

## The Influence of Active Learning Strategy which is integrated with Computer Simulation on the Students' Critical Thinking Skill

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**Abstract :** This research was a quasi-experimental design that aims to obtain a description of students' critical thinking skills between the students taught by active learning strategy which is integrated with computer simulation and the students taught using conventional learning at physics department in academic year 2017/2018. Based on the result of expert validation analysis on instructional device, it is found that all learning tools namely computer simulation, semester learning plan, student worksheet, and critical thinking instruments are valid and reliable with above 90% average value which is in a very high category. The result of the statistical analysis shows that the average score of critical thinking ability of experimental class is 19.53 in a high category while control class is 0.82 with a low category. In addition, the variance and standard deviation of the experimental class were 3.264 and 1.81 while for the control class it was 14.33 and 3.79. It indicates that the data deviation in control class is smaller than in the experimental class. Based on the non-parametric inferential analysis, it is found that the application of active learning strategy which is integrated with computer simulation significantly influences student's critical thinking ability. This study found that there is a tendency that the critical thinking skills of students increased after giving treatment. Based on hypothesis test through two free sample test namely Mann-Whitney test, it can be concluded that there is a significant difference in critical thinking ability between students who taught using active learning strategy which is integrated with computer simulation and the students who taught using conventional learning.

**Keywords -** Strategy active learning, critical thinking skills, computer simulation

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### I. Introduction

The rapid development of information technology and the flow of globalization in the 21st century cannot be avoided so that Higher Education as one of the higher education in the formal education after the secondary education is required to produce qualified graduates which can adapt to the situation faced.

In the curriculum of the Framework of National Qualification of Indonesia, it is mentioned that there must be competence that should be possessed by students to face the challenges of the future. They should be able to apply the field of expertise and utilization of science and technology in its field. They must be able to master the theoretical concepts of cognitive knowledge. In addition, they must be able to make informed decisions based on information and data analysis. They also should be able to provide guidance on choosing alternative solutions independently and in groups (high-order thinking skills).

Critical thinking is an academic competency as important as reading and writing. He thinks that critical thinking is a skilled and active interpretation and evaluation of observation, information, communication and argumentation [1]. Critical thinking is a disciplined way of thinking in evaluating the validity of a statement, idea, argument, and research. Likewise, critical thinking is a process that emphasizes sensible and rational trust through standard and procedures to analyze test and evaluate [2]. From some opinions above, it can be said that critical thinking is a thinking skill that involves students' cognitive thinking process so that people can interpret, analyze and evaluate ideas or arguments.

To achieve such competence, students need to be given meaningfulness activities in learning which are tailored to their environment. Students need to facilitate lectures that enable them to access all learning resources so that it can create meaningfulness in learning to build their own knowledge in their minds [3]. Therefore, qualified lectures by applying learning strategies that lead to the achievement of these two competencies are needed to improve understanding the concept of critical thinking skills

According to Indonesian dictionary, Physics is the science of matter and energy (such as heat, light, and sound). Meanwhile, according to the encyclopedia, physics is the study of objects and movements and their benefits for human life. Physics is taught in Indonesia from basic education to higher education.

There are some objectives of the Physics learning in the curriculum 2016. The students can define the physical phenomena through observation and experiment. They can produce a mathematical or physical model according to the hypothesis. They can analyze the various existing alternative solutions to physical problems and summarize them for appropriate decision making. In addition, they can predict the potential application of physical and technological behavior.

In its practice to achieve the above objectives the graduate's profile is realized through learning with the object of indirect study and the object of direct study covering concept, fact, process skills and principles [4]. The concept is a synthesis or logical connection to the relevant information through a mental formation of the given group of facts [5]. The principle is the object of physics that states the relationship of two or more other physical objects, such as facts, concepts, operations, or other principles. Principles in physics can be axioms (postulates), properties, lemma, or theorem.

The ongoing process of physics learning is more focused on the object of direct study. The objects of indirect study such as the theory of proof, critical thinking, and group work are still limited to the accompanying impact which is not specifically taught or trained [6]. It has an impact on the lack of attention by teachers and students in involving the objects of indirect study in learning.

Therefore, innovative learning oriented to the development of object studies directly or indirectly oriented to mastering the concept and mastery of critical thinking skills needs to be designed. Learning media that can train ways to develop the ability mastery of concepts and thinking skills is through computer simulation.

