

Analysis of the Cooperative Learning Effectiveness on Students' Critical Thinking Skills in Science Learning for Primary Students

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ABSTRACT

Elementary school students' lack of critical thinking skills in scientific learning is a result of a lack of opportunities for kids to exercise their critical thinking skills in decision-making and problem-solving. Appropriate learning models and strategies in science education can help students develop their critical thinking skills. Consequently, this research aimed to examine how well cooperative learning develops students' capacity for critical thinking. This research is novel in that it will examine different journals of environmentally friendly cooperative learning models while keeping in mind the theme of the SDGs, which has not been the focus of previous studies but has shown results related to environmental insights, especially in science learning. A method of the systematic literature review was adopted for this investigation. Previous relevant scientific studies on the same topic served as the basis for this research. Data reduction, presentation, synthesis, and conclusion drawing constitute the data analysis method. Students develop their critical thinking capacity through collaborative learning strategies, including game or role-playing, Jigsaw, TGT, STAD, and learning together, and by analysing previously relevant scientific materials. Reading these relevant, previously published scientific publications can bolster students' knowledge and ability to think critically and creatively. For topics not covered here, such as the effects of cooperative learning with an ecological lens on students' critical thinking, this study can serve as a useful resource.

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1. INTRODUCTION

Learning in the 21st century is expanding at an unprecedented rate, making this a truly remarkable time to be a student. Learning methods in the modern information age must change to meet new requirements. Moreover, educational resources need to be modified to fit Fernandos (2019). Where design-based learning is more robust, students engage in challenges where they work together to build solutions to problem-solving lessons. Care et al. (2016) state that students can use available information resources to search for problem-solving and learning contexts when they are prompted to ask questions while working on an issue.

Learning about science as part of a well-rounded education helps students develop the critical and creative thinking skills, logical reasoning, and initiative they will need to address the societal problems brought on by scientific and technological progress. Rizema (2013) defines science as the body of knowledge that examines, explains and investigates the empirical elements of natural occurrences. Active student participation is emphasised in acquiring scientific principles, ideas, and methods. Learning science well necessitates the ability to think critically in order to attain its goals, which may be broken down into four categories: attitudes, procedures, products, and applications (Ekapti, 2016). The capacity to think logically is crucial, so teaching it is a top priority. Having the ability to think critically aids in problem-solving and conquering obstacles.

Students have critical potential, but the problem is how to develop that potential through the learning process in the classroom. Parker (2009) argues that critical thinking skills are an organised process involving mental activity through problem-solving, formulating conclusions, gathering various possibilities, and making decisions, where this way of thinking develops cohesive, logical, reliable, concise, and convincing reasoning.

The low quality of students' science learning outcomes shows that the science learning process in schools is still far from the quality category. This is evidenced by data from the Program for International Student Assessment (PISA) in 2018. Indonesia is still in the lowest position for the category of competence in Reading, Science, and Mathematics. In fact, the ranking has tended to stagnate over the last 10 to 15 years (Schleicher, 2019). Thus, there is a need for special strategies or steps to improve student competence in Indonesia, especially in the field of science.

One way that can be used to improve student's critical thinking skills is to attract students' involvement and activeness in learning. Teachers can create a pleasant learning atmosphere and make students more ready to learn. Then the teacher can use various learning models that are suitable for learning, including the cooperative learning model. The cooperative learning model allows students to learn together, establish good cooperation, and student-centred learning to increase student activity and learning outcomes (Juhji, 2017).

Applying cooperative learning models and critical thinking skills is related to students being able to reconstruct knowledge directly or student-centred learning. Especially at this time, the learning approach used in the 2013 curriculum is a scientific approach which requires students to be active in acquiring knowledge through the surrounding environment (Cooper, 1995). Bamiro (2015) states that the cooperative learning model is able to improve student achievement in science learning. From these two studies, it is also necessary to conduct further research related to the most effective cooperative learning model used, especially in the environmentally friendly science learning process at the elementary school level. The aim of this study was to analyse the effectiveness of cooperative learning in enhancing students' critical thinking skills in science learning. This research has benefits for educational practitioners; for example, using an environmentally cooperative learning model can provide a meaningful learning process for students, where students are given space to form their knowledge independently and in groups through group work on a given problem. In addition, this research can be used as a reference for further research related to cooperative learning with an environmental perspective on students' critical thinking skills that have not been studied or explored for information in this study. This research is limited to the study of cooperative learning models with an environmental perspective in improving students' critical thinking skills.

