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THE IMPLEMENTATION OF EXPERIMENTAL METHODS TO STUDENTS' CRITICAL THINKING SKILLS IN ELEMENTARY SCIENCE LEARNING: LITERATURE REVIEW

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Abstract: *This research aims to explain how experimental methods applied in science learning in Elementary School can improve abilities. Critical thinking of students. The method used in this research is literature study research. This research uses secondary data in the form of scientific journals, research results and books and other relevant sources. Data analysis techniques include three stages: organizing, synthesize, and identifying. The results of this study show that experimental methods have stages, among others: (1) identify problems (2) search for data for problem solving (3) conduct experiments (4) test the correctness of problems (5) make conclusions that have critical relevance. Critical thinking indicators that include interpretation, analysis, evaluation, and decisions. This article discusses efforts to improve critical thinking in the learning process using experimental methods.*
Keyword: *Experimental Methods, Critical Thinking, Science Learning*

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INTRODUCTION

Life in the future is influenced by the dynamic forces of education in the present. Education can be said to be an "investment" for human life that requires strong effort as well as other things that can help facilitate education. In the process during the course of education, there is a process of development. Education is a process that helps students so that their development can be optimal and in accordance with the potential and values they embrace in society (Gantina 2016).

Education cannot be interpreted as a process of coercion from teachers to their students, but rather an effort to create good conditions for child development by providing ease to develop optimally. This means that there is no limit to space, and time in education because education is long-life education or lifelong education (Hakim 2020). The education process starts with learning. The learning process can be interpreted as providing experience directly to develop competencies carried out by teachers to their students by involving all learning components to support the achievement of learning goals (Basri, 2015). In line with this opinion, education is directed by inquiry and doing (to do) so as to help students in obtaining a deeper understanding of knowledge and its application in everyday life (Depdiknas, 2008).

Goals in higher education, critical thinking skills need to be honed in the 21st century. (Fajrianthi, Hendriani, & Septarini, 2016). The ability to think critically is an important thing to note in the development of the student's way of thinking, because it is needed in facing the challenges of an increasingly complex and comprehensive world. (Hamdani, Prayitno, and Karyanto 2019). Some developed countries have developed educational systems capable of training and accommodating students' critical thinking skills well (OECD,2015). In May 2015, the quality of education of member countries of the OECD Economic Cooperation and Development, Indonesia's ranking is still low compared to the average set in the OECD (PISA, 2016). This fact is seen from the assessment conducted by Trend In International Mathematics and Science Study (TIMSS) and Programe for International Student Assessment (PISA). The results of research conducted by TIMSS in 2015 showed that the science achievements of Indonesian students were ranked 36 out of 49 countries with an average score of 397. A research also conducted by PISA in 2015 showed indonesia's achievements which were ranked 69 out of 76 countries with an average score of 403 (Klieme, 2016). This showed that there was still a low ability to think critically when learning.

The low learning in the field of science is due to students' interest in proving something is still low. A research conducted by Suratno (Suratno & Kurnianti, 2017) pointed out that students' interest in proving something is still lacking because it is caused by improper learning methods. In Natural Science learning, it is necessary for students' critical thinking skills to be able to solve problems when conducting experiments.

Cottrell's opinion stated that critical thinking was the human ability to draw conclusions from a problem, then conducted a review and further research on the decisions that had been taken (Cottrell, 2005). In line with these opinions, critical thinking was a step in thinking to draw conclusions from an argument so that it can bring up new insights (Kartimi & Lilisari, 2012). Students' critical thinking skills need to be incorporated into learning as a goal in learning because being the provision of experience can compete in the future (Dwita & Rohaeti, 2018). This proves that critical thinking is needed in Natural Science learning because it is to support in solving a problem based on relevant sources. The low ability to think critically of students is caused by conventional and teacher-centered learning (Hamdani et al. 2019)

Natural Sciences is one of the fields of science that studies phenomena that exist in life around (Gantina 2016). In line with this, Natural Science learning aims to train students to have critical thinking skills and be able to solve science and environmental problems (Yuliati and Lestari 2019). Natural Science learning is related to finding out nature systematically, so that not only the mastery of knowledge is trained, but the discovery process also needs to be trained. The process of discovery or experimentation is carried out to create a real experience for students and avoid verbalism in learning(Juita 2019).