The results of the study conducted by [7], [8] show that computer simulation can be used as a learning medium to improve the understanding of the concept and thinking ability. In line with this statement, it is revealed that simulation is considered as something exciting, fun and better than conventional learning in improving mastery of students' concepts and thinking skills, especially in science exploitation [8]. Furthermore, it is stated that interactive media containing computer simulation is an interesting and interactive approach due to dynamic feedback, using constructivist approach [9]. There is room for playing and doing something. There is the visual model or access to the visual model, and there is the existence of limits for the purpose of increasing student productivity. In addition, there is a significant relationship between computer media, video and games and students' critical thinking skills [10].

In physics, there are abstract concepts, and therefore it requires an interactive media that can arouse emotions and facilitate students in understanding these abstract concepts. Applying computer simulations in student learning can help students in understanding the abstract concepts and can train critical thinking skills [9].

However, learning device using computer simulations that have been developed is not effective if it is not implemented using the right strategy. Therefore, appropriate learning strategies that can develop mastery of concepts and high-level thinking skills including critical thinking skills need to be designed.

National Education Standards Agency in 2010 wrote the paradigm of learning in the 21st century. Learning is no longer teacher-centered but student-centered and the teachers play a role as facilitators. Learning is designed for multi-way communication. Students utilize all available learning resources. Students actively find knowledge not only accept teacher explanations. The learning is contextual. There is team or group learning. Seventh, selection of materials should be appropriate according to the students' needs. There is the utilization of all the five senses in learning. There is the utilization of media and technology in learning. The learning accommodates cooperative learning. The learning is tailored to students' interests. The learning is from a single conscious effort to the plural. It is from one science to the knowledge of the plural discipline. It is from centralized control to autonomy and trust. It is from factual thinking to critical. It is from the delivery of knowledge to the exchange of knowledge.

With the above paradigms in learning, it is necessary to design a strategy that can accommodate those paradigm changes which can specifically improve students' critical thinking skill according to the purpose of this research. Learning strategy is designed to involve students in some activities by utilizing all sources and media such as simulations that can be accessed easily and accommodate the occurrence of multi-way communication.

The appropriate learning strategy according to the researcher is an active learning strategy. This is based on the results of various expert opinions. Active learning is a fun learning lesson because it involves students actively in learning process not only mental but also physical mainly in finding the main idea of subject matter, problem-solving, and applying its knowledge in real life [11]. The active learning is learning by involving students' activities in accessing various information and knowledge [12]. Therefore, the students gain experience in improving their competence. Active learning enables students to develop high-level thinking skills such as analyzing, synthesizing and evaluating learning events and applying them in their life.

From the above description, the researchers believe that critical thinking skills can be enhanced through active learning strategies integrated with computer simulation because it can attract the attention of students and engage students to be active in any learning process that allows them to analyze, synthesize, and evaluate.

Simulation here serves to dig more profound knowledge with a more youthful manner to predict an event or estimate the performance of a complex system. It is supported by the statement presented by [13] that learning by using a web-based simulation can improve the critical thinking skills of students majoring in physics.

### **1.1. Formulation of the problem**

Based on the background described above, the formulation of the problem in accordance with the root problem solving is how the active learning strategy which is integrated with computer simulation influence critical thinking skills of students in Physics Studies Program at Faculty of Science, Universitas Negeri Makassar. Therefore, the researchers proposed the following research questions:

1. How are the description of critical thinking skills of students who are taught by active learning strategies and those who taught by conventional methods?
2. Are there any significant differences in critical thinking skills between the students who are taught by active learning strategies and those who are taught by conventional methods?

### **1.2. The Objectives of the Research**

The implementation active learning strategy can improve students' critical thinking skills. Therefore, the objectives of this study are:

1. To know the description of critical thinking skills of the students who are taught by active learning strategies and those who are taught by conventional methods
2. To find out whether there is a significant difference between the students who are taught using active learning strategies and those who are taught by conventional learning.

## **II. Literature Review**

### **1.3. Active Learning Strategy**

A learning strategy describes the common components of a set of learning materials and procedures that will be used with those materials to produce a particular learning outcome for students [14]. They mention five common components of the learning strategy namely pre-learning activities, presentation of information, student participation, tests, and follow-up.

Active learning is learning that invites students to learn actively. When students learn actively, it means they dominate the learning activities [11] Active learning is intended to optimize the use of all the students' potency. Therefore, all students can achieve satisfactory learning outcomes according to their characteristics. Furthermore, active learning is also intended to keep the attention of students to stay focused on the learning process.