2. METHODS

This study design used a systematic literature review. The design of this study involves identifying all the main relevant scientific articles to the research questions, critical assessment, and synthesis of findings (Gough, Oliver & Thomas, 2012; Fazalare, Griesser & Siston, 2010). In systematic literature, review design consists of (1) explaining the aims and objectives of the research, (2) finding or seeking relevant research, (3) collecting data, (4) assessing research quality, (5) synthesising evidence, and (6) interpreting the findings (Pollock & Berge, 2018). A systematic literature review includes many different formal synthesis methods to be interpreted and conclusions from the findings (Barnett-Page & Thomas, 2009; Dixon-Woods, 2011; Dixon-Woods, Agarwal, Jones, Young & Sutton, 2005; Thomas & Harden, 2007).

The data collection technique extracted from relevant themes of previous scientific articles that met the inclusion criteria (Pollock & Berge, 2018; Harris, Quatman, Manning, et al., 2013). The data analysis technique in this study used qualitative data analysis of the relevant scientific articles. The stages in conducting data analysis are (1) reduction, (2) synthesise, (3) interpreting findings, and (4) making a conclusion.



Figure 1. Stages of Systematic Review

3. FINDINGS AND DISCUSSION

3.1 Findings

Relevant scientific articles that have been reduced and meet the inclusion criteria by extracted and presented based on the grouping of each research variable on the effect of cooperative learning models on students' critical thinking skills in science learning for elementary school students. After presenting the data on the research results, it is continued by synthesising the findings of the relevant studies that are reviewed as the findings of this study to be interpreted to decide on the follow-up to be carried out on the findings in this study. The following are the data and analysis results from previous relevant articles.

Table 1. Previous Scientific Articles Based on Inclusion Criteria

No	Scientific Article	Researcher	Analysis
1	Improving Critical Thinking Skills and Learning Outcomes of Elementary School Students by Applying Everyone is A Teacher Here Strategy in Cooperative Learning Model	Mochamad Yusuf (2018)	Students' critical thinking and learning outcomes both improve when the Everyone is a Teacher Here the technique is implemented inside the cooperative learning model, according to the research. Students have been instructed to construct their own learning concepts through the implementation of tactics from this framework. Students gain agency in their science education when they are encouraged to ask questions and offer feedback on assigned problems. Students will strengthen their abilities to express themselves and respond to questions in order to foster the growth of science and the acquisition of new knowledge through inquiry-based activities. As a result, the success of Everybody's a Teacher Here has an impact on students' ability to learn and think critically.
2	Students' Critical Thinking Ability with Guided Inquiry combined with Carousel Feedback on the Materials of the Properties of Light in Elementary School	Muspratiwi Pertiwi MR, Lia Yuliati, & Abd. Qohar, (2018)	Based on these findings, it can be concluded that guided inquiry learning combined with carousel feedback-type cooperative learning leads to improved critical thinking abilities among students in the experimental class. Students' topic mastery and critical thinking skills are more highly valued in classrooms where a guided inquiry model is used in conjunction with cooperative learning. Cooperative inquiry with a focus on syntactic integration has been shown to boost students' capacity for abstract reasoning (HOTS). Students will develop their critical thinking skills and take an active role in the learning process through guided inquiry and carousel feedback.
3	Implementation of What's In Here Game Based on TGT Model for Cultivating Thinking Ability	Novika Hapsari Susilo, Arfilia Wijayanti, & Filia Prima Artharina (2019)	Critical thinking abilities, such as analysis, synthesis, problem recognition and solution, conclusion drawing, and evaluation or assessment, are developed using the What's In Here game based on the Team Games Tournament concept. Teachers can use the What's In Here game, which is based on the Team Games Tournament format, to help students develop their critical thinking skills in a fun and engaging way.
4	The Effect of Game-Based Learning on Students' Learning' Performance in Science Learning – A Case of "Conveyance Go"	Eric Zhi Feng Liu & Po-Kuang Chen (2013)	The participants expressed positive attitudes concerning the use of the scientific card game, and they reported that the strategy aided their education. The vast majority of students were open to this kind of instruction and expressed interest in continuing to do so in the future. The students also noted that the instructional card game might help them acquire scientific knowledge and that the game-based learning method piqued their curiosity about various transportation and energy options.
5	Promoting critical thinking through effective group work: A teaching intervention for Hong	Dennis Fung (2014)	Students' critical thinking improved as a result of an educational intervention based on Kuhn's (1991) approach. Students acquired reasoning in GS classes taught using a wide range of pedagogical