In order for Natural Science learning goals to be achieved, teachers need to create an atmosphere and learning methods that can affect students' attitudes and critical thinking behaviors. One method that can be done is the experimental method. The experimental method is a teaching method that in learning conducts an experiment to be observed, written the results of the experiment, and delivered to the class the results of the experiment (Juita 2019). When applying experimental learning methods, students are invited to prove a topic under study, thus providing real experience and influencing critical thinking skills.

Experimental methods can be said to be effective to improve students' critical thinking skills (Jamaluddin, 2016). In line with this opinion, experimental methods can train students in critical thinking skills, because it is emphasized on conducting experiments systematically and scientifically, it is the ability to think critically that is important in achieving optimal learning outcomes (Ratunguri, 2016). The experimental method is the presentation of teaching materials that involve students directly in conducting experiments and provide opportunities for students to observe, analyze evidence, and draw conclusions (Hamdani et al. 2019). These stages are possible in training students' critical thinking skills in Natural Science learning.

Based on the background of the problem, researchers are interested in conducting Research with the title "The Implementation of Experimental Methods to Students' Critical Thinking Skills in Elementary Science Learning". The results of this research can be useful for teachers to see the benefits and apply experimental learning methods to train students' critical thinking skills in Natural Science learning in Elementary School. Teachers can apply this method to support student learning outcomes and practice critical thinking skills.

RESEARCH METHODOLOGY

The method used in this research was literature review. This research method examined the literature-sourced research so as to provide an overview and explanation of information related to experimental methods and critical thinking skills in Natural Science learning. The data collected and analyzed in the form of secondary data, those were research results, articles, and relevant sources regarding the application of experimental methods to improve students' critical thinking skills. The sources collected in the form of articles totaling 35 articles indexed in SINTA and 6 international articles indexed in SCOPUS. Researchers also used 5 supporting books, namely 3 books from abroad and 2 books from within the country. Researchers also used 1 international report. All sources used are still relevant to the research, so source filtering is carried out. The articles used in this study are articles that have criteria, namely articles published in the last 10 years, national articles and/or international journals, articles that have research on population numbers of elementary, junior high, high school, articles with experimental research types, CAR, and R&D. The sources of books used are those published in the last 15 years, published at home and abroad, and are still relevant to research and the times. The report used is only one and was published 7 years ago and is still relevant to the conditions of the

times. The Ministerial Regulations used are still in use today so they are still relevant to research.

The data analysis techniques included three stages, organizing, establishing, and identifying. The organizing stage was the stage to search for topics, ideas, goals and conclusions from the relevant literature. The stage of establishing was to compile the findings data into a summary of interrelated literature. The third stage was identifying, looking for important data to be discussed in the research, so the research was interesting to read and used as a reference for future research.

RESULT AND DISCUSSION

A. Ability to think critically

The ability to think is classified into 2 in context, namely the ability to think high level (High Order Thinking Skils) and the ability to think low level (Low Order Thinking Skils)(Wahid and Karimah 2018). Natural Science learning in Elementary School emphasizes on critical abilities, so as to be able to apply these skills with the knowledge that has been obtained. Educational goals can be achieved in accordance with the mandate of the 2013 curriculum that prepares students to have critical thinking skills.

The ability to think critically is the ability to know a problem or information in depth from various points of view and find a way out of the problem (Putri, Soebandi and Suwatno 2018). Another opinion said that critical thinking is decision making through rational steps that he believes in (Slavin 2008). Someone who makes decisions well, must have applied the ability to think critically (Susilowati, Sajidan and Murni 2018).

Another opinion said that the ability to think critically is a refraction carried out in training the ability to analyze, synthesize, and evaluate information used in solving problems found. (Alghafri and Ismail 2014). In line with this opinion, critical ability is interpreted as an impulse made to organize themselves through interpretais, results of analysis, evaluation, explanation by linking evidence, conceptualizing and contextual considerations (Facione 2013). This opinion is also supported by other opinions that say that the ability to think critically is a combination of all activities such as conducting analysis, synthesizing, taking consideration, creating and applying new knowledge to the real world (Hatari, Widyatmoko and Parmin 2016).

