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Implementation of Scratch Application to Improve Learning Outcomes and Student Motivation on Basic Programming Subjects

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Abstract:

This study aims to improve learning outcomes and student motivation on Basic Programming Learning by utilizing the Scratch application. Research begins with identifying problems that occur in the classroom. Then designed an action to overcome it in an action cycle. In this study giving of the action takes place in two cycles. Each cycle consists of planning, implementation, observation, and reflection. In cycle 1, learning is implemented using problem-based learning model, while in cycle 2 using project-based learning. The technique of data collection is done through comprehension test, observation of learning activity, assignment of portfolio, and interview to students and related teacher. Data analysis was done using quantitative and qualitative interactive analysis techniques. The results showed that the use of Scratch application can improve learning outcomes and student motivation. This is indicated by the percentage of the student's learning outcomes completeness by 25.7% in pre-cycle, 71.4% in cycle 1, and 94.3% in cycle 2. While the percentage of student motivation is 40.3% in pre-cycle, 75.1% in cycle 1, and 83.9% on cycle 2.

Keywords: classroom action research, Scratch, learning outcomes, student motivation, problem-based learning, project-based learning

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Introduction

Basic Programming is one of the basic subjects in the field of Technology, Information and Communication (ICT) expertise. These subjects must be mastered by all areas of expertise. For beginners like class X students, basic programming subjects are still different. Basic programming subjects are subjects that require an in-depth understanding to master them. Not infrequently student finds it difficult to understand the basic material of the programming, especially the less effective teacher delivery. According to Pebruanti (2015), there are two types of novice programmers characterized by encountering problems, which are "stop" and "mover". When faced with the problem, the novice programmer will stop working and seek help, while the movers will continue to attempt to solve the problem with feedback from the program code either active or inactive. It is influenced by the mastery of basic concepts and learning motivation. Mastery of basic concepts in depth can reduce errors that resulted in the error of a program, while learning motivation can help students to become "mover" as a novice programmer. Sri Rumini, et al. (2007) argues that motivation is a condition or personal conditions in students who encourage him to perform certain activities with the aim of finding what the student's goals are concerned. Thus, students will be encouraged to explore the basic programming when there is motivation from within himself. According to Sardiman (2014), learning outcomes will be optimal if there is the right motivation. Vice versa, less optimal learning outcomes when there is no motivation in students.

From the description above, it can be concluded that teachers need to generate motivation students at the time of learning basic programming. Programming Assistance Tools or application support programming can be said as a learning media that helps the basic programming learning process. Instructional media has a function as a carrier of information from source to receiver. In this case, the intended source is the teacher and the recipient is a student. Instructional media in accordance with the needs will stimulate the interest of students on a lesson. Programming Assistance Tools is specifically designed to support understanding of programming knowledge and help develop programming skills for beginners (Koorsse, M., Cilliers, C., & Calitz, A., 2014). The enthusiasm of students towards learning can foster their inner motivation. When the motivation is already owned will affect the learning outcomes of students. As in a study conducted by Lies Pebruanti (2015) which shows that the use of learning modules as a medium to support basic programming learning can improve the motivation of learning and learning outcomes of students of class X majors Multimedia lesson 2014/2015 in SMK Negeri 2 Sumbawa.

One of the programming applications that can help students understand the concept of programming and foster a sense of interest is Scratch. Scratch is a programming application based on image blocks to control the flow of the program. The use of blocks as a command is intended to enable children to easily create programs (Kadir and Putra, 2015). Thus, it allows students easier to make the program because it is not fixated with the rules of writing syntax. In addition to easy to use, Scratch also has an attractive interface. Script programming language in this application is packaged in drag and drop view and the results of the programs created in the form of animations are interesting, so it can eliminate the saturation of students when learning basic programming. The advantages of other Scratch applications are to train the creativity of students and provide provision to students to deepen the programming. As the results of research conducted by Ouahbi Ibrahim, et al. (2015), ie from 20 students using Scratch apps, 65% of them consider continuing their studies in programming. While only 10.3% of students who do not use Scratch applications are interested in programming.

This study aims to improve learning outcomes and learning motivation of students by utilizing Scratch application as a supporter of learning. Learning outcomes measured include 3 aspects, namely cognitive (knowledge), affective (attitude), and psychomotor (skills).