	Kong primary school students		methodologies by working in small groups to solve a variety of problems. Teachers used the SPRinG project's findings on effective group work practises to see if those same methods could help their students develop their critical thinking skills.
6	Primary students' scientific reasoning and discourse during cooperative inquiry-based science activities	Robyn M. Gillies, Kim Nichols, Gilbert Burgh, & Michele Haynes (2014)	The ability to do so is crucial if students acquire a critical knowledge of various scientific statements and a more in-depth grasp of fundamental scientific concepts (Duschl et al., 2007; Smart & Marshall, 2012). At the end of each inquiry science lesson, students completed a reasoning and problem-solving (RP-S) exercise meant to gauge how effectively they had used what they had learned throughout their collaborative small-group work.
7	A collaborative game-based learning approach to improving students' learning performance in science courses	Han-Yu Sung & Gwo-Jen Hwang (2013)	To encourage students to think critically and creatively, a grid-based Mind tool was integrated into a game-based learning environment to facilitate information organisation.
8	An evaluation of the cooperative learning process by sixth-grade Students	Murat Genc (2016)	Students learn more and perform better when they work together. Cooperative learning, which encourages students to work together and develop their social skills, is becoming increasingly valued. Cooperative learning in small groups promotes student independence while delivering superior learning results and improved critical reasoning skills, which are unavailable through more traditional methods of instruction.

3.2 Discussion

Cooperative learning has been shown to improve elementary school students' critical thinking skills in a number of ways, as evidenced by the following studies: (1) students are able to construct their learning concepts or knowledge or understanding; (2) students are able to ask questions and express opinions or ideas on a given problem; and (3) students are able to analyse, synthesise, solve problems, draw conclusions, and evaluate. Cooperative learning has been shown to improve students' critical thinking skills when combined with other learning methods of science learning for elementary school students. These methods include (1) game or role-playing (everyone is a teacher here game based on the Team Games Tournament model, an educational card game, and a grid-based Mind tool integrated educational game), (2) Jigsaw, STAD, (3) inquiry learning (everyone is a teacher here game based on the Team Games Tournament model, an educational card game, and an inquiry-based

Cooperative learning, when combined with learning methods that are in accordance with the characteristics of the material in science learning, like the TGT method, STAD, Jigsaw, learning together, and GI, can improve students' critical thinking skills, as shown by the results of the analysis of relevant articles in table 1, namely research that has been carried out based on grouping several countries like Indonesia, Taiwan, the UK, and Turkey. These relevant previous scientific studies also impact students' personal and social constructivism to build students' knowledge and high-order thinking skills. The contribution of the relevant studies for this research is that cooperative learning can be integrated with environmental insight and contributes to students' critical thinking skills both independently (personal constructivism) and in groups (social constructivism), especially in building students' understanding or knowledge, the ability of students to work together and discuss in groups, the ability of students to argue, ask questions, analyse, synthesise, draw conclusions, evaluate, and solve problems.

