Implementation of constructivism approach in physics learning on students’ critical thinking ability of junior high school students

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Abstract. The background of this study is the problem of education in pandemic of Covid 19 where the students should study from home. The students are tended to extra learn and they are asked to understand and comprehend the material deeply by themselves. One of learning approach that can solve their problem is by implementing constructivism approach, especially in physics learning. This study aims to analyze previous studies related to implementing constructivism approach in improving students’ critical thinking ability and to obtain sources to develop physics learning module about constructivism approach for grade VIII. This research method is a meta-analysis with a sample of 10 articles in national and international journals. The data collection is done by collecting and classifying similar scientific articles and then analyzing them. The result of study shows that there are 8 out of articles used experimental research, and others used field research and classroom action research. Furthermore, there are 40% of articles show the effectiveness of constructivist approach to improve students’ critical thinking ability in physics learning such as students can express their ideas by discussing with others students, they can make a conclusion after doing experiment activity, and they train to express their mind by debating. In conclusion, constructivism approach can improve students’ critical thinking ability and it is needed developing beneficial physics module to get more improvement and to be a source in physics learning.

1. Introduction

Physic learning in Junior High School integrated into Science Subject. Although, there are some materials that are separated from Biology. It means that physic material cannot be integrated into biology entirety [1]. Physic learning includes the concept which it needs students’ critical thinking to solve the questions. One of topics of Physic in Junior High School that need students’ critical thinking are reading graphic or ticker time and droplets in motion. If students misunderstand the graphic of motion, they will get a wrong conclusion.

Basically, the most of materials in learning Physic are related to our daily lives. However, the problem is students just think physic is about counting and learning formula. If it is researched deeply, by learning physic students can train their mind to solve their problems in their lives systematically. Even though, physic learning is learnt by Junior High School students, it helps them to solve their problem by themselves.

Therefore, students in class VIII SMP are at 14-15 years old. Commonly, who are at the age of 14-15 years are categorized as adolescents who are greatly influenced by puberty. As a condition in millennial era, many students are less than optimal in learning in general and studying physics in
particular. Therefore, there needs to be a renewal that is developed to be able to increase the reasoning power of class VIII SMP students.

Furthermore, there are some problem happened in physics learning, they are, the students’ interest to learn physic is lower. The lower of their interest is based on their ability to think critically on physic questions such as story, picture and graph is still less. The questions in the form of stories, pictures and graphics can be solved by students if they are able to think or analyze the questions critically. Another problem is the current condition of the world of education during the Civid-19 era, where students are required to learn more at home. They are expected to study the material presented by the teacher independently and draw conclusions by themselves. In this case, it needs students’ critical thinking highly so that they can understand learning well.

Hence, to overcome the problems that are happening at this time, it is very necessary for reforms in learning physic carried out by teachers. The reforms that can be done by the teacher are implementing learning with an approach that can activate students’ critical thinking as a whole and be able to develop their potential into maximum. The learning approach that is thought is student-centered learning. Learning that can make students actively build their own knowledge. One of approaches that can increase the students’ critical thinking in understanding physics material is a constructivism approach.

Constructivism learning is a learning which centered on students (student centered) while the teacher acts as a mediator, facilitator and learning resource in learning. The teacher has the main task of building and guiding students to learn and develop themselves according to own abilities. Constructivist-oriented learning emphasizes self-understanding by students actively, creatively and productively through a meaningful learning process. Students do reasoning through selection and experience of organization and integrate them with what they have already known (Rusman, 2012)[2].

Beside, paying attention to the approach that is used, another thing that must be considered in learning is the tools used to convey messages to students. One of the tools that can be used is learning that is guided into modules. The integration of a constructivism approach in the development of a physics learning module is a combination which is expected to improve the students’ critical thinking ability.

In addition, the learning approach is our starting point or point of view of the learning process [2]. The approach is the main step in forming an idea in looking at a problem or object of study. The approach is the direction of implementing the idea to describe the treatment of the problem or object of study to be studied. Constructivism comes from the word “to construct” which means to form. Constructivism means that the knowledge we have is the result of constructing ourselves. Learning in constructivism is prioritized to assist students in internalizing, reshaping or transforming information. Learning with a constructivism approach is student-centered learning (student centered) while the teacher acts as a mediator, facilitator and resource in learning. By using a constructivism approach, the implementation of learning increases understanding, be more creative and productive through a meaningful learning process.

