Cooperative Project Based Learning Models in Programming Languages: A Proposed

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Cooperative Project Based Learning Models in Programming Languages: A Proposed

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Abstract

This study aims to Analyze the learning process in programming language courses to get information about the needs of lecturers and students as well as expectations in programming language learning. Analyze the need to develop project-based learning models and cooperative-based learning. The research method used was a survey method. Data were collected using questionnaires, interviews, and observations. The research sample was Bachelor of Information Systems Study Program students and lecturers at the Faculty of Computer Science, Universitas Putra Indonesia YPTK Padang. The results of this study obtained the level of mastery of pedagogical competencies of current students and the types of learning styles of each student that describe the characteristics of their learning styles. Then, the model used in the development of learning planning is a learning model that can learn students according to student learning styles to create student activity in learning, critical thinking, creative, communicative, and collaborative by the demands of 21st-century learning equipped with quality model books and lecturer manuals that are expected to be able to improve student competencies in accordance with the learning outcomes to be achieved.

Keywords: *Need Analysis, Cooperative Learning; Project-Based Learning, 21st-century learning, faster*

1. Introduction

The development of technology and information and communication in the 21st century demands a change in the educational process because most of the work normally done by humans at this time has been carried out by machines with increasingly sophisticated technology [1]. These changes have resulted in every country in the world must be able to transform the educational process to knowledge based on the utilization and development of technology in the 21s`t century. Progress in Technology and Information inevitably also changes the patterns of people's lives that are increasingly complex and completely new. Mindset, mental attitude, and behavior patterns are strongly influenced by the environment in which they live [2]–[4]. Those who live in urban areas with easy communication networks will also easily adapt to their times. Still, people who live on the periphery are reached by modern means of communication.

The shift of the 21st-century learning paradigm that has the characteristics of learning includes learning in free space, being independent and collaborating, learning with digital materials, learning to use information technology, and electronic communication media resulting in the need for balancing in educational and learning programs [5]. This is done to balance the conditions and challenges of the 21st century, including paradigms and challenges in the world of work that are full of unlimited business competition, doing business by collaborating and forming networks, doing business by selling ideas and doing business by utilizing digital media.

The 21st century, known as the century of openness, has fundamentally shifted the order of human life. This has resulted in demands for the quality of human resources who have competitive competencies that are in harmony with the spirit of entrepreneurship as a superior character that is highlighted to be able to become a strong, resilient and characterized person so that they are able to compete in the era of globalization [6]. Therefore the learning process carried out should refer to the preparation of learning outcomes that have the competencies needed to compete in the 21st century.

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Higher Education, as the highest educational unit that has a strategic role in providing quality human resources has the responsibility to solve the 21st century's competency challenges [7]–[9]. Through the education process in higher education institutions which are obliged to organize education professionally through the learning process, they must innovate through developments that aim to create learning outputs that are ready for the challenges of the 21st century. Thus, a breakthrough in the learning process is needed to shape people with mindsets 21st century is the task of education and the parties involved in the education process. This breakthrough and innovation are a must so that the quality of higher education graduates is not oppressed by the changes and developments of the times.

Based on the 21st-century learning framework developed by business communication, education and policymakers in America require students to have skills, knowledge, and abilities in the fields of technology, media, and information, learning, and innovation skills as well as life and career skills, this implies that learners can master a skill as well as the process of producing, synthesizing and evaluating information from a variety of subjects and sources of understanding [10]. Students must demonstrate the ability of Reading, Writing, and Arithmetic and 4C, namely Communication, Collaboration, Critical Thinking, and Creativity [11], [12]. Besides, there are also competencies in mastering digital literacy by being able to utilize information and communication technology to improve the ability and daily performance, to be independent in learning activities and the ability to use communication media to be able to collaborate in activities easily.

Learning models that fit the needs of the 21st century will only be realized if there are shifts in thought patterns, mental patterns, and patterns of action in various contexts of the implementation of education and learning processes [13], [14]. To become a visionary and future-oriented educator, what must be understood is: changes in student conditions; student views; student profile in the future; the student needs to adapt to change; selection of suitable learning models and methods; the selection and procurement of learning evaluation tools that are appropriate to the needs and contextual; creating supportive learning conditions; and the quality of educators that is constantly being updated.