The ability to think is a capital that needs to be owned by students in the face of the rapid development of science and technology in the present (Dwijananti and Yulianti 2010). Facts and data are something in science that can be applied in the ability to think critically to solve problems (Reeve 2016). The ability to think critically involves the value of argument, credibility, identifying, and drawing conclusions of an information. (Ennis 2013). This ability can see and distinguish which information corresponds to reality and is not based on certain beliefs. (Changwong 2018).

Students' critical skills need to be trained to be handed over in order to be able to be rational and choose the best choice for themselves in making decisions. (Jumaisyaroh, Napitupulu and Hasratuddin 2015). Critical thinking skills urgently need to be developed in Natural Science learning because it aims to solve problems by proving natural phenomena and symptoms to see a way out. Its application includes the activity of analyzing problems, synthesizing, finding solutions and solutions to problems, drawing conclusions and evaluations. (Matsun, Sumarno and Masykuri 2016).

The ability to think critically has been developed by several experts. Experts define that the characteristics of people who have the ability to think critically, namely: 1) clear and accurate in designing questions and answers; 2) the effective and efficient use of thinking in search of relevant sources; 3) draw conclusions used as solutions with effective exits in various perspectives; 4) open-mindedness with all

opinions; 5) Effective communication in problem solving (Paul, Elder and Hawkins 2019). Another opinion says that the indicators of a person having the ability to think critically are interpretation and analysis of problems, evaluation, conclusions as well as explanations and self-regulation. (Facione 2013).

Students' critical abilities can be improved by changing the focus of learning, which was previously centered on teachers (teacher centered) changed to student-centered (student center). (Hamdani et al. 2019). Learning also does not emphasize students on memorization, but rather problems that can train critical thinking skills. (Widiadnyana, Sadia and Susatra 2014). Another opinion said that critical thinking skills can be trained with scientifically based ability, namely conducting environmental exploration, conducting experiments, discovering and solving problems through small study groups. (Aini, Ramdani and Raskun 2018). This opinion is supported by Lau that the ability to think critically is needed to communicate thinking, decision making, analysis and problem solving. (Lau 2011)

Based on the above exposure, it can be concluded that the ability to think critically is one of the abilities in thinking that aims to understand problems in depth, find ideas for solutions, applications and decision making according to what is believed based on various perspectives. This ability has indicators that can be met such as interpretation and analysis of problems, evaluating the idea of a way out, as well as decision making to solve problems.

B. Experimental Methods

Learning in the 2013 curriculum becomes a student as a learning center or can be referred to as a student center. Teachers are only facilitators and directors in learning. (Hamdani et al. 2019). In Natural Science learning, students are given the widest opportunity in the learning process. Natural Science training aims to train students to understand the symptoms of nature and its environment scientifically. The need for methods that can facilitate teachers in doing learning.

Experimental methods are present as one of the solutions to involve students directly and concretely in solving problems through scientific experiments. Through this scientific trial, students are able to understand the symptoms or events around them. (Anggraeni 2015). In line with this opinion, Ismini concluded that the experimental method is a learning carried out in understanding the material that has been given through scientific experiments. (Ismini 2015).

Another opinion says that the experimental method emphasizes students to conduct systematic trials through scientific means of work. (Ratunguri 2016). Experimental methods are carried out by students to prove a statement or hypothesis with reality in the field through trials. (Suparno 2015). This method is defined as the method performed by teachers to conduct trials in order to emphasize that proves a problem.

The experimental method is the presentation of teaching materials to students to perform stages such as observation of an object, analysis of problems found, and drawing conclusions of certain trials. (Ardiansyah 2018). This opinion is supported that experimental methods place more emphasis on conducting experiments, data collection, problem analysis, and drawing conclusions. (Maliyah, Sunarno and Suparmi 2012).

Based on some of the above definitions, it can be concluded that the experimental method is a method in learning that emphasizes students to be active in learning activities through scientific experiment activities directly to prove the symptoms of nature and surrounding life, in order to be able to be understood in depth by students.