Methods

This research is a Classroom Action Research with the subject of first year students in high school, amounting to 35 people. The data used in this study in the form of learning outcomes and learning motivation students. According to Bloom (1959) in Ratnawulan, E. & Rusdiana, H. A. (2014), learning outcomes consisting of three aspects, namely cognitive, affective, and psychomotor. Sources of data obtained from several sources, namely basic programming teacher, students of computer and network engineering classes 3 and documents in the form of observations, interviews, and test results understanding. Data collection techniques were conducted in various ways, that are tests performed to obtain the cognitive value of students, observations were made to obtain affective values (attitudes),

learning motivation data, and the suitability of the learning process with the Learning Implementation Plan that has been designed as well as interviews as follow-up of the results observation of the motivation of students. In addition, document analysis of existing documents, such as observation sheets, interviews, and learning outcomes of students consisting of cognitive test results, affective judgment (attitude), and psychomotor assessment (skills). The technique of data validity test used is triangulation data test. In this study, researchers used triangulation of data sources. Types of data analyzed in this study are quantitative data and qualitative data. Quantitative data are analyzed descriptively while the qualitative data are presented in the interesting narrative. The indicators of research performance are measured from the completeness of learning outcomes and the percentage of motivation to learn, that is equal to 75% of the number of students.

This research is based on the Deakin Model proposed by Kemmis and Robyn McTaggart (Tanujaya, B. & Mumu, J., 2016) which is implemented in two cycles, cycle 1 and cycle 2. Cycle 1 is held in 3 meetings while cycle 2 is held in two meetings. In each cycle, there are three activities, namely planning, action and observation, and reflection. The material taught in this research is the loop control structure. Learning cycle 1 applies Scratch application with Problem Based Learning model. Model Problem Based Learning is a model that can train the ability of students to solve problems. Therefore, at the beginning of the cycle required a model that can help students to think to solve problems in programming concepts. This is evidenced by Nofitasari (2016) through his research that shows that problem-based learning by using Robomind application can improve understanding of basic concepts of student programming algorithm. Learning in cycle 2 applies Scratch application with the model of Project Based Learning. The Project Based Learning model emphasizes students to learn independently, actively, and creatively. In this case, the model is combined with Scratch application so that it can improve students' understanding through project work. This has been done by Sitaresmi, K. S., et al. (2017) in his research indicating that the application of project-based learning can improve the activity and learning achievement of students.

Result and Discussion

3.1 Result

3.1.1 Pre-Cycle Data

Pre-cycle phase begins by making observations on the learning process, interviews with teachers and students as well as tests of cognitive understanding. From the observation, the researchers identified the problems that occur when the learning process takes place. Basic programming lessons get the attention of students. The motivation of students to follow the learning is low. On average of the five indicators observed, only 40.3% of the students attended the basic programming learning process. To be more clearly presented data of observation result of pre-cycle learning motivation in Table 1. Low student motivation cause students' understanding of basic programming material less than optimal. From the results of interviews with students can be concluded that students difficulty receiving the material given because of less interesting learning. Monotonous learning causes a lack of motivation for students to follow. Conveying the programming algorithm concept material is not accompanied by the practice of making students bored and difficult to understand the material. Lack of understanding of the concept of programming algorithms that impact on low learning outcomes is demonstrated through pre-action testing (as a cognitive assessment), attitude observation (as an affective judgment), and portfolio assessment (as psychomotor judgment) conducted by the researcher. Learning outcomes taken from the average value of these three aspects show a low number of mastery. Of the 35 students, only 25.7% had values above the KKM (Minimum Criterion of Completeness). For more details, preliminary learning results are presented in Table 2.

Student learning outcomes are less optimal indicated because of lack of motivation in the students to follow basic programming learning. This is because the learning provided by the teacher still does not attract the attention of students. Therefore, efforts are needed to improve the motivation to learn so that learning outcomes can increase. Efforts made to improve both aspects are (1) provide an understanding of the basic concepts of programming algorithms through interesting learning, that is by utilizing Scratch application as a supporting media of learning; (2) train the ability of students to determine step completion of programming algorithm by using Problem Based Learning model.

Table 1. Observation Result of Student Motivation Pre-Cycle

Indicator	Average (%)
Showing enthusiasm for learning	49
Nice to try the exercises given	28.6
Not easy to despair when faced with obstacles	17.1
Diligent in doing the task	38.1
Diligent and energetic	68.6
Average	**40.3**

Table 2. Completeness of Learning Outcomes Pre-Cycle

Criteria	Complete (%)	Uncomplete (%)
Cognitive	14.3	85.7
Affective	14.3	85.7
Psychomotor	88.6	11.4
Learning outcomes	**25.7**	**74.3**

3.1.2 Result of Cycle 1

Basic programming learning in cycle 1 applies Scratch application using Problem Based Learning model. The teacher divides the class into several groups, then gives the worksheet as an exercise using the Scratch app. The first exercises of the students are asked to make simple animations, while the second exercise of the students is assigned to make the game simple.