Active learning is trying to strengthen and accelerate the students' stimuli and responses in learning so that the learning process becomes fun, and it is not a boring thing for them. By providing active learning strategies, the students can help their memory, so that they can be delivered to the learning objectives successfully.

In the active learning method, each new subject matter must be associated with various knowledge and experience that existed before. New learning materials are provided actively with existing knowledge. The teachers need to create appropriate strategies in such a way so that students have a high motivation to learn [15].

### **1.4. Active Learning in Higher Education**

Achievement of the lecture competence is highly dependent on some aspects. One aspect that greatly affects is how a teacher is implementing learning. The current learning trend is still centered on lecturers by lecturing method. Students are less actively involved in the learning process. As a result, the level of student understanding of lesson material is not optimal. Moreover, media is rarely used in learning so that learning becomes less meaningful.

Every student has tremendous potential to develop. It is like a gold mine which is ready to be dug. Therefore, a lecturer is expected to explore and develop the potential of each student. One way that can be taken is to manage the learning process which can provide opportunities for students to engage and express all their potentials. One of the strategies employed for this purpose is by PAKEM learning. This learning is active learning that emphasizes the active involvement of students to experience them, find, and solve problems so that their potential develops optimally.

As with active learning in school, active learning in the college is based on the principle that the best way to learn for students is to do, by using all of its senses, and by exploring the environment consisting of people, things, places, and events that occur in real life. Additionally, through the direct experience, the results will be more optimal and meaningful for students. Active involvement with the social and physical environment and ideas related to real life will encourage students to actively think to gain new knowledge and integrate it with the knowledge they already have.

To facilitate active learning, lecturers must employ various active and practical strategies, to generate cooperative learning and accommodate gender differences and learning styles of each student. It is useful to maximize the learner's ability to understand new things and be able to use the new information in their daily lives.

Active learning can also elevate the level of learning from the low levels to the higher level of critical thinking skill. The low level of critical thinking skill consists of observation, memorization and recalls information, knowledge of general ideas. It is about what, where and when. The higher level of critical thinking skill consists of problem-solving, analysis, synthesis, evaluation. It is about how and why. At the university level, the power of active learning that develops high-level thinking skills needs to be a concern.

### **1.5. Advantages of Learning based on Computer Simulations**

Computer technology can add an "interactive" feature to the learning media, which is the media's sensitivity to the user's response. This feature is designed through the application of a computer application program that is designed for this purpose. However, the user of computer media module is a student. Therefore, the display of such media should be designed in such a way, so that it attracts students to learn. This effort can be pursued by observing the principles of making visual media, namely the simplicity of unity, emphasis, and balance [16].

It is found that simulations are perceived as interesting, fun, enhancing creative thinking skills, and it increases achievement of learning outcomes compared to traditional teaching methods, especially in natural science [7]. It is identified the characteristics of interactive media containing physics simulations that support student learning [9]. There are at least six characteristics. It is an interesting and interactive approach. It has dynamic feedback. It uses constructivist approach. There is the existence of feedback space to play and work on things. There is the existence of a visual model or access to the visual model. It is to increase student productivity.

Many of the benefits can be derived from the use of computer media as a learning tool. Computer-based teaching can develop students' thinking skills [16]. Furthermore, the use of computer media can balance the needs of time and processing needs of certain tasks, and allows the development of varied learning approaches. The computer (micro) can be a teaching medium that can visualize facts, skills, concepts, and computers as well as display images that move according to their needs [17].

The use of computers that are interactive with the user is proposed by [18], [19]. They state that computer programs that can display diagrams or drawings can be designed to adjust to student responses. Furthermore, the use of computers can be designed so that they can interact with their users. Furthermore, it is stated that "computer system can provide delivery instruction by allowing them to interact with the lesson programmed into the system; that is referred to computer-based instruction [20]." It shows that the computer system can deliver learning individually and directly to students by interacting with subjects that are programmed into the computer system. It is called computer-based learning. In line with the opinions expressed by [20], the reality in the field shows that the speed of the students studying material is not only supported by the students' cognitive skills but also influenced by the students' skills in operating the computer.

