even respond to the task given by educators.

However, further research is needed to evaluate the model, such as, model’s acceptance test so that this model can be applied and followed by a test of

**REFERENCES**


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