Motivation students learn on learning cycle 1 gradually increase each meeting. Starting from the first meeting of 65.9%, second meeting 75.4%, and third meeting 85.1%. So that the average of the three meetings reached 75.1%, which means that the indicators of research performance have been achieved for aspects of learning motivation. This is due to the interest of students of Scratch application. Although initially a bit difficult to introduce Scratch applications, but students are always motivated to create games through the application. In addition to learning motivation, learning outcomes of students in cycle 1 also increased. Completeness of learning outcomes of students reached 71.4%. Percentage of completeness for each of the criteria of the completeness of cognitive test results of 52.9%, affective assessment of 74.3% and psychomotor assessment of 74.3%. Although the improvement in learning outcomes achieved in cycle 1 is significant, the results have not yet reached the established performance indicators. Presented data result of observation of learning motivation cycle 1 in Table 3 and data of completeness of learning result of cycle 1 in Table 4. Based on the results of action cycle 1, the implementation of cycle 2 considers the reflection, among others: (1) learning outcomes of students has increased by 45.7%. However, learning outcomes in cycle 1 have not reached the established performance indicators. This is due to the uneven learning experience of students. Due to computer limitations, some students do not feel the practice directly. In addition, the subject matter of the loop control structure has not been fully delivered through the Scratch app. So it is necessary to strengthen the understanding of the loop algorithm as a basis for understanding the structure of the iteration control in the middle of the game making game; (2) teacher guidance on learning using Problem Based Learning model is still dominant, so that participants can not learn independently. Alternative learning model that can spur the independence of students in learning programming is Project Based Learning. In addition, to train the independence of students, Project Based Learning also hone the creativity of students through a project-based assignment.

Table 3. Observation Result of Student Motivation Cycle 1

Indicator	Average (%)
Showing enthusiasm for learning	69.6
Nice to try the exercises given	86.2
Not easy to despair when faced with obstacles	64.5
Diligent in doing the task	68.9
Diligent and energetic	86.4
Average	**75.1**

Table 4. Completeness of Learning Outcomes Cycle 1

Criteria	Complete (%)	Uncomplete (%)
Cognitive	52.9	47.1
Affective	74.3	25.7
Psychomotor	74.3	25.7
Learning outcomes	**71.4**	**28.6**

3.1.3 Result of Cycle 2

Based on the results of reflection on cycle 1, Teachers and researchers strive for each student to operate the computer so that they gain the same learning experience. In addition, Teachers and researchers prepare the material to reinforce the material of the loop control structure that can not be covered in a Scratch application.

Student learning motivation is increasing, that is 82.8% at first meeting and 84.9% at the second meeting. The average of both meetings exceeded the predetermined target of 83.9%. This is because the student feels challenged after being given the project task of creating a program. In this 2nd cycle, students can operate their computer, so that all students get the same learning experience and focus their learning better. For more details can be seen in Table 5 that is the result of observation of learning cycle 2 motivation.

Learning outcomes of students in cycle 2 experienced a significant increase. Completeness of learning outcomes of students cycle 2 reached 94.3%. Percentage of completeness for each criteria include cognitive test result completeness of 85.7%, affective assessment of 94.3%, and psychomotor assessment of 91.4%. The result has reached the set target. Presented data completeness of learning outcomes of students cycle 2 in Table 6.

Based on the results that have been described, the results of reflection for learning cycle 2, among others: (1) learning outcomes and motivation students have achieved the target set; (2) the learning focus of students improves. Students are no longer preoccupied with anything else that disrupts the learning process; (3) learning by applying the model of Project Based Learning is considered quite effective, because it can train students to learn actively and creatively; (4) students more easily understand the basic programming material when they practice directly using an application, especially the application is easy to use by students; and (5) obstacles that occur during learning one of them is lack of time. This leads to less than optimal learning.

Table 5. Observation Result of Student Motivation Cycle 2

Indicator	Average (%)
Showing enthusiasm for learning	81.8
Nice to try the exercises given	96.5
Not easy to despair when faced with obstacles	64.9
Diligent in doing the task	78.6
Diligent and energetic	96.5
Average	**83.9**

Table 6. Completeness of Learning Outcomes Cycle 2

Criteria	Complete (%)	Uncomplete (%)
Cognitive	85.7	14.3
Affective	94.3	5.7
Psychomotor	91.4	8.6
Learning outcomes	**94.3**	**5.7**

3.1.4 Comparison of Cycle Results

Based on the description of the results of the actions of cycle 1 and 2 that have been presented, then to show improvement of students' learning outcomes and motivation, the researcher presents the improvement of the result completeness of the action in Table 1 and graph of the improvement of the result of action in Figure 1 below:

Table 7. Improved Completion of Action Results

Indicator observed	Percentage Completed Learning Students (%)		
	Pre-Cycle	Cycle 1	Cycle 2
Learning outcomes	25.7	71.4	94.3
Motivation to learn	40.3	75.1	83.9

