

# Using Project-based Learning Coupled with Mobile Learning Technologies to Enhance Students Cognitive Skills: How the Approach Shapes Creativity among Learners in Higher Education

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**Abstract** - The present study sought to examine and evaluate the implementation of project-based learning using mobile learning technology as one way of improving students' cognition skills and thinking creativity. In a preliminary study, it was established that poor cognition leads to low skills and reduced creativity in thinking, especially when it comes to students' comprehension of content more so for high school students. One way of overcoming this challenge, is through the use of instructional technology that makes students to be more active in learning, thinking creatively, problem solving, decision making, creative thinking and also interested in learning content presented at any given time through mobile learning technologies. Based on this, the researchers, conducted a study in a vocational school in Banjarmasin in a high school. This study employed quantitative approach using quasi-experiment method. The results showed that students' cognitive skills and creativity improved after the treatment. Based on this, it is concluded that the use of project-based learning through mobile learning technologies has the ability to enhance students learning, hence a successful approach to learning.

**Index Terms** - Use of Technology, Project Based Learning, Mobile based and Learning Technology, Learning Technology, Instruction Technology and Cognition.

## INTRODUCTION

The implementation of a project-based learning model in civic education and values education with the help of mobile learning technologies is expected to improve learning quality, by easily helping to enhance teachers' skills, simplify students' learning activities, and lead to improvement of students' learning outcome [1], since both the students and the students can easily access relevant material and content with ease through the online mobile prepared content [2]. Project-based learning is expected to contribute to a meaningful and fun learning atmosphere [3] that can help students develop their potentials fully and achieve required competencies [4][5]. This learning model can be implemented with the aid of learning technology. Technology can be used to improve students' skills and creativity in most education courses, including instructional technology, citizenship or civic education, mathematics education, etc. Learning technology is an alternative innovative learning design that can be selected to facilitate teaching and learning process. According to McDonald and Gibbons [4] technology can be defined as a tool or system used by people to solve problems and achieve goals. Technology used in education, such as computer/laptop, overhead projector, graphical calculator, television, etc, is commonly called ICT.

According Walsh [5] learning technology is an idea and development plan about how learning process can be made of quality through the use of the most appropriate, effectiveness and efficient learning devices, as well as accelerating changes in students' behaviors.' An example of learning technology that can be used in project-based

learning model is mobile learning. Mobile learning is a new paradigm shift in learning [6]. Mobile learning exists to respond to the advancement of information and communication technology (ICT), especially in today's age of rapid development. Mobile learning can provide fresh atmosphere in learning process, bringing the advantage of availability in which learning materials can be accessed all the time in interesting visualization. Based on the research problem, this study was implemented in an elementary school in Banjarmasin with the aim to discover:

- improvement in students' cognitive skills by implementing project-based learning model with mobile learning aids in the topic of processing.
- improvement in students' creativity by implementing project-based learning model with mobile learning aids in the topic of processing.
- the difference between students' creativity improvement in the class that use project-based learning with mobile learning aids and that in the class that does not use project-based learning with mobile learning aids in the topic of processing.

#### LITERATURE REVIEW

Learning is a process that individuals perform to gain a new whole change in behaviors as a result of the individual's own experiences in interacting with his or her environment [6]. Trianto [7] argues that learning is 'a plan or a pattern used as the guidelines in designing learning in classrooms or learning in tutorials. Thus, selecting the appropriate learning model will greatly help the learning process. One of the recently developed learning models is the project-based learning model. Project-based learning is a learning approach that provides freedom to students to design their learning activities, to collaboratively finish projects, and to produce working products that can be presented to other people [8].

This learning model can be implemented with the aids of learning technology, that is mobile learning. In the context of education, mobile learning is defined as a learning process that is mobile, in the sense that it is flexible without time or space limitations. It has been established through literature that mobile learning is an alternative in which learning should be implemented anywhere and anytime [9].

Mobile learning serves three main functions in learning process [10]. It serves as learning supplement, complement, and substitute. Mobile learning serves as a learning supplement when students are free to use it or not. It serves as a learning complement when it is used as a complement to learning material taught to students in classroom. Cognitive skills are mind-based skills that individuals need to perform every task, from the simplest to the most complex ones. An individual's cognitive process correlates with his intelligence, characterized by various interests that particularly aimed at ideas for learning. Cognitive factor

plays great role in students' successful learning because most learning activities have to do with students' retention and reasoning abilities.

