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The development of cooperative project: Based learning model in web programming course

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Abstract---The research aims to review the development of a model of Cooperative Project-Based Learning in Web Programming Course to analyze the collaborative learning process between cooperative learning with the Jigsaw technique and Project-based learning (PJBL) that involve learning abilities in 21st, 4C (Critical thinking, Communication, Collaboration, and Creativity) in order to produce a learning model that can provide instructional and accompaniment impact for students. This model has the concept of learning in groups and the existence of expert groups. It also incorporates project learning, project monitoring, 4C-based Project Planning Design, and Information system-based development where projects are developed based on information systems and technology, project reports and presentations, and evaluations that include rewards and reflections.

Key words: a model of cooperative, project-based learning

Introduction

Vocational education is expected to equip employees with knowledge, attitudes and skills that can enable them to effectively secure and

maintain their jobs. It aims to prepare graduates to be work-ready. In order to accomplish these goals, vocational education institutions as providers of future workers must be able to implement effective teaching strategies. In 21st century, one of the skills that must be possessed by students is collaboration skills (Mendikbud, 2020); (Aliftika & PurwantoUtari, 2019). Through collaboration, students will establish and grow an attitude of empathy and caring for others. Collaboration encourages all students to actively participate in accomplishing common goals in a responsible manner with integrity. Not only the active students will acquire all benefits from collaboration events but also students with limited skills are also assisted in achieving learning goal. This state can reduce individual differences and produce a high degree of positive dependency in tackling issues in science, education, and daily life (Wilson, 1986) (Schleicher, 2018).

Based on the research results of the collaboration ability profile of students from five study programs in Pekanbaru, the results show that the student collaboration skills profile is still far from expectations, which is in the low category with a score of 51.14%. In the meantime, the implementation of the 2013 curriculum places an emphasis on collaborative learning according to Permendikbud No. 20 of 2016 (Permendikbud, No. 20 Th. 2014). The results of observing the implementation of learning plans made by lecturers have not found any learning steps that intentionally (by design) facilitate the occurrence of positive dependence among students which can encourage students to collaborate so that they can practice student collaboration skills. In the observation results of the learning plan implementation created by lecturers, no learning steps have been identified that purposefully (by design) facilitate the occurrence of positive dependence among students, which can encourage students to collaborate so that they can practice their collaborative skills. In addition, the observation results about the learning process that took place in the classroom show that students are less encouraged to develop collaboration skills. The lecturers have not facilitated the learning activities with the emergence of positive dependence among students. Besides, the assessment of student collaboration abilities is not performed yet.

The lack of positive dependence among students on carrying out their learning that can motivate them to collaborate is the source of their poor collaboration abilities, which is brought on by the lecturers' during the learning process. In addition, there are no learning activities that can train and develop these collaboration skills so that optimal and equitable learning outcomes can be achieved. In the learning process of Programming course, the lecturer's assessment of these skills is still low. (Beydoun et al., 2020). Based on their analysis of the assessment of programming teaching materials on the ability to enhance students' collaboration skills claimed that the assessment of programming materials has not optimally empowered student collaboration abilities.

In collaborative learning, students are required to work collaboratively and be able to innovate in solving new problems, behave divergently and uniquely. This learning is also characterized by a high positive dependence between students in the group, students are not left alone, and they will achieve goals only if other students in the same group can achieve their common goals (Arends, 2012). The effectiveness of collaborative learning for students has been demonstrated in the learning process. (Dewi et al., 2020). Based on these circumstances, it is necessary to develop a learning model that not only promotes the growth of collaboration abilities but also offers guidelines for maximizing the role of lecturers as mediators and facilitators to create constructive dependence in classroom learning interactions that will motivate students to collaborate. The cooperative learning of the Jigsaw model is one of the cooperative learning methods that focuses on collaboration in small groups to help each other in learning subject matter.