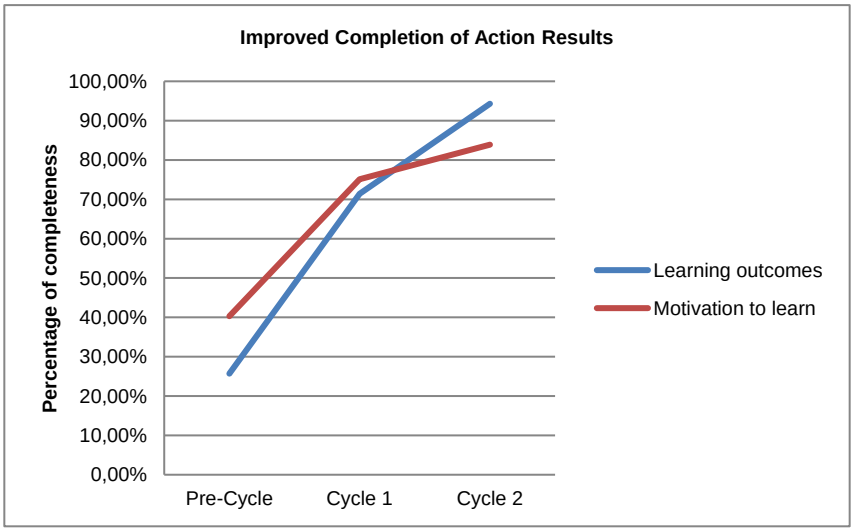

Figure 1. Graph Improved Results Complete Action

3.2 Discussion

Based on the description of the results of research that has been submitted shows that the basic programming learning by utilizing Scratch application can improve learning outcomes and motivation students class X TKJ 3 SMK N 1 Sawit on the basic competence of the loop control structure. During the research process, found several important findings that are correlated with the basic theory and relevant research. The findings are: (1) understand the basic concepts of recurrence algorithms through Scratch apps. Based on the results of the actions that have been done, basic programming learning with the help of Scratch application can improve understanding of the basic concept of a learning algorithm. Understanding the basic concepts of algorithms is not easy to do by students if only done by memorizing. The Scratch application as a programming tool is applied to this research to help teachers give a clear explanation of the recurrence algorithm. In addition, Scratch application provides convenience to students to understand basic programming concepts because the application does not impose syntax rules in making a program. This is in line with research conducted by Malan and Leitner (2007) which showed a decrease in the failure rate of students in the introductory programming learning when Scratch application used to introduce the concept of programming; (2) creating students motivation through Scratch application. Motivation to learn has an important role to the learning process. One such role is to determine learning diligence. According to Hamzah (2016), a child who has been motivated to learn something, he will try to study it well and diligently, in the hope of getting good results. In that case, it appears that the motivation to learn causes a person to diligently learn and encourage someone to succeed. From the results of this study indicate that the motivation students learn to increase. Students complete the exercises given vigorously. Utilization of Scratch application conducted on this classroom action research is proven to motivate students to deepen the programming material. This is in line with the results of research conducted by Ouahbi Ibrahim, et al. (2015) indicating that the use of Scratch apps greatly motivates students and provides them with the tools to deepen programming. Of the 20 students using the Scratch app, 65% of them are considering continuing their studies in programming. While only 10.3% of students who do not use Scratch applications are interested in programming.; and (3) improving student's learning outcomes through project work. Project-based learning is used as one of the learning models combined with the application of Scratch application in this study. Project-based learning is a learning model that provides an opportunity for teachers to manage the classroom by involving project work. Project-based learning has the potential to provide an exciting learning experience. Through project-based learning can train the student, creativity, and independence of students in doing the assigned task (Thomas in Made Wena, 2009). In this study, students are given the opportunity to carry out the practice of making games or animations through the Scratch app. From the results of research that has been done, student's learning outcomes have increased significantly. In cycle 1 the completeness of learning outcomes of students only amounted to 71.4% while in cycle 2 by applying project-based learning mastery learning achievement increased up to 94.3%. This suggests that project-based learning involving students in project work can practice students to learn independently, innovatively, and creatively. In line with research Fikriyah, M., et al. (2015) implementing project-based learning. The results of this study indicate that there is a relationship between science process skills and student physics learning outcomes using project-based learning model with audio-visual media. In this study, project-based learning can improve student's understanding of the basic competence of a looping control structure.

Conclusion

Based on the results of classroom action research using Scratch application on basic programming learning in class X TKJ 3 SMK Negeri 1 Sawit academic year 2016/2017 can be summarized as follows: (1) Scratch application utilization on basic competence Structure of Repetitive Control able to improve students learning result, namely classical completeness in cycle 1 of 71.4% then in cycle 2 increased to 94.3%; (2) the utilization of Scratch application can increase learning motivation of students, that is in cycle 1 the average of learning motivation percentage of students reach 75.1% then in cycle 2 increased to 83.9%.

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