The development of technology has changed the procedure of human life in terms of behavior, social attitudes, and even actions taken in daily activities. Various organizations are also competing to renew their human resources in dealing with this problem. The shift in organizational needs to the use of technology forces people indirectly to adapt the use of technology to meet their needs with the aim that it can be used more practically and efficiently. Research conducted by Achim and Kasim [15] shows that changes in computer technology recommend the need for training for every employee working in an organization because without increasing knowledge of human resources, the organization will find it difficult to face challenges and competition.

To prepare human resources in facing challenges in the 21st century, education graduates must be equipped with various types of expertise that can enable them to compete and win competitions. The research of van Laar et al. [16], [17] found that there are seven core skills and five contextual skills that humans must master in the 21st century. The core skills in question are specific field technical expertise, information management skills, communication skills, collaboration and synergy skills, creativity, ability to think critically, and the ability to solve problems while contextual expertise is: awareness in ethics, awareness in culture, flexibility, the ability to direct oneself and the ability to learn for life.

Programming language learning is one of the courses held by the Faculty of Computer Science, Putra Indonesia University YPTK Padang, and aims to train students to be able to apply simple algorithms to programming. This course is carried out by S1 Information Systems students with a note that the student has taken courses that are the prerequisites of this course. Learning outcomes from this learning are that students are able to design a simple software application based on design analysis conducted in the learning process. Based on the learning objectives that have been formulated, it can be explained that this learning aims to have students the ability to design and build mobile applications that run on multiplatform mobile applications based on the principles of software engineering, by utilizing sensors and multimedia so as to produce creative work and innovative.

Project-based Learning departs from the view of constructivism theory, which refers to the teaching and learning approach of Contextual Teaching and Learning. Project-Based Learning is a learning approach that requires standard content in the curriculum [18]. Through this learning approach, the inquiry process begins with raising guiding questions and guiding students in a collaborative project that integrates various subjects or materials in the curriculum [19], [20].

The Project-Based Learning Model is supported by constructivism learning theory which states that the basic structure of activity consists of the objectives to be achieved as a subject in the context of a society where the work is carried out with intermediaries of tools, work rules, and division of tasks in its application in class relies on active activities in the form of doing something rather than passive activities or receiving a transfer of knowledge from the teacher [21], [22]. Project-Based Learning is an innovative learning approach model that emphasizes contextual Learning through complex activities, according to Cord et al. [23] . whereas, according to Thomas [14] says that Project Based Learning is the use of projects as a learning model.

One of the first theoretical foundations for group learning (Cooperative Learning) comes from the social constructivist view, Vygotsky [24]. According to [25], students' mentality first develops at the interpersonal level where they learn to internalize and transform their interpersonal interactions with others, then at the intra-personal level where they begin to gain new understanding and skills from the results of the interaction.

The use of various types of assessment strategies that validly reflect the actual learning outcomes expected of students. This strategy can include assessing students' projects and activities, using portfolios, rubrics, checklists, and observation guides while providing opportunities for students to take an active role in determining their Learning and using it to improve their writing skills.

Based on the background that has been explained, it is necessary to follow up on the situation as a preliminary study in developing a Cooperative Project Based Learning model in learning programming languages. Early studies of learning models Cooperative Project Based Learning models are very important in determining the learning competence of each student.

2.Method

Based on the research objectives that have been set, this study wants to get preliminary results from the development of the Cooperative Learning Model Project-Based Learning on learning the appropriate programming language in order to increase the competency of the Information Systems Study Program.

Rare preliminary analysis is a process of defining what will be determined by students, namely conducting needs analysis; identify problems (needs), and do a task analysis. Therefore, the output (output) that will be generated is in the form of; 1) the characteristics or profile of students or students, 2) identify gaps or problems that hinder students in the learning process, 3) identify the competencies that are the needs of the world of work and industry and 4) analyze the tasks given in the learning process so that it is relevant to work and industry.