This Jigsaw type learning aims to encourage students to master knowledge in-depth and to develop cooperative learning skills and teamwork since it is impossible for them to absorb all the content alone (Slavin, 2015) (Slavin, 2014). However, the issue with the Jigsaw model's implementation is that it frequently results in poor learning outcomes for groups of students and expert groups. This demonstrates that the implemented learning was not collaborative enough. This condition occurs because there hasn't been a different role for students in the use of the Jigsaw model of learning. It creates the situation where the students with low abilities tend to be passive during the discussion. This also shows that there is no high positive dependence among students that motivate every member of the group to work together. Another drawback of the Jigsaw Model is that it takes longer for its implementation. It must be linked with the curriculum's requirements for critical thinking, communication, teamwork, and creativity in the 21st century. And there is no reflection from the results of group discussions and experts groups so it is necessary to add a reflection syntax.

On the other hand, the researcher combines the concept of project-based learning (PJBL). In its implementation, students take part in activities to produce projects, such as problem-solving (Lucas, 2005) and (Nizwardi, et, al, 2018). While the shortcomings of the PJBL model itself are still not combined with the 4C elements and there is no project development that has been implemented yet and no reward and recognition are yet available for students. It is therefore required to create a learning model based on this limitation. As a result, it is necessary to develop a learning model. In addition to promoting the development of collaboration skills, this model should include syntax or step that encourages positive dependence among students by encouraging those with strong aptitudes in order to help their friends who have difficulty understanding the subject matter, so that collaborative activities actually occur during the learning process. Moreover, the 4C competencies are also required for the 21st century and the utilization of technology in creating information systems. This study aims to provide a

review about the development of the Project Based Cooperative Learning model in order to produce a learning syntax.

Method

The study employs research techniques of the development model of Borg & Gall. The following stages are included in this process:

- aggregating information;
- planning;
- product development; and
- validation and testing. However, the results of developing a learning model only consider the stage of aggregating data from literature studies from various references.

Results and Discussion

The Rationality of Learning Model

Higher education has a close relationship with the global world, economic growth, increasing prosperity which is driven by the current knowledge. Higher education institutions not only have the responsibility to generate and create new knowledge, but also to equip the new generation with the superior competencies and skills required for employment in the twenty-first century. Competing in the 21st century requires the ability to think critically and conceptually. According to (Wagner, 2008), the nation will be put at danger if educational systems and institutions do not prepare students for the challenges existed in this century. To improve the quality of students, the quality of learning must be improved by identifying models and types of effective learning that are appropriate and balanced between the cognitive, affective, and psychomotor domains for the realization of the success

The basic foundation in developing a learning model framework in the implementation of vocational education must continue to be carried out so that the graduates' quality is in line with the needs of the labor market. In this study, researchers provide a solution to develop a Project Based Cooperative Learning model in Web Programming Courses. The position of the model development variables takes into account a number of pertinent studies, benefits, and slices of the already-existing models from the cooperative jigsaw model and project-based learning. The contribution of this research is to provide a learning solution where the concept is to learn in groups with Cecil's group serving as the "home team". Each home group assigns each member to become a different expert. Students who receive the same task or topic in different groups come together to form an expert team (expert team). In addition, it also includes project learning, project monitoring, 4C-based Project Planning Design, Information system-based development, where

projects are created based on information systems and the use of technology.

Project reports and presentations, where students present the results of projects that have been conducted and present the reports in the form of portfolios. the existence of an evaluation process to carry out an assessment to determine the worth of learning accomplishments as well as rewards and reflections, so that students are passionate and motivated in their learning and reflect on learning outcomes for the improvement of the next learning to achieve an effective of the cooperative learning model with Jigsaw technique and project based learning to improve students 4C abilities. Meanwhile, to achieve the instructional impact, students are able to have the ability in solving problems and produce products. Students will be able to collaborate, take responsibility, apply technology, and create information systems as a result of the accompaniment.