Learning by using computer media makes students active in learning because a statement of reinforcement accompanies the questions. Student motivation increases because they are easier to follow and understand the material given. The advantages of computers can be a new means for the student that can motivate them to pursue the subject matter [16]. Their speed in responding to student responses is something that contains reinforcement values and allows individual teaching to work properly.

### **1.6. Learning, Learning Outcomes, and Critical Thinking**

Learning is a process of behavioral change due to individual interaction with the environment. Individuals are said to experience learning, although in themselves there is only a change in behavioral trends [21]. These behavioral changes include knowledge, understanding, skills, and attitudes that can or cannot be observed. It is stated that learning is an internal process for each (outcome) that is the result of the transformation of stimuli originating from external events in the personal environment (condition) [18].

The success of learning is measured by student learning outcomes. Learning outcomes are the abilities owned by students after they have received their learning experience. Howard Kingsley divides three kinds of learning outcomes, namely skills and habits, knowledge and understanding, attitudes and aspirations. Meanwhile, Gagne divides the five categories of learning outcomes, namely verbal information, Intellectual Skills, cognitive strategy, attitude, and motor skills. Learning outcomes are divided into three domains, namely the cognitive, affective and psychomotor domains [22].

Learning outcomes in the cognitive domain at the application level (C3), analysis (C4), evaluation (C5) and creation (C6) are high-level cognitive aspects as measured by students' thinking ability [23]. Critical thinking skills include one of the highest-order thinking skills that are essential in problem-solving problem

[24]. Meanwhile, critical thinking is the ability to reason and reflective thinking that is directed to decide the things that are convincing to do [24]. Critical thinking process includes the use of the basic thinking to analyze the arguments and generate insight into the meaning and interpretation of specialized. It develops patterns of reasoning cohesion, which logically, understand the assumptions and biases. It marks special signs and gets the style of presentation that is credible, solid and convincing (TOT National-Expansion 2010).

There are 12 critical thinking indicators summarized in 5 groups of thinking skills, namely providing elementary clarification, building basic skills, making the inference, making the advance clarification, and providing strategies and tactics [24].

### III. Research Methods

#### 1.7. Types and Research Subjects

This research used quasi-experimental research method with quantitative approach. The research was conducted in 2017 with the subject of the study of physics study program of Faculty of Natural Science, Universitas Negeri Makassar located at Daeng Tata Parangtambung Makassar Street.

**Table 1.** Research design

Group	Treatment	Test
Experiment	X1	T1
Control	X2	T1

Notes:

X<sub>1</sub> : The treatment of the experimental class by using

Active learning Strategy which is integrated with computer simulation

X<sub>2</sub> : Treatment of control class using conventional learning

T1 : Test after Magnet Power Lesson

The research subject is determined by using purposive sampling techniques based on certain considerations. The selected samples were physics students of physics study program in the academic year 2017/ 2018 consisting of two classes in which each class consist of 17 students. The first group or experimental group is taught by active learning strategy integrated with computer simulation while the second group or control class is taught by conventional learning.

#### 1.8. Research Instruments

The instruments and learning tools used have been validated and it is feasible to be used in research. Such instruments and devices are critical thinking skill instruments, observation sheets, validation sheet and computer simulation, and student perceptions of learning by using computer simulation and its device. Data were collected using test instrument and non-test instrument. The test instrument technique in this study is in the form of written test (multiple choice questions) in which the number of questions is 30 numbers to measure critical thinking skills of physics students.

#### 1.9. Data Analysis Technique

Descriptive analysis and inferential analysis of data obtained in this study were conducted. To assist the analysis process, the researchers used SPSS software.

##### 1.9.1. Descriptive Analysis

Descriptive statistics are used to describe the critical thinking skills that students acquire after following the subject matter both in the experimental class and in the control class. It is intended to know the state of the sample. SPSS is then used to determine the average score, standard deviation, and variance. Furthermore, frequency distribution table is for categorizing posttest score.

##### 1.9.2. Quantitative Descriptive Analysis

Based on the assessment by three validators, the content validity analysis for each statement item using CVR (Content Validity Ratio) is used, while the validity analysis of each aspect consisting of several items using CVI (Content Validity Index) equation.

Assessment is categorized valid if CVR or CVI is in the range value 0 to 1. To calculate the CVR, the researchers used formula according to [25] as follows:

$$CVR = \frac{n_e - \frac{N}{2}}{\frac{N}{2}}$$

### 1.9.3. Inferential Analysis

Inferential statistics are used to test the research hypothesis. Before the hypothesis is tested, the prerequisite test is conducted. The prerequisite test is the test of data normality and homogeneity test. All the data of the tests were analyzed using SPSS.