Furthermore, critical thinking means a process of thinking to be able to draw conclusions. Critical thinking is doing an experiment in the mind so that the result at each step in the experimental sequence is known to the reasoned from that experience. Critical thinking is also defined as the process of reaching logical conclusions based on facts and relevant sources.

The activity of critical thinking is needed in physic learning. Because it doesn’t only comprehend material commonly, but also comprehend the concept of the materials. By having the activity of critical thinking, the students can draw a conclusion related to the material that they have learnt. Based on the illustration above, this study aims to analyze the review of studies that are relevance of constructivism approach in physics learning on students’ critical thinking.

2. Methodology
This type of research is a qualitative meta-analysis with subject of this research is a collection of international journals related to the implementation of the constructivism approach in physics learning.
The sample is taken using the homogeneous strategy, which is to choose samples with the same characteristics so that they can be studied in depth. The research sample was 10 of national and international articles related to the implementation of the constructivism approach in learning physics on students’ critical thinking abilities.

The procedures in this study were based on to the steps of conducting a meta-analysis [3], they are: (1) Determining the problem or topic to be studied. The problem or topic that was studied in this study was articles related to the constructivism approach to learning physics (2) Determining of the period of research results that are used as data sources. Research results that are used as data sources in this study are a collection of journals related to the topic;(3) Looking for research reports related to the problem or topic to be studied; (4) Reading the titles and abstracts of the research report to see if the contents correspond to the problem to be studied; (5) Focusing of the research on problems, research methodology such as type of research, place and time of research, methods, population, samples, sampling techniques, data analysis techniques, and results; (6) Categorizing each study; Comparing the results of all studies according to their categories; (8) Analyzing the conclusions found by examining the results of the study by examining the methods and data analysis in each study so that the advantages and disadvantages of previous research can be identified; (9) Drawing conclusions on the meta-analysis research on the basis of the seventh and eighth steps above.

In this research, researcher chose 10 articles related of constructivism approach. After getting articles, they classified based on title, design of the research and purposes. Then, they were calculated into percentages. These percentages were compared and discussed.

3. Results and Discussion

Based on the analysis of the data from national and international articles related to constructivism approach, there are some articles that showed results of constructivism approach could improve students’ critical thinking. By doing the steps of meta-analysis research, the researcher mapped the result of the data in the following table:

| No | Title                                                                 | Methodology | Output                                      |
|----|----------------------------------------------------------------------|-------------|---------------------------------------------|
| 1  | *Pengembangan perangkat pembelajaran berbasis konstruktivisme pada topik gerak pada benda* | R & D       | Students’ final test is higher & students’ cognitive (mind) |
| 2  | The effect of using the constructivist learning model in teaching science on the achievement and scientific thinking of 8th grade students | Experiment  | Students’ achievement and critical thinking |
| 3  | The effect of constructivist teaching model on sss physics students’ achievement and interest | Quasi-experiment | Students’ achievement and interest |
| 4  | *Pembelajaran fisika dengan pendekatan konstruktivisme emelalui metode mind map dan diskusi ditinjau dari kemampuan memori dan verbal siswa* | Experiment  | Students’ memory                            |
| 5  | *Pembelajaran fisika melalui* | Experiment  | Students’ critical thinking                 |
Based on the table above, it can be seen the classification of researchers’ research related to implementation of constructivism approach in physic learning. There are 8 of articles that used experimental research. These researches aim are to investigate of the implementation of constructivism approach in physic learning. Then, there is an article used R&D, where the this study aims to develop a material of physic by using constructivism approach. The last article used classroom action research which aim to know the implementation of constructivism approach in solving students’ problem. It can be seen from the following table.

Table 2. The classification of design of the research of the articles

| No | Design of the research | Frequency | %   |
|----|------------------------|-----------|-----|
| 1  | Experiment             | 8         | 80% |
| 2  | R&D                    | 1         | 10% |
| 3  | CAR                    | 1         | 10% |
|    | Total                  | 10        | 100 |

Furthermore, all of these articles used constructivism approach related to the problem in the field. Constructivism is known as a cognitive theory focuses on the role of the learner in the self-construction of knowledge refer to it as a learning theory offers an explanation of the nature of
knowledge and how the learner learns [4][5][6]. Furthermore, constructivism refers to a process of receiving involves learners’ building of new meanings within the context of the current knowledge according to their experiences and learning environment [7][8].

It was one of the most important revolutionary theories in the field of education, as it focused on the knowledge and how to provide it to learners in gradual steps, and it receives growing interest in contemporary educational thought, its importance as a new theory in teaching and learning based on the idea of teaching for understanding, and the adoption of the learner as the center of the educational process; the constructivist teaching is based on the principle that the learner is active and positive [9][10].