Studies have revealed that everyone has inherent creativity and abilities to express themselves creatively, even though the fields and levels are different [5][6][7][11]. What is particularly important in education is that those inherent creativity and abilities can and should be developed and improved. Creativity is more than just idea that one produces. It is a combination of reasoning and commitment to follow up the ideas until they are realized in creative products. Creativity is important. The more creative an individual is, the newer the innovative products he can produce.

#### RESEARCH METHOD

This study employs quantitative approach because it is presented in numbers. This is in line with Darmawan [12], who states that 'quantitative approach is a process to discover knowledge using numerical data as a means to find information about the topic that a researcher may want to investigate.

The research method used in this study is the experimental research method. According to Sharp [13], 'experimental research uses a specially designed experiment to gather necessary data to answer research problems.' More specifically, this study employs quasi-experiment method, that is a design that has control group but cannot fully function to control external variables that affect the experiment. Hence, the experiment in this study is designed to have two groups, i.e., the experiment group that will receive the treatment and the control group that will not receive the treatment.

The research site was a purposively selected high school in Banjarmasin city. The population of study comprised of all XI grade students selected from a state vocation high school in Banjarmasin in the 2020-2021 academic year. The population consisted of four classes with a total of 60 students. Data has been analyzed using normality test, paired sample t test (for normally distributed data), Mann Whitney test (for not normally distributed data), and Normalized Gain test.

#### DISCUSSION

Based on students' scores obtained through data processing, the following results are found. Each finding will be described as follows:

##### Comparing Students' Cognitive Skills

Students' cognitive skills improvement is inseparable from the appropriate selection of learning model that teacher implemented in the learning process. Out of the existing learning models nowadays, the researcher is interested to use project-based learning model in this study. Project-based learning is a model that put emphasis on students'

independent learning by solving problems and create a real project or product.

The official Indonesian dictionary, gives the definition that 'Project is a work plan with certain goals and strict deadline.' Advancement in information technology, especially computer and internet technology in both hardware and software, has bring many positive effects on the advancement in education. It not only offers the advantage of quick access to information but also makes learning more interesting, more visual, and more interactive.

Media has big contribution in improving the quality of learning. Media not only aids teachers in delivering the lessons, it also gives added values to learning activities. One of the programs, or computer softwares, used in implementing media in learning is mobile learning, which is used in this study.

Implementation of project-based learning model with the aids of mobile learning, as a concrete form of learning multimedia, was found to contribute to students' cognitive skills improvement in the eleventh grade of SMK Negeri Bengkulu city. Multimedia has indeed been used in various fields and for various purposes.

Based on the pre-test and post-test results, especially on the experiment group, there are several findings that need to be discussed. In terms of classroom average, the pre-test score of the experiment group is 44.5. It is far below the Minimum Completion Criteria for crafts and entrepreneurship subject in the eleventh grade for the topic of processing, which is 75. It means that the experiment group's pre-test score is not good. During the treatment, that is implementation of project-based learning model with mobile learning aids, the students in the experiment group were very enthusiastic and enjoy the learning process. In addition, students were more focused in learning that it improved their cognitive skills.

It was apparent from the post-test result, in which there was a significant improvement in the average score of the group. The average pre-test score of 44.5 increased to 78.17 in the post-test. Referring to Gain's interpretation, the increase in cognitive skills for the topic of processing in the experiment group was in high category; with a distribution of 13.3% in high category, 83.3% distribution in medium category, and a 3.4% distribution in low category. Meanwhile, in the control group, students' cognitive skills improvement for the topic of processing had a distribution of 66.7% in medium category and 33.3% distribution in low category. These scores suggested that the experiment group, which used project-based learning with mobile learning aids, was better than the control group, which did not use project-based learning with mobile learning aids.