This research is part and the initial step of Research and Development, namely the preliminary study stage. The development of the ADDIE model learning system is one of the models that are often used by educational product developers. ADDIE stands for Analysis, Design, Development, Implementation, and Evaluation. The steps of the ADDIE development model are more rational, structured, and more complete than the 4D model (Branch, 2009). The ADDIE model is described as figure 1

Figure 1. ADDIE model

This research is limited to the analysis of needs derived from initial observations in the field and also the study of relevant literature. The research method used was a survey method. Data were collected using a questionnaire containing questions related to competencies expected in programming language learning and a questionnaire about student learning styles. This research was conducted at the Fakultas Ilmu Komputer, Information Systems Study Program, Universitas Putra Indonesia YPTK Padang.

Data will be obtained from the use of a questionnaire analysis of the needs of lecturers and student needs. The data obtained is processed in four stages. The first stage is collecting data from questionnaire distribution. The second step is tabulating data to see the class, nature, type, and frequency of the data. Data tabulation aims to facilitate reading, to categorize, and to analyze data. In the third stage, qualitative analysis, where data will be broken down to be linked to information related to the research focus. The fourth step is to make an interpretation of the results of the analysis of problems and questions

In the needs analysis phase, which is to carry out an analysis of the state of learning and information system competence, the current state is then compared to the normal condition. The gap (discrepancy) between the current situation and the hope condition is used as a learning problem that will find a solution. Data collection will be carried out from diploma program students and lecturers as well as the industrial world with instruments designed for that. Collect information from various sources. A questionnaire was used to collect data. Quantitative data are analyzed using descriptive statistics and inferential statistics. Inferential statistics use a different test with a t-test to see the difference between expectations and the conditions of achievement now. The results of the discussion and discussion will provide recommendations for learning models that can improve the competence of vocational education graduates. At this stage, the Cooperative Project-Based Learning model and also the Focus Group Discussion (FGD) will be implemented.

3. Result and Discussion

In the preliminary research stage (Analyze) is analyzing the problems that arise in learning activities so that the competencies of graduates become weak, curriculum analysis is applied and analysis of student characteristics. Curriculum analysis conducted includes the curriculum applied in the learning process, the scope of material, learning objectives, and the methods used. At this stage, the data collection process is carried out by carrying out surveys and distributing questionnaires to vocational education institutions, interviews with the manufacturing industries and educators, or lecturers/instructors.

Analyzing the concept of learning models carried out with the aim to identify the material discussed in the learning process. Another use of this analysis is to arrange models or materials systematically so that there is continuity between one concept with another concept. This activity is carried out with a literature study by reviewing books and journals related to learning material and models. The results of the analysis in the preliminary research that has been carried out in the form of an analysis of problems that occur in graduates of the Bachelor's workforce in the

Information Systems study program, analytical curriculum using the Developing A Curriculum (DACUM) approach, analysis of the learning model concepts used and analysis of student characteristics and constraints that occurs in the Teaching and Learning Process.

Based on direct observations that have been made, observations and interviews with a number of vocational higher education institutions, managers, lecturers and students that the learning process which has tended to use lecture methods in learning, emphasizes more on the cognitive aspects only in the scope of the material and in the learning process, so students do not have the opportunity to develop their reasoning power.

Students have difficulty understanding what is taught by the lecturer, even though reasoning and understanding are abilities that are very important for anyone who wants to be professional in their field. The lecture method used in learning causes students to listen and observe the lecturer lecturing, the learning situation is directed at learning to know and the problems presented tend to be academic (book-oriented) not referring to contextual problems that are close to life, so learning becomes less meaningful for participants students.

According to Purnawan [26]engineering education should provide sufficient theories and provide examples of problem-solving in real projects. Thus, the development of the engineering profession is naturally stimulated by technical problems in real situations. This is based on the reason that knowledge and skills that are sturdy and meaningful-use can be constructed through authentic tasks and work [23].

The data and information obtained are used as study material and references in the development of learning models and supporting products in the form of an implementation manual for lecturers/instructors and a working guide for students. The models and supporting products are designed to improve the competence of Bachelor graduates, especially in the field of computer science so that they have the ability to solve technical problems in real situations and be brave in making decisions. The learning experience is gained through the direct involvement of students in a series of activities to explore the environment and interaction with the subject matter. The models and products developed can facilitate the active learning of students and as a source for learning.

