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Critical Thinking through Discovery Learning

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Abstract. Education in the industrial revolution era 4.0 required students to have high-level thinking skills. One of the high-level skills that must be possessed by students was critical thinking skills. This skill was one of the important skills in improving Indonesia's ranking of PISA (Program for International Student Assessment) which was still considered low so there was a need for learning models that can give effect to students' critical thinking skills. In this study, researchers used the library method as a research method. After researchers conducted a literature review from various sources, researchers found that the discovery learning model had an effective influence on students' critical thinking skills.

Keywords: Discovery Learning, Critical Thinking Skills, Literature Study

INTRODUCTION ~ Mathematics is a science which has a very important role for human life, because mathematics provides enormous potential for humans to be able to improve their problem solving abilities, through mathematics humans learn something concrete to abstract and something simple and complex (Amir A. , 2014). Therefore, mathematics needs to be taught from the age of elementary school according to (Kemendikbud, 2016)that mathematics began to be taught from basic education to advanced education.

(Suparni, 2012)argues that the nature or characteristics of mathematics are deductive, axiomatic, symbolic, and abstract. Where mathematics needs to be learned starting from the basics first so that it can easily understand the next concept, mathematics is also something that is definitely the truth, and mathematics is full of various abstract terms and symbols. Thus it is not surprising when trying to measure a person's intelligence can be seen from his mathematical abilities(Priatna & Yuliardi, 2019).

In elementary school mathematics has become a subject that students must master, of course in elementary school becomes the initial gate students learn the concepts of basic mathematical concepts. Like geometry, geometry is the material found in mathematics in elementary schools especially in class V (five). But that does not mean that learning geometry material is easily mastered by students, as well as the results of the study (Pranata. 2007) that geometry is the most difficult material for students to understand, apart from fraction material and its operations. Likewise with the results of the study Suwaji (2008: 8) that the ability of students in solving three dimensional problems is still low. As an example, sometimes students cannot identify a picture of a square pyramid simply because the presentation in the picture requires that the square be a parallelogram.Like the results of the PISA survey that the weakness of students in learning geometry is the difficulty of understanding the concepts of space and form. As for the inside(Suwaji, Untung, &

Trisna, 2008)the results of his study illustrate that students find it difficult to imagine a block that has a cavity in it.

From some of the discussion above explained that, mathematics and mathematics learning are two things that can not be separated, both likened to coins that have two surfaces. A teacher cannot teach well if only mastering mathematics (content knowledge) or mastering how to teach mathematics (pedagogical knowledge). To be able to teach mathematics properly a teacher must have both of these knowledge (Yurniawati.2019).Coinciding with the entry of the 21st century where the development of the industry stepped on the revolution era 4.0 where many demands that must be mastered by teachers or students one of which is critical thinking. Some experts define critical thinking with different expressions but have similar meanings, critical thinking is the ability of reflective thinking that is reasonable and is focused on determining what is believed or done(Baron & Sternber, 1987). Furthermore, it is said that critical thinking is related to five key ideas, namely reflective, practical, trustworthy, reasonable and action. There are several indicators in critical thinking skills, Ennis (Baron & Sternber, 1987)elaborating on critical thinking indicators in detail.

John Dewey emphasized that critical thinking is essentially as an active process in which a person thinks things through, asking questions, finding relevant information rather than waiting for information passively(Fisher, 2011). Critical thinking is the process by which all knowledge and skills are mobilized in solving problems that arise, making decisions, analyzing all assumptions that arise and conducting investigations or research based on data and information obtained so as to produce the desired information or conclusions(Ariyana, Pujiastuti, Bestary, & Zamroni, 2018). Once the importance of high-level skills, one of which is critical thinking to be the target of the government in meeting the character of students as the demands of the 21st century, teachers must be able to present innovative learning or learning models to support all of that.

The choice of variant and innovative learning models is one of the factors of student learning success. This is in line with(Trianto, 2009)that the application of innovative models is able to develop and explore students' knowledge. Mathematical learning model becomes one of the elements that must be mastered by the teaching staff whose purpose is to create effective and efficient learning. So students can understand the material presented more optimally. According to(Bruner, 1961)students will learn well if students can find their own concepts, theories or rules through examples in their daily lives.