The increase in students' cognitive skills on the topic of processing in crafts and entrepreneurship subject was further confirmed by questionnaire data. Based on data processing, it was clear that the implementation of project-based learning model with mobile learning had a positive response from the students. It made students more enthusiastic in

learning, able to understand the topic quickly, and able to improve their comprehension. Students stated that they liked teacher's activities in teaching using project-based learning model with mobile learning.

### **Enhancing Students' Creativity through a Combination of Project-based and Mobile Learning Technology in Citizenship Education Classes.**

Everyone has the potentials to be creative. However, if that creative potential is not developed, the individual will follow and do what he or she gets from other people without any effort to find his or her own way. In other words, the individual only mimics what is already there and only accepts what is in front of him. Conversely, activities that actively engage the individual in problem solving will develop his or her creativity.

Producing a meaningful project as expected requires not only knowledge but also high level of creativity. The balance between knowledge and creativity will further promote the success of a project, which will indicate the learning results of an individual.

In other words, creativity and learning results are interrelated and influence each other. Project-based learning will maximize creativity development as well as instill better characters or behaviors because students will engage in many activities in which they socialize with others and obtain new experiences they seldom get from conventional learning. Socializing, collaboration, and new experiences are factors that can shape one's behaviors.

Mobile learning is a product of education technology that has been used quite frequently. It marks the shift of 'updated learning' concept from multimedia learning to mobile learning. In this study, mobile learning means learning activities using smartphones as the primary learning media. The implementation of project-based learning model with mobile learning aids has big effects on students' creativity. It has to do with students' attention to an object, coupled with their interest to know and learn about the object or further prove something about the object. Improving creativity should be supported by the use of appropriate and interesting teaching media.

The implementation of project-based learning model with mobile learning aids means that the learning process will be more interesting and engaging because in mobile learning, a tutor can present interesting things that will cure the students of their boredom. In this study, it was expected that the students could improve their cognitive skills and creativity because they were actively engaged and were not bored in the lessons. This was proven by students' responses on the questionnaire items.

Comparing the pre-test and post-test on students' creativity, it was found that there was an increase in the average score of the experiment group, from 33.00 to 60.208. Meanwhile, in the control group, the average score increased from 42.48 to 53.58. Referring to Gain's interpretation, creativity improvement in the experiment group was in medium

category; with a distribution of 23.33% in low category, 73.34% in medium category, and 3.33% in high category. In the control group, creativity improvement was in medium category, with a distribution of 33.67% in medium category and 63.33% in low category. These scores indicated that students' creativity improvement was better in the experiment group than in the control group.

### **Difference in Students' Cognitive Skills: A Look at Mobile Learning Technologies and Project -based Learning**

According to Surya [14], cognition is a process of recognizing everything around an individual and an inseparable part of that individual's whole behaviors in his or her life. Based on this, it can be concluded that cognitive skills are obtained from learning process, which is a combination of inherent and external factors.

Implementing cognitive approach in learning must be accompanied with changes in the evaluation of learning process and result. Evaluation of learning result is a process to determine students' grade through assessment and measurement of learning results. Its primary goal is to determine the rate of success (comprehension) that students achieve after undergoing learning activities. The rate of success is then indicated with a scale of scores in the form of letters, words, numbers, or symbols.

Yau [15] states that indicators of success as benchmark or references to know students' comprehension level is 'the level of absorption of materials delivered could reach high achievement, both individually and collectively, and the grades stipulated in learning objectives (basic competencies) have been achieved by the students, both individually and collectively.'

Based on the comparison between cognitive skills improvements, as can be seen in the Gain Score in Table 1 and Table 2, the increase in students' average learning results in the experiment group was 60.7% while that in the control group was 40%. It showed that there was a difference in cognitive comprehension skills between students who received the treatment using project-based learning model with mobile learning aids and those who were not treated using project-based learning model with mobile learning aids, in that students' cognitive skills in the experiment group were better than that in the control group.

### **Difference in Students' Creativity Improvement in Relation to Project-Based Learning with the use of Mobile Learning Aids**

Creativity is often considered a skill based on inherent talent, in which only those with that talent can be creative individuals. This notion is not completely true, even though in reality it seems that only certain kind of people have the skill to produce new ideas quickly. In fact, everyone possesses creative thinking skill.