3.1 Need Analysis of Learning programming languages

The preliminary study was carried out at the UPI YPTK Padang Information Systems study program. The preliminary study data came from the university's academic information system, as well as lecturers and students in the Information Systems study program that took the programming language course. Data were analyzed to obtain an overview of the curriculum, student characteristics, and the learning process of Programming Languages conducted by lecturers.

In this study, there are two aspects of competency that are assessed, namely the ability to solve problems and the ability to produce creativity. Rating indicators refer to taxonomy bloom developed by Benjamin S. Bloom. Bloom divides learning objectives into three domains, namely cognitive, affective, and psychomotor. In the cognitive domain, which is assessed is the problem-solving ability, while for the psychomotor domain that is assessed is the ability to produce creativity. For the measured problem-solving aspects are the analytical skills and students' rationalization abilities, while for the aspect of producing measured creativity is the ability to design and create.

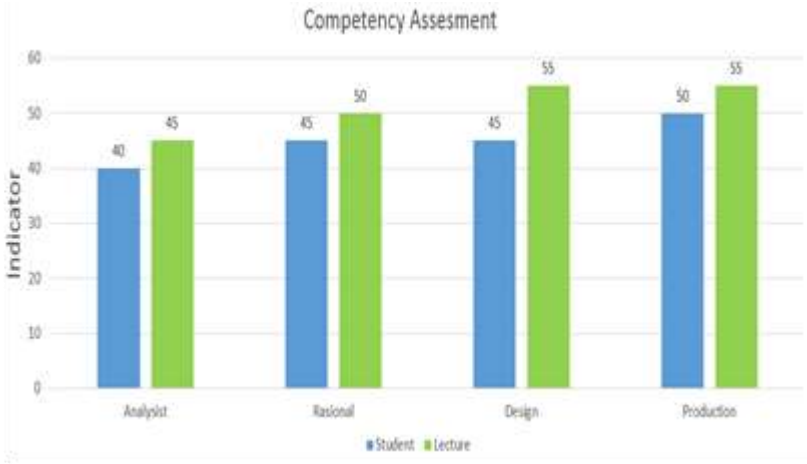

Fig. 2 Comparison of College Student and Lecturer assessments about the current learning model

The results of the assessment of students' analytical skills are at 40%, and lecturer ratings are 45%. While the ability of rationalization is at 45%, and lecturer ratings are 50%. These results indicate that cognitive aspects in terms of problem-solving are still low, which is below 50%.

The results of the assessment of the designability of students are at 45%, and lecturer ratings by 55%. While the ability to produce is at 50%, and the assessment of lecturers is 55%. These results indicate that for psychomotor aspects in terms of creativity is still low, which is below 60%.

Based on the assessment of both aspects, as shown in Figure 2, namely problem solving and creativity, then we need a new model that can answer the learning needs that are in accordance with HOTS criteria and meet some of the competencies needed in dealing with competition in the 21st century. The model is then implemented in learning.

The results of the analysis of student constraints in learning the programming language include students not ability to develop the concept of programming (critical) by 16%, not understanding the techniques of model design and making applications by 23%, Know the basic concepts of object-oriented programming techniques by 7 %, Competence to create simple menus and databasesby 14%, Competence to work with friends (collaboration) classmates by 35%, and not trying to pour ideas in the form of a programming algorithm (Creativity) by 5%. the results of the analysis of learning problems need from the student side as shown in Figure 3