Constructivism theory is based on three bases demonstrates [11]: The meaning is self-built by the cognitive mechanism of the learner, and the (meaning) is not transfer from the teacher to the learner, but created inside the mind of the learner as a result of interaction with the outside world, and definitely influenced by previous experiences. The formation of meanings is a psychological process requires active mental effort.

1) The cognitive structure of the learner is resistant to change

The following table shows purpose of the research:

| No | Purpose                  | Frequency | %  |
|----|--------------------------|-----------|----|
| 1  | Critical thinking ability| 4         | 40%|
| 2  | Students’ achievement    | 3         | 30%|
| 3  | Improving memory         | 1         | 10%|
| 4  | Students’ interaction    | 1         | 10%|
| 5  | Students’ comprehending  | 1         | 10%|
|    | Total                    | 10        | 100|

Based on the table, the analysis of the articles found that there are 4 articles (40%) found discuss about implementation of constructivism approach in physic learning on students critical thinking ability. Then, that there is a significant effect on students’ achievement after implementing the module of material by using constructivism approach on students’ critical thinking ability. In developing the module of physic learning, Tees did several steps, they are (1) Giving meaning (2) Designing (3) Developing and (4) Distributing.

As a same result, Ahmed (2016)[12] also showed in his research that by using experimental research, he investigated the effect of using constructivism in teaching science. The result showed that there is statistically significant difference for the effect constructivism approach on the achievement and scientific thinking. He also stated constructivism approach helps learners to identify the strength and weakness in their prior knowledge, and through the questions that enable the teacher to identify previous knowledge. It is requested teacher to ask students’ of their previous knowledge or engage them into a new subject by asking their daily activity to relate the material so that they can be motivated to learn, think and to figure out their ideas and knowledge necessary for learning a new subject.

In addition, Netianingsih had done an experimental research about the physic learning by using constructivism approach to improve students’ creative thinking ability on Motion topic. The result of the study showed that constructivism approach could create students’ creative thinking ability which seen from five aspects such as fluency, flexibility, authenticity, elaboration and evaluation. And their creative thinking ability improves after implementing constructivism approach that can be seen from the averages of their scores.
Furthermore, the research about the using of constructivism approach in physic learning by using computer animation to improve students’ critical thinking [13][14]. The result of study showed the there was an improvement of students’ critical thinking ability by implementing constructivism approach.

These studies showed that constructivism approach could improve students’ critical thinking in physic learning. Teachers are asked to apply this approach especially for Junior High School students to improve their mind so that they can solve their problems in their daily lives.

Here, there are some characteristics of learning by using constructivism approach:
1) The building of the knowledge is based on experiment or previous knowledge
2) Study is a meaning thing
3) Study is a process to be active where it can be developed in experience
4) Knowledge grows based on discussion

Related to critical thinking ability is an ability of students to analyze or critic a knowledge that they have had. To create critical thinking students need to collaborate their previous knowledge and their experience into their mind so that they analyze information critically.

Furthermore, other researches that have been done in the table above also show the implication of constructivism approach. It is not only improving students critical thinking ability, but also they can improve students’ achievement to get a good score, their comprehension and also their interest to study. Constructivism approach could improve students’ achievement in physic learning and also their interest to study. Students who teach by constructivism approach have a good score than students who just teach by conventional [15]. Constructivism approach could improve students’ achievement in physic learning, and there is an improvement on students’ memory [16].

Based on the data above, it can be compared of ten articles from its purpose. From the table shows the applying constructivism approach could improve students’ ability, especially critical thinking ability. From the 10 of articles shows higher percentage in improving students’ critical thinking than other researches.

Finally, these related review are needed to be a reference to create a module of physics learning by implementing constructivism approach for Junior High Students in Motion topic. Motion is a topic that is studied by Junior High Students which related to their daily lives, so that it is suitable to use constructivism approach to create their critical thinking ability.

4. Conclusions

Based on the result above, it can be concluded that constructivism approach is needed to be applied in learning of physic, especially in Junior High School grade. It is founded in some articles constructivism approach could improve students’ critical thinking ability. If the students have good critical thinking ability, they can solve their problem in learning physics or solving their problems in their daily lives.

Furthermore, this study would be a reference especially for researcher to do next research about developing module of physic learning by using constructivism approach on students’ critical thinking ability in Motion topic.

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