#### a. Normality test

To test the hypothesis, then first the basic test of data normality test is conducted. Normality test is intended to determine whether the data normal distribution or not. Data is normally distributed when  $\chi^2_{count} < \chi^2_{table}$  where  $\chi^2_{count}$  is obtained from  $\chi^2$  with dk = (k-3) at significance level ( $\alpha$ ) = 5%.

#### b. Homogeneity Test

Homogeneity testing is used for knowing what data will be correlated that meet homogeneous. The criterion of the testing is if  $F_{count} \leq F_{table}$ , then the data is homogeneous. On the contrary, if  $F_{count} > F_{table}$ , then the data is not homogeneous with degree of freedom = (n-1) and degrees denominator dk = (n-1) at the significance level ( $\alpha$ ) = 5%.

#### c. Hypothesis Test

Hypothesis testing is intended to answer the hypothesis that has been proposed is whether there is a significant difference between students who are taught using active learning strategy which is integrated with computer simulation and the students who get conventional learning. For normally distributed data and having the variance which is homogeneous, then the test is carried out using t-test in which the hypothesis statistics used is as follows:

The research hypothesis that will be tested is:

$$H_0 : \mu_1 = \mu_2$$

$$H_1 : \mu_1 \neq \mu_2$$

## IV. Results

### 1.10. Descriptive analysis of Critical Thinking Skills

The description of the students' scores of critical thinking skills who are taught using active learning in experimental class and the score of students who are taught by traditional learning are shown in Table 2.

Table 2 shows that the average score of critical thinking skills of students who are taught using active learning strategies in experimental class is 19.53 with a standard deviation of 1.81 and variance of 3.26. Meanwhile, the average score obtained by students in the control class is 10.88 with a standard deviation of 3.76 and variance of 14.11. It shows that the average score of students who are taught using active learning strategies in the experimental class is higher than the average scores obtained by students in control class who are taught using conventional teaching.

The description of the categorization score of critical thinking skill of the students in experimental and control class can be seen in table 3.

**Table 2.** Description of Critical Thinking Skills of Experimental Class and Control Class of Physics Program, Faculty of Natural Science, Universitas Negeri Makassar

Statistics	Critical Thinking Skills	
	Experiment	Control
Average	19.53	10.88
median	20.00	11.00
Mode	19.00	13.00
Standard Deviation	1.81	3.76
Variance	3.26	14.11
Range	8.00	15.00
Minimum	15.00	4.00
Maximum	23.00	19.00
Count	17	17

**Table 3.** Frequency Distribution of the critical thinking scores of the students in experimental and control class

interval class	Category	Experiment Class		Control Class	
		Frequency	(%)	Frequency	(%)
24-30	Very high	0	0	0	0
18-23	High	15	88.24	1	5.88
12- 17	Medium	2	11.76	7	41.18
6- 11	Low	0	0	8	47.06
0-5	Very low	0	0	1	5.88
Total		17	100	17	100

The results of the analysis in Table 3 shows that the average score of critical thinking skill in the experimental class is 19.53 in which the interval is 18-24 which is in the high category where the percentage is 88.24%. The average score in control class is 10.88 in which the intervals of 6-12 which is in the low category where the percentage is 47.06%.

### 1.11. Results Analysis Critical Thinking Skills inferential

In addition to the descriptive analysis, the research data were also analyzed inferentially to test the hypothesis. Before testing the hypothesis, normality data is first tested.

#### 1.11.1. Normality Test

Testing normality can be performed by two methods. They are the method of Kolmogorov-Smirnov and Shapiro Wilk. Based on the results of the analysis, the significance of the data on critical thinking skills is 0.048 in experimental class. However, the significance value in the control class is 0.200. If the significance value > 0.05, it means that the data normal and otherwise if it is <0.05, it is not normal. From the above data, the experimental class is not normally distributed whereas the data in control class are normally distributed.

#### 1.11.2. Hypothesis Test

Hypothesis testing can be conducted by two methods. They are parametric and non-parametric methods. The non-parametric test using Mann-Whitney test is performed because the research data are not normally distributed. Based on the analysis, the significance value of the critical thinking skills data is 0.00. If the significance value > 0.05, it means that the  $H_0$  is accepted and  $H_a$  is rejected, otherwise if the value is <0.05, it means that  $H_a$  is accepted and  $H_0$  is rejected. It can be concluded that the significance value is 0.00 then  $H_a$  is accepted, and  $H_0$  is rejected.