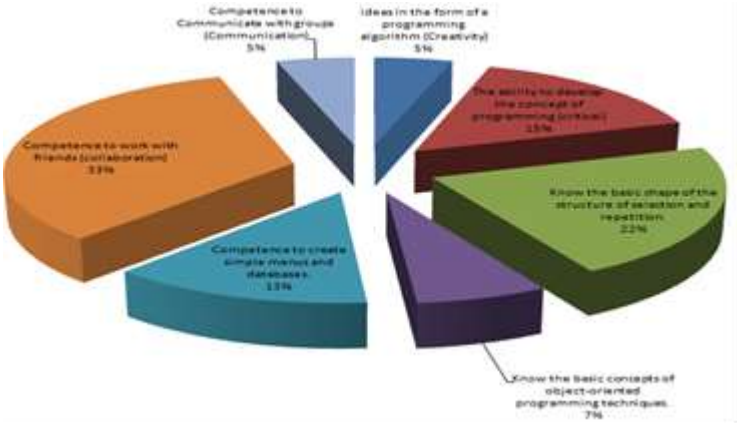

Figure 3 Student problems in learning programming languages

In the learning of programming languages, 37% of students said they had heard information and knew about the learning model of project-based programming language, and 63% had never known the project-based learning model in the eyes of the programming language.

The average indicator needs for the initial preparation of lectures is 4.0733, with a response rate (TCR) = 81.47%, and the category needs the development of the PjBL model in the

Programming Language course. The average indicator of aspects of lecture information needs is equal to 4,2067, with TCR = 84.13%, and the categories need model development. The average indicator for lecturing is 4.0667, with a TCR of 81.33%, which means it needs the development of the model.

Indicators of the availability of teaching materials and the application of learning models on average by 4.0905, with TCR of 81.81%, meaning that they really need the development of learning models. Guidance in learning an average of 4, with TCR = 80%, meaning that it requires the development of the model. The project workgroup task requirement indicator is 4.0867, with a TCR of 81.73%, and the category really needs model development. The assessment criteria for learning outcomes of 4.04, with TCR = 80.80%, means that students need the development of models.

Based on the results of data processing, in general, it can be analyzed that the average of all indicators of need analysis is 4.0805, with an average response rate (TCR) of 81.61%, which is in the category of very need.

The conclusion of these results is that students really need the development of cooperative project-based learning models in the Programming Language course. The findings are very rational and essential so as to strengthen the motivation of researchers to conduct research and development of project-based programming language learning models.

3.2 Results of the Focus Group Discussion (FGD)

Focus Group Discussion (FGD) is a scientific discussion activity that is carried out. Based on the explanation above, the purpose of carrying out this Focus Group Discussion (FGD) is to dig up information, provide input and advice, and discuss tools and products for the Development of Cooperative Project-Based Learning Learning Models in learning programming languages in the information systems study program.

Based on the results of the Focus Group Discussion (FGD) that has been carried out, obtained some input and suggestions on the Cooperative Project-Based Learning Learning Model and its supporting products need to be improved. The results of the discussion in the Focus Group Discussion (FGD) can be summarized in the following summary:

- The learning model to be developed must have specific characteristics compared to existing learning models, clear steps in its implementation and need to be supported with relevant theories, especially theories about Competency Based Training, the addition of this theory is very closely related to the development model done.
- Existing material in the Programming Language course is too much and dense with a weight of 2 credits, so it is necessary to do a curriculum analysis in order to select material and subjects that are appropriate and relevant to the circumstances for project work.
- The teaching material modules that are made must meet the competency demands of the Bachelor level, which is level 6 according to the Indonesian National Qualification Framework, which is to the analysis phase and needs to be supplemented with a complete design example of project work and a learning evaluation system at the end of the chapter or sub-chapter.
- The results of this research and development are manifested in several products, including; CPBL learning model books, CPBL teaching materials modules, and implementation manuals for lecturers/instructors. All of these research and development products need to be validated before being used. The results of the FGD implementation described above are the main inputs and suggestions for improving the Development of Cooperative Project-Based Learning and their supporting components.

3.3 The Basis of the birth of Syntax FASTER

The purpose of the learning design is for the lecturer to choose the suitable learning method so that the learning process was directed towards achieving the goals that were formulated. Choosing the right learning method means determining the type of learning model that is most effective

in achieving learning objectives. The learning design also serves to direct the lecturer to choose and pay attention to the importance of the learning objectives formulated in each lesson, so that learning can truly achieve the purposes as stated in the curriculum.

The design of learning models in programming languages is a learning model where students work together in small groups (cooperatives) to explore lecturing language lecture material actively related to real-world objects so that at the end of learning, students can produce tangible products from the project.