C. Natural Science Learning

Learning is a process that is carried out systematically, effectively, and efficiently by teachers and students in achieving educational goals. In line with this opinion, learning is an activity that is arranged so that students are able to be active in learning activities. (Dimyati & Mudjiono, 2006). Learning is an activity that has been prepared by teachers for students in achieving learning goals and producing a positive impact on cognitive, psychomotor, and affective.

Natural Science Learning is a learning process about nature to be able to help students learn more meaningfully through process skills, so as to be able to master scientific skills and apply them to everyday life. (Grahito Wicaksono 2020). Another opinion says that the learning of Natural Sciences must be able to connect real and direct situations because the nature of Natural Sciences is related to what exists in nature. (Gita, Annisa, & Nanna, 2018). In line with this opinion, Natural Science learning is a learning that discusses Natural Sciences that are scientific, objective, and rational. (Wisudawati, 2014).

Based on this opinion, it can be concluded that natural science learning is learning that studies SCIENCE as the main study in science topics that study the symptoms of nature and surrounding life through a process of experiments, observations, systematic and scientific experiments.

Natural Science Learning in elementary school uses the 2013 curriculum where the Natural Science learning process integrates between physical, chemical, and biological sciences. Integrated Natural Science learning can train students to care about the surrounding environment (Latifah & Wilujeng, 2016). The purpose of Natural Science learning is listed in the attachment of Permendikbud No. 22 years 2-16, namely developing attitudes, knowledge and skills as a whole. (Kemendikbud, 2016).

In another opinion, the purpose of Natural Science learning is to develop knowledge and understanding of the chosen and useful Natural Science concepts to be learned in everyday life. (Erlangga 2021). According to Maslichah Asy'ari, the purpose of studying science in Elementary School is to train curiosity and develop a postifi attitude towards science, technology, and society as well as processes to find out the environment, solve problems related to natural symptoms so that students are able to think critically and objectively. (Surahman & dkk, 2015)

Based on the description above, that the purpose of learning Natural Sciences is to develop knowledge in the concept of Natural Science to study environmental and life symptoms with researching steps to train objective critical thinking skills for students.

D. The Relationship of Experimental Methods with Critical Thinking in Natural Science Learning

The development of students' critical thinking skills in the Natural Science learning process is realized through a learning process that applies high-level critical thinking skills or called High Order Thinking Skills. Through the development of this process, it can make students active in teaching and learning activities. (Hamdani et al. 2019). Learning that applies methods that are appropriate to students, able to improve learning outcomes. (Nasution 2018).

Critical thinking skills can be trained by methods that actively engage students in learning. With learning that actively involves, it can support students' understanding of the material that has been delivered and knowledge building. A suitable method to apply is the experimental method. In his activities, the experimental method is carried out by the step of analyzing the problem, conducting the experiment directly, and concluding the results of his own experiment. (Nasution 2018)

According to Hamdani (Hamdani et al. 2019), The experimental method at the time of its application in learning has several stages, namely: 1) establishing what the purpose of the trial is; 2) divide students into small groups; 3) students begin to conduct experiments with the help of teachers as a companion; 4) students conduct an analysis of the problems found in the experiment; 5) Draw conclusions on the experiments that have been conducted.

The relationship between the application of experimental methods with students' critical thinking skills in Natural Science learning is proven to be an increase in student thinking. Research conducted by Triwiyono that with the application of effective experimental methods to improve students' critical thinking skills compared to conventional learning (Triwiyono 2011). In line with this opinion, the results of research conducted by Vivi et al that the application of experimental methods can improve student learning outcomes, because students conduct experiments, where they can prove and experience for themselves. Through this process, students become active and happy in following the learning process in the classroom. (Hasibuan, Suwatno, and Rambe 2021). Other studies conducted by Retno et al obtained the same results that the experimental method had an influence on the results and liveliness of students in the class. In addition to liveliness, students also already have the ability to think critically because they can explain logically about the results of their experiments. (Utaminingsih and Nizaar 2020).

CONCLUSION

Related to the opinions of the experts above, it can be concluded that the ability to think critically is one of the aspects that need to be fulfilled in supporting learning in the 21st century. Critical thinking is needed for proper analysis, evaluation, and decision making to solve problems in the future. The development of critical thinking skills in Natural Science learning can be done through a student-centered learning process or student center with 21st century learning principles that are close to technology.

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