$H_0$ : There are no significant differences in the critical thinking skills of physics students who are taught using active learning which is integrated with computer simulation and the students who are taught using conventional methods.

$H_1$ : There are significant differences in the critical thinking skills of physics students who are taught using active learning which is integrated with computer simulation and the students who are taught using conventional methods.

Based on the results of hypothesis testing using non-parametric methods, it can be concluded that "there are significant differences in students critical thinking skills of the Physics students who are taught using active learning which is integrated with computer simulation and the students who are taught using conventional methods."

### 1.12. The Observation Results of the Student Activities during Learning Process

The observation results indicate that the level of student activities for each indicator of Critical Thinking Skills for learning increases in every meeting that consists of several aspects observed. The students' activities during the learning process are conducted by providing an individual assessment in each group, and they are then summed for each individual score to determine the average score as the score group.

**Table 4.** The results of the analysis of activities for each group in three meetings (P1, P2, and P3)

Group	The average percentage of Critical Thinking Skills			Average
	P1	P2	P3	
1	83.64	88.48	93.33	88.48
2	83.03	86.06	92.12	87.07
3	84.85	89.09	90.91	88.28
4	92.52	93.33	93.33	93.06
5	73.33	80.00	78.18	77.17
6	92.73	90.34	95.15	92.74

Based on the assessment in Table 4, it shows that in general the activity of each group has increased and is in the very good category in which the percentage is 76-100 %. The student group that has the highest percentage score is categorized as a super team that is group 3 and 6 in which the scores are 93.06 and 92.74. The next sequence is called a very good team that is groups 1 and 3 in which the percentage of each group is 88.48 and 88.28. The lowest value is categorized as the fair team that is group 2 and 5 in which the percentage is 87.07 and 77.17. The analysis of the overall student activity assessment which includes 12 aspects of critical thinking skills that are observed at three meetings is as follows.

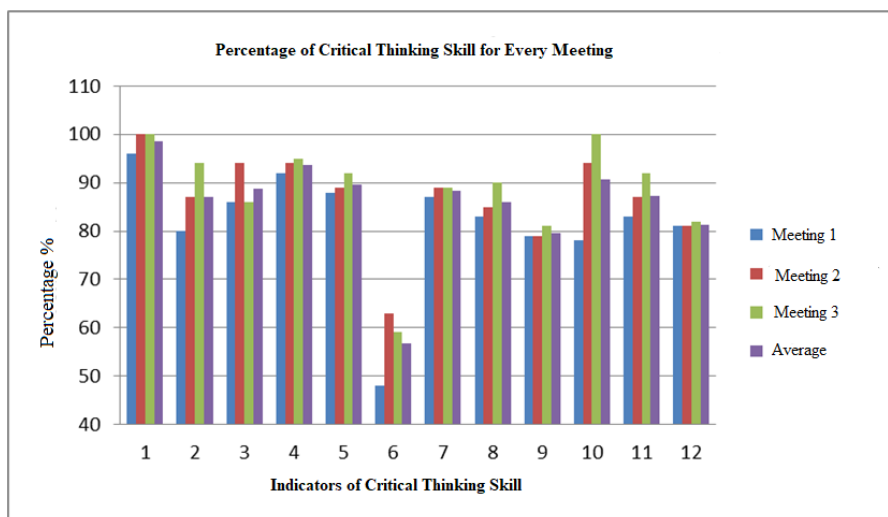


Figure 1. Diagram of Student Activities for Each Indicator of Critical Thinking Skill

From the figure 1 above, it can be seen that in general an increase in the percentage of student activities for all aspects from the first meeting to the third meeting. The aspects are focusing questions, analyzing arguments, asking and answering questions, considering resources, observing and reporting observations, deducing, inducing, considering, defining, identifying assumptions, arranging strategy and integrating with others. Based on figure 1, the students' activity in the aspect of "Focusing Question" had the greatest percentage that is 99%. If it is seen the students' scores on the aspect of focusing questions, almost all the students get the maximum score that is three even though two people obtain 2. The smallest percentage is the aspect of "deducing and considering the results of deduction" that is 57%. The majority of students only get one on this aspect of meeting 1. However, it increases in the 2 and three meeting although it is not significant.