The design of this new learning model is based on two basic models, namely project-based learning and cooperative learning models. This design is based on the rules of developing learning models. The results of this model design are called the FASTER model. The syntax of FASTER on the Cooperative Project Based Learning Model is adopted from the model Cooperative Learning and Project-Based Learning. The merging of two models, as shown in figure 4 below, became the basis of the birth of syntax FASTER. The name FASTER is taken from the initial letters of each step of the developed model. Not every stage in each model adopted; only a few stages are used and combined because it is adjusted to the needs of the syntax FASTER.

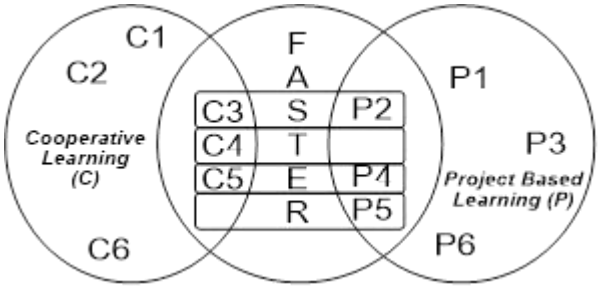

Fig. 5 The Adoption of Syntax Development

- Cooperative Learning (C) adopted and developed by Slavin, with stages as follows Slavin (2006);
  C1: Conveying goals and motivating students
  C2: Presenting information
  C3: Organize students into study groups
  C4: Guiding study and workgroups
  C5: Evaluation
  C6: Giving awards
- Project-Based Learning (P) developed by George Lucas, with stages as follows ;
  P1: *Start With the Essential Question*
  P2: *Design a Plan for the Project*
  P3: *Create a Schedule*
  P4: *Monitor the Students and the Progress of the Project*
  P5: *Assess the Outcome*
  P6: *Evaluate the Experience*

3.4 The Proposed of Syntax FASTER Learning Model

The FASTER model is designed as a learning model that uses projects as the primary learning activity. Students explore, assess, interpret, and synthesize information to obtain various learning outcomes (knowledge, skills, and attitudes). The results showed that most of the learning process in national education institutions is the result of learning in the form of knowledge and only at the level of memory and understanding. In contrast, cognitive learning outcomes have not yet reached the aspects of application, analysis, evaluation, or synthesis (C5), and to create products (C6), based on Bloom's taxonomy. Need analysis This research has produced recommendations,

one of which is the syntax which is the result of collaboration based on project-based learning and cooperative learning models, as shown in Figure xx.

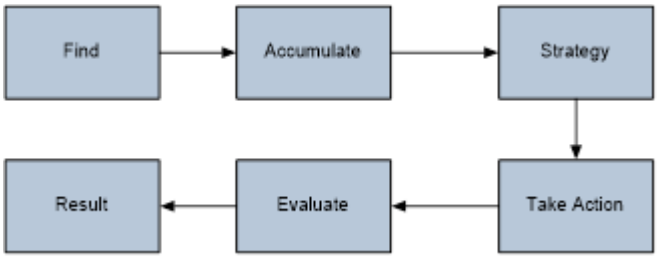

Fig. 5 The Proposed of Syntax FASTER Learning Model

The FASTER model will need a support system to be created a special learning environment in the form of the ability or skills and technical facilities to support the implementation of the effective language learning process programming (optimal). Mapping learning outcomes programming language courses can be seen in the picture below. The development of the FASTER model is adapted to the characteristics of programming language courses. Some elements of learning tools developed to support the programming language learning models are the FASTER model guide book, Learning Plan and syllabus, and programming language teaching materials.

4. Conclusion

Research conducted during the preliminary study through a needs assessment shows that there is a need for the application of a new learning model that replaces the current learning model. This is evidenced by the low scores for aspects of problem-solving competencies and student creativity that are below the 60% level. The weaknesses of the old model need to be adjusted by implementing the new model, which better answers the needs of learning models in the Programming Language course. The model developed is the Cooperative Project-Based Learning model. Model development uses six steps, namely FASTER. The new model produces three kinds of products in the form of learning tools, that is; FASTER learning model book, lecturer guides, module books, and college student guides. The model developed is adapted to 21st-century competencies, one of which is the ability to solve problems and the ability to produce creativity.

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