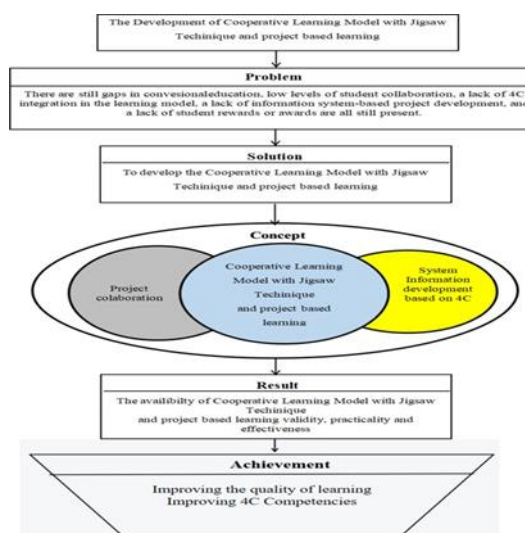


Figure 1. 4.1 The framework of Cooperative Project-Based Learning Model

Syntax Model of Previous Research

The comparison of previous research with the topics of cooperative project based learning model in the Web Programming course is presented in table 1.

Model development must be relevant with the learning needs based on 21st century skills, vocational philosophy for the development of the Cooperative Project Based Learning model in the Web Programming Course by combining this Project Based Learning with a Jigsaw technique. This model is developed due to the fact that it has the benefit of combining the idea of groups and expert groups with the jigsaw concept. (Şengül & Katranci, 2014); (Slavin, 2005); (Inayah, et al, 2021); (Budiarti, 2017); (Affandi, et al, 2022). In Jigsaw learning model, each group member receives a task, therefore they are dependent upon one another to execute the assignment (interpersonal dependence). It also provides a number of benefits, including valuing students' individual competence, fostering a sense of community among students, encouraging them to use one another as resources for learning, and fostering a sense of mutual trust and cooperation (Şengül & Katranci, 2014).

Therefore, it can improve students' social competence, ability to work in pairs, and academic achievement (Van Dat, 2016; Rahmah, 2017). This learning activity also provides a cooperative learning situation that can increase student activity (Hoerunnisa et.al, 2017). The results of the research of Yemi et.al. (2018) states that the weakness of Jigsaw learning is that it cannot be applied to all learning materials. The students with low academic ability have difficulty understanding the material because it requires higher-order thinking skills (Darmuki & Hariyadi, 2019). The possible issue with learning Jigsaw, according to Darmuki et al. (2018), is that students are able to grasp the information but fail to pass it along to their classmates in the same group. The Jigsaw cooperative learning model has various advantages as follows (1) Facilitating the work of teachers in teaching because there is already a group of experts in charge of explaining the material to their colleagues.; (2) Increasing student's motivation and responsibility in learning activity towards themselves and others; (3) Even distribution of mastery of the learning material can be achieved in a shorter time; (4) To train students to be more active in speaking and debating; (5) Students who are more knowledgeable about the course material can assist the weak students in addressing challenges; (6) Deeper understanding of the material because it applies peer guidance. Students will be easier to understand if they are guided by peers; (7) Students are positively interdependent in the learning process; (8) Providing opportunities for students to work together with other groups; (9) Each student complements each other.

Cooperative learning is a learning activity centered on problem solving skills followed by strengthening creativity and developing problem solving in the learning process (Santayasa, 2007). Jigsaw cooperative learning is expected to generate student's interest, creativity and motivation in learning, therefore they can obtain maximum benefits from both the process and learning outcomes. Thus, their learning outcomes are expected to become better. In this this kind of learning, students are required to be active so that they are able to bring out their abilities to

solve problems that they have never experienced. According to this idea, which is consistent with Musfiqon's viewpoint, happy learning emphasizes student-centered learning more and uses teachers as facilitators, trainers, consultants, and intermediaries to achieve the best outcomes.

In cooperative learning with the Jigsaw technique, there are several stages that students must go through during the learning process, including problem clarification, opinion expression, evaluation and selection, and implementation. They are defined as active students if they are able to engage in a lot of activities throughout the learning process. These activities are not only about listening and taking notes but also include other activities including mental, physical and social activities that use different approaches depending on their level of creativity to solve problems such as asking friends during discussions, daring to express opinions, etc. They have to be able to model the problems into the problem solving model. At this level, students are likely to create a wide variety of problem-solving models and strategies. The disadvantages of cooperative learning with the Jigsaw technique are as follows:

(1) There will be more active students who dominate the discussion and tend to control the discussion. To anticipate this problem, the teacher must really pay attention to how the discussion takes place. The instructor needs to emphasize that group members should first hear the expert's explanation. If there is an explanation that is not understood, then ask questions; (2) Students with reading and thinking skills will struggle to describe the learning material if they are designated as experts so teachers must choose the appropriate experts then monitor their performance when explaining the material, so that the material can be delivered accurately; (3) Smarter students tend to get bored easily; (4) It will be challenging for students who are not used to competition to keep up with the learning process; (5) requires a longer study time, because there is no good planning. (Subiyantari, A. R., & Muslim, S. 2019). Additionally, when the Jigsaw model is used, there are frequently discrepancies between how the students in the expert group perceive it and how poorly the home group does in terms of learning. It requires a longer study time, because there is no good planning. This demonstrates that learning has not been done in a collaborative manner. This demonstrates that there is no strong positive dependence among students that is no high positive dependence among students that can encourage each individual in the group to collaborate.

Teachers are particularly skilled at implementing the syntax in cooperative Jigsaw learning model based on critical thinking, communication, collaboration, and creativity and use it to solve learning problems. For this reason, the cooperative learning model with Jigsaw technique is integrated with the 21st century curriculum's requirements for critical thinking, communication, teamwork, and

creativity. It is believed that this model is be able to improve students' problem solving abilities. As a result, academics believe there is a need to conduct research about the development a cooperative learning model based on the 4Cs (critical thinking, communication, cooperation, and creativity) for strengthening problem-solving skills (Kesuma, et, al, 2021) and includes the reflection syntax as the reflection from the results of group discussions and also add the role of lecturers as facilitators and mediators.

On the other hand, researchers also incorporate the idea of PjBL learning into this model. The idea of implementing the PjBL model allows students to be involved in activities to solve problems and other meaningful tasks such as loading project learning, problem solving, and project monitoring (Lucas, 2005) and (Nizwardi, et al, 2018). Students are given the chance to work independently and develop their ability to perform collaboration. The final process leads to the result of a real product that is valuable and realistic (Valenzuela, 2022). The Project based learning syntax developed by (Lucas, 2005); (Wena), and other researchers have the advantages as follow, 1). Determining the basic questions. In this step, the lecturer determines the direction and goals of the learning outcomes or projects that must be carried out by students; 2). Developing project planning that aim to facilitate implementation for project completion; 3). Arranging schedules, so that all of the planned plans may be implemented effectively and on schedule and that certain milestones can be reached; 4). Monitoring is carried out by lecturers continuously to monitor the process of student's project work; 5). Testing the results, it is required to determine the quality of the product or work that has been completed by students; 6). Evaluation by carry out the *asesment* to obtain the results of the value of the feasibility or unworthiness of the work that has been completed by students.

While the shortcomings in the PJBL model itself are still not combined with the 4C elements, there is no project development based on information systems, there is no reward or award for students. So from this weakness, it is necessary to develop a model. The explanations of each syntax in the Cooperative Project Based Learning model in the Web Programming Courses are as follows,

- Form a group. Small groups of 5–6 individuals are established at this point and are referred to as the home team. Each member is assigned to be a different expert. Students who receive the same assignment or topic coming from different groups will join together to form an expert team and to perform the discussion about the material in their expertise then distribute the discussion result to their friends in the home group. In this stage, lecturers act as facilitator and mediator.
- Problem identification. In this stage, students are given problems to discuss in each group that consist of critical thinking's elements.

- Project Planning Design based on 4C. In order to facilitate the implementation of project completion, the project planning design that is carried out should be organized and systematic with a clear schedule.
- Model development based on information system. In this stage, all projects are created based on information system and use of technology.
- Project monitoring. In this stage, the projects that are made can be monitored on a regular basis using information system technology then a discussion about the obstacles appeared during running the projects is performed.
- Project reports and presentations. In this stage, students present the results of the projects and make reports in the form of portfolios.
- Evaluation. In this stage, an assessment is performed to acquire the student's project results of learning outcomes. Then, the results will be evaluated.
- Reward and reflection. In this stage, students are rewarded based on their learning achievement in order to encourage them to be more motivated in learning process. The reflection of learning outcomes are also established to provide correction.