Creativity is creative potential that individuals possess as a form of reasoning in finding connections or patterns in existing elements or finding new ways to face internal problems in themselves. It is a strong desire to create. In learning activities, creativity can be defined as the whole driving force in students that drives learning activities, ensures that those activities are sustainable, and provides directions for learning activities so that the learning objectives that the students want to reach can be achieved. This is in line with Satiadarma [16] who states that 'creativity is one of the capitals that students must possess to have learning achievements.'

Students' creativity should not be narrowly defined as abilities to create something entirely new. Students' creativity also includes the ability to combine existing ideas and implement them to create something different from what has already existed. To improve creativity, it is necessary to implement learning process that urges students to be more creative.

Creativity is a non-intellectual psychological factor. Its unique role in learning is to grow students' desire to learn so that they become enthusiastic to learn and enjoy the process. Learning results will be optimal if the learning process involves creativity. Students' failure in learning may not be entirely the students' faults because there is a possibility that teachers failed to provide necessary stimulus to induce students' creativity and enthusiasm to learn. In other words, '... [it is] teachers' task to develop and improve students' creativity so that creative skills can grow in each student, that is a way of thinking to solve problems creatively or techniques to come up with original ideas' [17].

Creative learning requires teachers to stimulate students to be creative, in the contexts of both creative thinking and creative actions. Creative thinking is imaginative but rational thinking skill. Creative thinking always stems from critical thinking, that is finding and producing something that has not been existed before or fixing something that needs to be improved.

Based on the comparison between creativity improvements of students in the experiment and control groups, and the comparison between students learning results improvements from pre-test and post-test, as can be seen in the Gain Score in Table 4.5 and Table 4.9, the increase in students' average learning results in the experiment group was 40.8% while that in the control group was 26.3%. It showed that there was a difference in creativity improvement between students who received the treatment using project-based learning model with mobile learning aids and those who were not treated using project-based learning model with mobile learning aids, in that students' creativity in the experiment group were better than that in the control group.

Based on the results of the study and the conclusions on the implementation of project-based learning model with mobile learning aids, the following suggestions are proposed:

Lessons using project-based learning model with mobile learning aids should be further developed and be made an alternative teaching method available for teachers. It is because lessons using project-based learning model with mobile learning aids have positive impact on students' cognitive skills and creativity improvements. Considering that learning using project-based learning model with mobile learning aids affects the improvement in students' cognitive skills and creativity, it is expected that the implementation of this learning model can be a positive and constructive input for policy makers to initiate changes in learning activities paradigm to provide students with opportunities to participate in learning activities.

In the implementation of learning using project-based learning model with mobile learning aids, several modifications and adaptation are needed to adjust the model with the actual condition in the teaching-learning process. It is because every learning condition and situation has different characteristics. In addition, the implementation of learning using project-based learning model with mobile learning aids should be adjusted to the subject being taught. It is because every subject has different priorities, especially between subjects in science and social studies.

Future researchers are expected to further this study to get deeper understanding of how project-based learning model with mobile learning aids can be implemented in different subjects and levels of education. It is also suggested that future studies on this topic involve more numbers of meetings (lessons) so that the learning activities can be more effective.

### CONCLUSION

Based on the research questions, objectives of the study, and the discussion of findings, the researcher drew the following conclusions:

Cognitive skills improvement in students who learned using project-based learning with mobile learning aids is in medium and high categories, while that in students who did not learn using project-based learning with mobile learning aids did not improve significantly, i.e., in low and medium categories.

Creativity improvement in students who learned using project-based learning with mobile learning aids is in medium and high categories, while that in students who did not learn using project-based learning with mobile learning aids is in low and medium categories. There is a difference in cognitive skills improvement between students who learned using project-based learning model with mobile learning aids and students who were not treated using project-based learning model with mobile learning aids. Cognitive skills improvement for the topic of processing in students who learned using project-based learning model with mobile learning aids was better than that in students who did not learn using project-based learning model with mobile learning aids.

There is a difference in creativity improvement between students who learned using project-based learning model with mobile learning aids and students who were not treated using project-based learning model with mobile learning aids. Creativity improvement in students who learned using project-based learning model with mobile learning aids was better than that in students who did not learn using project-based learning model with mobile learning aids.

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