Development of Blended Learning Model Based on Project in Computer Network Design and Management

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Abstract. Entering the industrial era 4.0, the role of the world of education is very important in forming graduates who are competent and can compete in the business world. Graduates are required to have understanding and expertise / skills in their respective fields. Therefore learning activities must innovate in meeting the demands of the workplace. One of them is by utilizing technological advances in learning activities in the form of learning applications based on project tasks. With this project-based blended learning model, students are trained to complete a project designed according to the needs of the industry / company and can take advantage of learning applications as learning media. Lecturers can monitor the development of projects carried out by students through learning applications, besides that this application can be used by lecturers and students to discuss when problems are encountered during learning activities. The assessment activities are not only from mastering the material but also from student project assignments. By giving projects to students, it can train students' ability to solve problems and do simple designs on computer networks. This learning model was implemented at STMIK Indonesia Padang in the Computer Network Design and Management course. The development of this project-based Blended Learning model was carried out using the Borg and Gall development model. From the results of the development produced a learning syntax of project-based blended learning models.

1. Introduction
In Higher Education especially in Study Programs Information Systems Computer Network Design and Management courses become one of the compulsory subjects that are popular among students, because of the high demand of companies and industrial markets for people who have expertise in this field. Various studies were conducted with a focus on research to help students in computer network learning activities using various learning methods and tools [1]
In the Computer Network Design and Management course students are required to have competence in designing and designing complex computer networks [1]–[4]. The unavailability of labolium which can be used by students in simulating network design and management activities due to the high cost of tools and care that must be borne by Universities [5], [6]. Regarding the problem of the unavailability of laboratories that can be used by students in designing computer networks, a visual laboratory design (V-lab) is designed so that students can design and create simple visual networks [5]–[8].

In addition, students are expected to be able to build an understanding of network components and how they can be integrated to produce complete systems [2], [6], [9], [10]. On the other hand industry requires graduates who have the knowledge and ability to design networks in the real world [1]–[3]. Development of learning models using auxiliary media is also carried out by conducting learning activities using learning applications such as Packet Tracer [1], [8], [11], [12].

Students are also expected to be able to compromise with network users in this case the company or industry to produce a system that fits the user's needs and balance it with the company's targeted budget [3], the ability to analyze data and networks and control network flows [13] and able to keep abreast of network technology development [6]. Have practices that are able to connect the theory to the field [9], [11]. The Problem Based Learning learning model was also developed in increasing the motivation and enthusiasm of student learning, where the problems given and must be solved by students are expected to reduce and even eliminate students' boredom and boredom with the lecture learning model that has been applied [3], [9].

Based on the problems and solutions that have been carried out by previous researchers, the authors are interested in developing a learning model by combining learning activities by using application assistance and project assignments to students or also called project-based blended learning models. Project-based Blended Learning model was developed using the Bord and Gall method by performing 5 stages, namely product analysis, initial product development, expert validation and revision, field testing and implementation. The implementation of the Project Based Learning Blended Learning learning model is planned to be tested in the STMIK Indonesia Padang Information System study program in the Computer Network Design and Management course.

2. Method

2.1 Planning Phase

At this stage, information is first needed to develop the learning model. This information can be obtained from field studies to see the conditions of the learning activities that take place and literature study activities to obtain information and knowledge relating to the products to be designed.
2.2 Stage of Learning Model Design.
The next step is to design learning models of information that has been collected at the planning stage. After the analysis and needs of students and the learning model that are currently running and found weaknesses, a new learning model is designed that is expected to overcome learning problems. Then an analysis of learning materials, methods to be used, and learning media will be analyzed later to support the learning model that will be developer.

2.3 E-Learning Application Design Phase
The next step is to design and design E-learning applications that will be used in implementing the learning model. E-learning applications are made based on the needs and availability of facilities and infrastructure.

2.4 Validation and Product Testing Phase
The next step is to validate the product that has been designed. Validation is done through FGD (Focus Group Discussion) activities by presenting relevant experts in accordance with the field under study. In addition, content validation was also carried out by filling out the questionnaire that had been provided for the instructional materials produced. The results of this validation were then revised before implementation tests were carried out. From the results of trials in the field, revisions were made to refine the program so that the products produced could overcome learning problems.

2.5 Implementation Phase
If the model developed has been declared effective in testing in the field, the product is ready to be implemented.

3. Discussion and Result
3.1 Old Models
During this lecture activities are conducted traditionally with the lecture method. In the traditional learning model by using this lecture method the lecturer begins learning activities by presenting the lecture contract and the rules that will be followed during the lecture meeting. After that the lecturer will continue by giving a brief explanation of the material to be learned during the lecture and to distribute syllabi and modules to students so that they can be studied more deeply.

Furthermore, in the following meetings the lecturer will explain the material for the sake of the material in accordance with the syllabus and modules that have been distributed at the beginning of the lecture. Students can record the material explained by the lecturer. In this learning activity the lecturer will use power point media to explain the lecture material and present some pictures related to the lecture. Students are expected to be able to understand the theory explained and imagine the material with the help of the pictures given. To improve student knowledge, the lecturer will provide several assignments related to the material being studied.

A series of tests will be given to measure the extent to which students understand the subject matter given. Tests can be in the form of quizzes as well as midterms and final semester examinations. From this set of tests, the lecturer can evaluate each student and determine whether or not the objectives of the lecture are achieved or not.