Based on the observers' assessment of each meeting, it is found that students, in general, are active in learning. The student activeness occurs in all aspects except for the aspect of "deducing and considering the deduction results." The results of the analysis of students' perceptions of learning Physics-based computer simulation can be seen in Table 5 as follows:

Based on Table 5, it is obtained students' perceptions of the learning device Physics-based computer simulation that is over 85% which indicates that the students strongly agree on the learning process.

Table 5. The results of Students' Analysis for indicators of statement

Number	Indicators	Percentage (%)
1	Facilities of <i>Computer simulation</i>	90.08
2	Fascination Learning by Using <i>computer simulations</i>	87.89
3	Learning Activities by Using <i>computer simulations</i>	91.05
Average		89.67

### V. Discussion

The preliminary study conducted by the researchers before this study is conducted found that designing a study that could improve critical thinking skills to be able to adapt to changes in the information technology and globalization which are proliferating is required. The development of learning tool which is integrated with computer simulation is believed to be appropriate to improve critical thinking skills because by using the simulation students will be interested in learning. Furthermore, their understanding of the concept will be better



because not all of the material in physics can be an observation or experiment directly. It will help students not to accept a concept or information based on the submission of a person or teacher immediately, but they will be trained to discover knowledge through investigation.

Learning tools and instruments as the result of the development is valid and reliable based on data analysis. The developed learning tool greatly assists teachers and students in teaching and learning in the classroom. From the observation results during the implementation of learning, it is found that the students are more enthusiastic in learning because they are not just passive hearing the lectures as usual but they are more actively communicate to investigate problems raised by lecturers through student activity sheets. To support understanding of the material being taught, they are not difficult to find the source of learning some vital lessons because they have been provided in the form of learning packages such as simulations, video, textbooks and teaching materials which are combined in a single integrated file. It is supported by the selection of appropriate strategies that is active learning. This strategy is considered very appropriate to be applied because it allows them to access all the learning resources for discussion in groups or classes that will increase their ability to analysis and synthesis.

After the implementation of learning, the critical thinking test is given to see whether there is a difference among the group of students who are taught using active learning which is integrated with computer simulations and the group of students who are taught traditional learning. Descriptive analysis showed that the group of students who are taught using active learning which is integrated with computer simulations is more effective in improving students' critical thinking skills than the group of students who are taught using conventional learning. Active learning which is integrated with computer simulation can make the learning process that is no longer centered on the lecturers but the students. The students also become more active and accustomed to think and talk through the activity sheets students who are prepared in groups by requiring students to investigate its own concepts and solve physics problems that require analysis. Meanwhile, the implementation of learning in the control class is that lecturers explain the material along with the tasks performed by the students in groups. The results of the descriptive analysis show that the average score of the critical thinking skills of students in experimental class is 19.53 while in the control class it is 10.88. The average score of these two classes is at the high category for the experimental class and the low category in the control class.

Based on the above description, it can be argued that active learning strategy which is integrated with computer simulation has a role that can help students understand, analyze and resolve problems in physics accurately and can ultimately increase to the inability of critical thinking of students, especially Physics students. It is in line with several previous studies. It is concluded that the use of interactive media in learning could improve critical thinking skills of students [26]. It is also concluded that the critical thinking skills of students could be improved through the use of interactive media for learning [27]. The students who are taught by using active learning strategy which is integrated with computer simulation are more effective in improving their critical thinking skills than the students who are taught using traditional learning. It is in line with what is stated by in [28]. They applied for PhET simulation program on quantum physics learning, and He concluded that applying the model of physics teaching by exploiting computers is more effective than conventional learning. It is in line with the theory of learning, according to [8] in the constructivist theory in which the students have to find themselves and transform complex information. They have to check the new information with the old rules and revise it when the rules are no longer appropriate.

## **VI. Conclusion**

Based on the results of research and discussion which are adapted to the formulation of the problem, conclusions can be drawn as follows:

1. The critical thinking skill of students in Physics study program in academic year 2017/2018 who are taught using active learning which is integrated with computer simulation is the high category while those who are taught by using conventional teaching are in a low category. It means that active learning strategy which is integrated with computer simulation is effective in improving students' critical thinking.
2. There are significant differences in the critical thinking skills of students who are taught using active learning strategy which is integrated with computer simulation and the students who are taught using conventional teaching.

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