The most recent model created is envisioned as a formula for a new learning model in vocational education that is based on the benefits of the PJBL and jigsaw cooperative models, has uniqueness regarding the drawbacks of both models, and is furnished with arguments based on relevant researchs, so that the better cooperative is achieved. The cooperative project-based learning model combines PJBL and the jigsaw cooperative model, and it emphasizes group learning with a smaller group known as the home team. Each member of the home group is tasked with becoming a different expert. Students who receive the same assignment or topic in different groups join together to form an expert team. In addition, it also includes project learning, project monitoring, 4C-based Project Planning Design, and Information system-based development.

Reports and project presentation is where students present the results of their projects and report them in the form of portfolios. Evaluations is conducted to assess the obtain results of learning achievements. Based the evaluation results, students will be given rewards therefore they are becoming enthusiastic and motivated in learning. The last step is reflection to reflect on results learning to improve the next learning. The developed model has the following syntax: 1) Forming group 2). Problem Introduction, 3). Project Planning Design based on 4C 4). Information system-based development, 5). Project monitoring, 6). Project reports and presentations, 7). Evaluation, 8). Reward and reflection.

The main advantage of the Cooperative Project Based Learning model in learning activities is to emphasize the intention to perform learning

activities in group that consist of the main group and expert group, the occurrence of interaction for mutual discussion and cooperation, this model already includes an information system-based development model in creating the project, there is a stimulus to motivate students through rewards, and the existence of learning reflection to improve learning. The novelty resulted from this model originality comes from the transformation of learning models that were once conventional into learning models that incorporate 4C, technology, and syntax, specifically information system-based development by integrating two models.

The reason for the emergence of syntax: In syntax 1. Form group, sourced from (Inayah, et, al, 2021); (Budiarti, 2017); (Affandi, et al 2022); (Kesuma, et al, 2021). In this syntax, students will be grouped into small groups consist of 5-6 people referred to as the home team. Each home group assigns each member to become a different expert. Students who receive the same task/topic in different groups jointo become an expert team. Each expert group discusses to understand the material that is their expertise, which will be shared with their friends in the home group (Arends, 2012). In Syntax 2, Problem Identification sourced from (Lucas, 2005). The reason for giving problems to students aims to contain elements of critical thinking. In syntax 3. Project Design Planning based on 4C sourced from (Lucas, 2005); (Jalinus dan Nabawi, 2018); (Kesuma, et, al,2021). a project planning design is required to be implemented so that the projects carried out are organized and systematic. In syntax 4, Development based on information systems is a new concept sourced from (Inayah, et al, 2021). In Syntak 5 sourced from Project Monitoring (Lucas, 2005); (Jalinus and Nabawi, 2018), this syntax explain the reasons for making projects and seek instructors for assistance because project monitoring is necessary to track project progress and determine how far the project has advanced. In Syntax 6 Reports and project presentations sourced from (Lucas, 2005); (Jalinus dan Nabawi, 2018), The reason for the project presentation report is to explain the results of the project that has been made after that the report is written in the form of a portfolio through papers. In syntax 7 sourced from (Lucas, 2005); (Slavin, 2005); (Wena); (Affandi, et, al 2022). The reason for seeing the achievement of student project results and the results of students 4C then feedback will be given. In syntax 8, sourced from (Lucas, 2005); (Slavin, 2005); (Wena);(Inayah, et, al, 2021). The reason is that students stay excited and motivated in learning, and reflect on the learning outcomes that have been done, then plan improvements for the future.

Conclusions

The Cooperative learning is a learning activity centered on problem solving skills followed by strengthening creativity and developing problem solving in the learning process by combining the Jigsaw cooperative model and PJBL. This model has the concept that the learning process is performed in know as home team. Each home group assigns each

member to become a different expert. Students who receive the same task/topic in different groups join to become an expert team. In addition, this model also includes project-based learning, project monitoring, 4C-based Project Planning Design, and Information system-based model development where projects are created based on information systems and use of technology. Then, in this model, reports and project presentations are included, where students show the results of the projects they have completed and create reports in the form of portfolios. Then the evaluation is carried out to assess learning outcomes. Rewards will be offered to keep students enthusiastic and motivated in learning. The following step is the reflection of learning outcomes that is carried out for the improvement of the next learning.

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