3.2 Development of Project-Based Blended Learning Learning Models
According to Joyce & Weil, there are 5 (five) basic elements to develop a model, namely (1) syntax, namely operational learning steps, (2) social system, namely the atmosphere and norms that apply in learning, (3) principles of reaction is to describe how the teacher should look at treating and responding to students, (4) support system that is all means of material tools or learning environment that supports learning and (5) Instructional narturarant effect that is in the form of learning outcomes
obtained directly based on targeted goals (instructional effects) and learning outcomes that are beyond those targeted (nurturant effects).

3.2.1 Syntax

Table 2. Syntax of project-based blended learning model

| Week  | Syntax |
|-------|--------|
| Week 1 | Deliver the objectives of management learning and computer network design with project-based blended learning models, and how to use e-learning learning applications (Syntax 1) |
| Week 2-5 | Understanding the outline of lecture material and the use of e learning learning applications (Syntax 2) |
|        | Understanding of concepts and lecture material (Syntax 3) |
| Week 6 | A description of the project to be assigned (Syntax 4) |
| Week 7 | Distribution of work group projects and issuing assignments (Syntax 5) |
| Week 8-9 | Conduct a Summative Evaluation (Syntax 6) |
|         | Discussion and understanding of how to design and simulate networks using learning applications, as well as making business proposals (Syntax 7) |
|         | Initial project presentation (planning Activities) (Syntax 8) |
| Week 10-13 | Design and simulate the project network and prepare the final project report (Syntax 9) |
| Week 14-15 | Present project results / diagnostic tests (Syntax 10) |
| Week 16 | Conduct a Summative Evaluation (Syntax 11) |

Based on the table above, it can be seen the learning steps every week. Learning activities before the mid semester exam are activities in understanding the material and after the mid exam followed by student project task.

3.2.2 Social System

In this learning model lecturers and students get a proportional portion, where students are required to be active and creative in utilizing learning applications. On the other hand lecturers are also required to be active in exploring, guiding and providing direction and arguments related to student questions and statements. The full duplex communication model or multi-direction communication model is applied in this learning, and the learning communication model is not bound by time and space, because learning using this learning application can be carried out anytime and anywhere.

The visit to the company also requires students to be active in communication. The principles of communication remain highly upheld in this learning, such as vocational education, politeness, mutual respect, respect for others' opinions, not imposing opinions, and democratic. So that these characteristics will grow in students. The existence of a project that must be completed requires students to be creative in channeling their ideas so that they can complete the task / project well and on time.

3.2.3 The Principle of Reaction

The principle of reaction tells how educators react to students and how students respond to assignments given. In a project-based blended learning model, the principle of reaction that occurs is how the lecturer creates a conducive environment such as smooth communication without being hindered by time and place. Then proceed with social interaction, where between lecturers and students have understood the tasks and functions of each in this learning model. Furthermore, between
students and the company there is also a principle of reaction about how students respond to requests and problems raised by the company related to computer network problems (project tasks).

3.2.4 Supporting System

- Internet Internet Network and Bandwidth. Internet network and adequate bandwidth are the main supporting factors in this learning.
- Handbook. There are 4 (four) books which are references used in the implementation of Project-Based Blended Learning learning models that can be used. Book I is a Project Based Blended Learning model book, which provides guidance on how to use the Project-Based Blended Learning model. Book II is a module book that contains learning material that has been adjusted to the Semester Learning Plan (RPS) and lecture syllabus. Book III is a Semester Learning Plan (RPS) book which is a guide in one semester of learning activities. Book IV is a guidebook for the use of learning applications in learning.
- Learning Tools. Learning tools that support the implementation of Project-Based Blended Learning are RPS, syllabus, reference books.
- Readiness of Educators and Students. In addition to the pedagogical competencies that must be possessed by a lecturer, also must have the ability or skill in planning, utilizing and using learning applications that are supported by technological readiness such as computers / laptops. Likewise with students, of course, must be in a state ready to receive learning. Prepared here means students have been able to with all facilities to take part in learning, such as computer / laptop and adequate internet connection.
- College Support in facilitating cooperation with the Company. There are several companies that are willing to work together in terms of accepting students to practice and analyze the company. In addition, the College supports and gives permission to carry out this activity by issuing a Letter of Assignment and a Letter of Introduction to the company.

3.2.5 The Direct Impact and Accompaniment Impacts

The direct impact is in the form of students gaining knowledge and knowledge about the material in accordance with the learning objectives. In addition, students get experience about problems in the field / world of work that can be used as a provision later in entering the workforce. Whereas the indirect impact of the project-based Blended Learning model is to cultivate and foster noble values such as honesty, mutual respect, being able to listen, be polite and be able to increase motivation, creativity and discipline.

5. Conclusion

5.1 Conclusion

Based on the description described above, conclusions can be drawn as follows:

- The application of this project-based Blended Learning learning model can train students to learn independently because learning takes place anytime and anywhere without being limited by time and space.
- With the application of this learning model students will be equipped with a great experience of completing a task / project that is their responsibility and working together in completing the project and the obstacles faced. Students will have experience interacting with the company in solving problems related to the project to be completed.
5.2 Suggestion

- 1. The institution leader (Chancellor / Chair / Director / Head) is expected to make information technology such as learning applications a policy priority to be used in learning given the advantages of the project-based Blended Learning learning model.
- 2. Lecturers / teachers / educators can utilize project-based Blended Learning models in learning and to always innovate in using information technology products in learning in order to optimize resources and potential so that learning objectives can be obtained more optimally.

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