Learning models that adhere to the views above one of them is discovery learning,Discovery learning is a learning

method that requires teachers to be more creative in creating situations that can encourage students to actively learn to find their own knowledge. In the Discovery Learning method, students are not given complete teaching material in the final form, but students are encouraged to identify their own concepts to be continued followed by finding information, then organizing them into meaningful knowledge(Rohaeti, Hendriana, & Sumarmo, 2019). Some experts say that discovery learning is learning that advances active learning, process oriented, self-directed, self-seeking, and reflective(Suryobroto, 2009). Sani (Hendriana, Rohaeti, & Sumarmo, 2018)explains that discovery learning is learning that facilitates students discovering concepts through observation of a series of data or information obtained in an experiment. Suryosubroto (2009) states, that discovery learning is learning that advances active learning, so that teachers and students are active in learning. This is in line with those on the surface(Aqib & Murtadlo, 2016)that in discovery learning there are situations where the teacher actively creates learning arrangements and students actively find concepts in their learning. Therefore, the researcher intends to conduct a literature study to see the impact of learning on the curriculum to students' critical thinking skills.

METHOD

This research is based on the results of studies of several books, journals and other literature reviews. The collection of data used in this study is based on the literature study method by conducting a review study of books, literature, and notes relating to the issues raised(Nazir, 2013). Literature technique is a way of collecting various material data contained in libraries, documents, etc. that are relevant to research(Koentjaraningrat & Satori, 1984). Meanwhile according to(Komariah & Satori, 2011)explained that literature study is a supporter of research that began from the view of experts in writing in the form of reference books, journals, research reports or other scientific works. From the explanation above explained that literature study has a meaning as a way to find research sources in the form of printed references and print numbers that are in accordance with research.

Research Procedure

According to(Zed, 2004)there are several steps in the study of literature study as follows:

1. Prepare equipment

The tools used in this library method include laptops as a means and infrastructure to find data and record the data needed, highlither to mark sentences and notebook ballpoints to manually record important things or material

2. Prepare a work bibliography

This research source uses books as main reference and journals and internet as additional references.

3. Set the time

This research begins with the purchase of books and journal collection which is concerned with the researcher's problem then records as reflection material to be re-typed starting from data collection to reflection from all sources, so that the research process gets the most effective and efficient time possible.

4. Read and make research notes

Documentation notes that are important in research from several books and journals are written manually or digitally and mark books or journals with highlighter. The important thing is arranged into a unified unit that is interwoven with the common thread in accordance with the research procedures that have been prepared.

Data Collection Techniques And Instruments

The data collection in this research uses literature study techniques which are mostly taken from books, papers and journals plus a number of other important notes

Data Analysis Technique

The content analysis technique was chosen to analyze the data used in the study, this is in line with(Holsti, 1969)that "any technique for making conclusions by objectively and systematically identifying the characteristics of the specified message" is in accordance with the literature study research method which does not carry out calculations like quantitative research but in the form of studies of several books, articles and other journals.

RESULTS

Disovery Learning

There are three models suggested in the 2013 curriculum, namely discovery learning, problem-based learning, and project based learning. In this study, researchers chose discover learning as a model in this study. Discovery learning is a model that is implemented by organizing learning like an experimental class, the teacher as a guide, and the teacher must prepare instructions for students during the learning process that will help students in solving problems that exist before them(Hanafi, 2016).

This model can create an atmosphere that makes students actively participate in conducting an investigation of a problem faced by those who in turn, they will find their own answers to the problems they face(Oktaviani, Kristin, & Anugraheni, 2018). This is in line with(Ott, Carpenter, Hamilton, & LaCourse, 2018)which says that discovery learning is based on group learning that asks students to learn in a small group to solve a particular problem. Basically this model is designed as one of the learning models that provides an opportunity for educators to freely regulate classrooms in the learning

process(Dearden, 1973). This model focuses on students' deeper thinking activities so that in the end this model will provide an increase in the improvement of critical thinking skills and student learning outcomes(Hidayat, Mawardi, & Astuti, 2019). This was also conveyed by(Rosdiana, Boleng, & Susilo, 2017) that discovery learning is able to explore the activeness of students in learning.

Discovery learning model has 5 activities that are important in learning, namely stimulating students, identifying problems, collecting data, processing data and verifying results (Wedekaningsih, Koeswanti, & Giarti, 2019). According to(Mubarok & Sulistyo, 2014)There are four advantages of this model, namely (1) more emphasis on active learning; (2) it is easier for students to understand; (3) more flexibility in applying it to other subjects; (4) students' reasoning is more in-depth using this model.

Discovery Learning is learning where the educator acts as a facilitator for students to find knowledge without being known by students(Cahyo & N, 2013).Students are led to understand concepts, meanings, and relationships through intuitive processes to finally arrive at a conclusion. In the application of discovery learning must pay attention to several things in order to achieve an effective learning.(Carin & Sund, 1970)added that discovery occurs when students engage in the use of their mental processes to find several concepts and principles.

There are several steps to the discovery learning model, one of which follows(Hamalik & Oemar, 2015) : 1) simulation, namely the teacher gives several problems, 2) problem statement, which asks students to identify problems, 3) data collection, gives students the opportunity to collect information and data, 4) data processing, then students process information and data that has been obtained, 5) verification, proving the results of information processing, 6) generalization, students draw conclusions after the verification process. A good discovery of discovery will have a positive impact on learning. (Sylvi, 2019)explained that Discovery Learning is able to improve and improve cognitive skills and processes, foster a sense of joy in students, rely on independent learning that involves reason and self-motivation, strengthen understanding of concepts, student-centered.

Student's Critical Thinking

According to Baker in (Baker, Rudd, & Pemeroy, 2001)argues that critical thinking is used by someone when in the process of mental activities such as identifying the core of each problem and assumptions in an argument, providing valid conclusions from a data, making conclusions from information or data provided, interpreting whether each conclusion is guaranteed based on data provided, and evaluates authentic evidence. Critical thinking does not necessarily make a person happy to argue and oppose any other people's

opinions that are wrong, but critical thinkers can also provide a solution to the falsification and opinions expressed that have a clear basis of information and evidence. As is the case with opinions(Ennis, 2011)that critical thinking is the ability to think logically or reasonably which focuses on making decisions about what is believed and done by someone.

Jufri in(Wahab & Jufri, 2013)explained the stages carried out by critical thinkers include formulating the problem, giving arguments, making deductions, doing induction, evaluating, then taking decisions and determining actions. These opinions are similar to those presented by(Polya, 2004)that is, he understood the problem, planned the solution, carried out the planning, and reexamined it. Furthermore, the steps of reasoning carried out by critical thinkers are more logical, rational, careful, detailed step by step according to the problem fiction before making certain decisions. Amir inside(Amir A. , 2015)argues that critical thinking is also more complex than ordinary thinking processes in general where it is limited to understanding a concept or problem without being able to identify and explore problems to find further solutions because critical thinking requires higher mental abilities and intellectual abilities.

Continue according (Chukwuyenum, 2013)explains that critical thinking includes one's efforts in gathering, interpreting, analyzing, and evaluating information to arrive at a set that can be tested for its validity. While the opinion of Shapiro in(Friend, 2002)argues that critical thinking is a mental activity that focuses on the use of reason that uses mental processes such as paying attention, categorizing, selecting, and deciding to solve a problem. Based on the opinion of the expert opinion above, it is concluded that critical thinking is an activity that does not only rely on the ability of reason alone, but rather than that where the critical thinker must be able to use mental processes in gathering, categorizing, analyzing, and evaluating information or evidence in order to make a valid conclusions to solve the problem.

Furthermore, regarding the mental activity of students in thinking critically in solving a problem can use the steps expressed by Facione in(Peter, 2012)i.e. identify, define, enumerate, analyze, list, and self-correct. These steps can be abbreviated as IDEALS, as for a brief explanation of each of these steps as follows:

1. Identify (I), which is determining the main idea of the problem at hand
2. Define (D) is to determine the problem that is limited by the facts of the problem which includes what is known, asked about the problem and what information is not used or not needed.
3. Enumerate (E), that is, determining or arranging answer choices that might appear on a problem.
4. Analyze (A), namely analyzing the best alternative answers.
5. List (L), which is to state the exact reason for all answers taken.

6. Self-Correct (S) is to check thoroughly again, whether there is an action to solve the problem that was passed

Criticism Thinking Skills of Elementary School Students Through Discovery Learning Model

Following are the results of several literature studies that illustrate the impact of discovery learning models on the critical thinking skills of elementary school students, based on Oktaviani's research findings in(Oktaviani, 2018)who conducts classroom action research on the application of discovery learning models to improve critical thinking skills and mathematics learning outcomes of 5th grade students, get an average of 54 results in pre-cycle then increase to 68 in cycle I, and increase to 78 in cycle II.

In the action research conducted by(Ratih, Mawardi, & Suhandi, 2019)The level of critical thinking and learning outcomes in the pre-cycle category is very high by 7%, the high category by 41%, and the low category by 52% so that the impact on learning outcomes with a percentage of 46% achieving completeness and 64% not achieving completeness. After doing the research in the first cycle phase, students' critical thinking skills increased to 22% in the very high category, 63% in the high category, 15% in the low category. Student learning outcomes 63% have reached mastery and 37% have not reached mastery. In the second cycle increased more significantly that is 63% of all students the level of critical thinking is in the very high category and 37% are in the high category, student learning outcomes are also seen 85% of students achieve mastery and 15% of students have not reached mastery.

Next to the action research conducted by(Wedekaningsih, Koeswati, & Giarti, 2019)get results in the first cycle of critical thinking skills and student learning outcomes increase to 4.3% very critical categories, 21.7% critical categories, 34.8% quite critical categories, 30.5% less critical categories, and 8.7 % the category is not critical, so the overall learning outcomes in the first cycle are 52% complete and 48% are incomplete. In the second cycle of action increased again, namely 17.4% very critical categories, 30.4% critical categories, 43.5% quite critical categories, and 8.7% less critical categories, so that the learning outcomes of students increased to 87% complete and 13% of students have not yet finished.

Next on research(Prasasti, Dianita Eka; Koeswanti, Henny Dewi; Giarti, Sri, 2019)using the research method of getting action results that there is an increase in students' critical thinking skills from pre cycle 38% increased in cycle I to 73% then increased to 81% in cycle II. Increased critical thinking skills have an impact on student learning outcomes namely in the pre cycle 35% increased in cycle I to 77% then increased to 85% in cycle II; (2) the application of the steps of the Discovery Learning model can improve critical thinking skills and student learning outcomes through providing stimulation,

formulating problems, collecting data, processing data, proving data, and drawing conclusions.

Based on the results of a literature review on research that looks at the impact of discovery learning models show that there is a significant increase in the improvement of critical thinking skills of elementary school students, seen from the increase in each cycle of each researcher, so it can be concluded temporarily that the discovery learning model can improve students' critical thinking skills, although actually there is a need for more research to see a comprehensive picture of the effect of discovery learning models on critical thinking skills of elementary school students.

CONCLUSION

Critical thinking skills are needed in the 4.0 revolution era. The teacher has naturally inserted these skills in each learning as a concrete step that the teacher is ready to accept the development of the times and respond to the demands of 21st century skills that are being faced by the Indonesian nation as a developed country. Discovery Learning is an alternative solution to answer the above problems, seen from several sources that discovery learning can improve critical thinking skills. There is a significant value when researchers examine some of the research results taken from several journals. Some research results say that the success of improving students' critical thinking due to the discovery learning model trains active students so that educators work only as facilitators(Ratih, Mawardi, & Suhandi, 2019). In learning also focuses on the discovery of concepts by students themselves who according to some theories of learning as it is more meaningful for students(Bruner, 1961).

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