Cooperative learning models combined with learning methods that match to the characteristics of science subject matter such as TGT, STAD, Jigsaw, learning together, GI methods, educational card-based games, inquiry, and problem-based learning can improve students' critical thinking skills, where students can build their understanding or knowledge, students can argue scientifically, students can analyse, synthesise, draw conclusions, and solve problems were given in learning both independently and in groups. Cooperative learning is learning in which a small number of students in a group work together to support each other's learning to complete a task or project (Slavin, 2010; Siegel, 2005). Cooperative learning is different from ordinary group work because student groups are arranged by the teacher based on elements that can mediate student collaboration effectively (Cooper, 1995). According to research conducted in the UK, they were building understandings, making connections, and demonstrating higher-level thinking during their small group discussions (Gillies, Nichols, Burgh, & Haynes, 2014).

Positive interdependence, individual accountability, interpersonal and small group skills, heterogeneous groups, mutually supportive promoted interactions, effective group processing, and equal opportunities for success are just some of the factors a teacher should keep in mind when designing and developing a cooperative learning strategy (Cooper, 1995). Cooperative learning is a teaching strategy in which students collaborate in teams to benefit both themselves and their classmates (Cooper, 1995). Teachers in cooperative learning situations must take on the role of facilitators, instruct pupils in working together, and devise planned, collaborative lessons (Cooper, 1995). Cooperative learning entails making decisions and addressing problems together (Cooper, 1995), in addition to exchanging knowledge and insight (Cooper, 1995). Cooper (1995) argues that the use of cooperative learning practises fosters an atmosphere in which students are more likely to engage with one another through the use of group discussion, the adoption of action strategies, and the pursuit of common learning objectives.

In addition, other research found that forming groups or teams that involve individuals in teams to make decisions and solve problems in group discussions contributes to critical thinking. According to (Cooper, 1995), problem-solving skills such as organising and analysing problems, planning and adjusting work progress, and being sensitive in making observations are positively related to critical thinking skills. Therefore, cognitive and metacognitive abilities are very important for critical thinking skills. Critical thinking ability is an intellectual discipline process to actively and skilfully conceptualise, apply, analyse, synthesise, and evaluate information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide for beliefs and actions (Forawi, 2016). According to Forawi (2016), critical thinking skills also involve evaluating reasoning and the factors considered in making decisions. This is in accordance with research conducted by Genc (2016) in Turkey, which states that cooperative learning positively affects student achievement. The importance of cooperative learning that allows students to socialise and directs them to play an active role in the learning process is increasing.

A variety of science-related skills, such as guided inquiry, experimenting, looking for evidence with support, teamwork, and communication, can be used to facilitate the development of students' critical thinking skills and integrate critical thinking with other competencies (Forawi, 2016). Experiments, manipulation of variables, data gathering, deeper analysis, and the integration of information and processes are all ways in which students' critical thinking can be guided towards improved science learning. According to research conducted in Hong Kong, the critical thinking abilities of students who participated in educational interventions based on Kuhn's (1991) paradigm were found to increase (Fung, 2014).

In learning science through a cooperative learning model, there are several methods used. The well-known methods of cooperative learning are Student Teams Achievement Divisions (Slavin, 1991), Team Game Tournaments (Slavin, 1991), Co-op co-op (Kagan, 1985), Cooperative Integrated Reading and Composition (Slavin, 1990), Team Assisted Individualization (Cooper, 1995), Group Investigation (Cooper, 1995), and Jigsaw (Slavin, 1995). Students can be actively involved in their

study groups through these cooperative learning methods. Paul & Elder (2007) argue that critical thinking ability is a structured cognitive process that requires active and skilled involvement in problem-solving, formulating concepts, application, reasoning, analysis, synthesis, observation, data collection and evaluation, reflection, and communication.

Cooperative learning has the basic principles of personal constructivism and social constructivism. The basic principles of cooperative learning can be integrated with environmental insight and contribute to students' critical thinking skills, especially in the components of building students' understanding or knowledge, students' abilities to argue, ask questions, analyse, synthesise, draw conclusions, evaluate, and solve problems given both individually and collectively. Environmentally-minded cooperative learning combines the environment as a learning resource for students to solve problems given in groups through discussions and carry out learning activities such as observation, analysis, synthesis, making conclusions, and evaluating the findings obtained in the environment. This statement is in accordance with the concept of environmental learning, which is learning that uses learning objects in the surrounding environment as real experiences (contextual learning). Students observe directly, obtain data accurately and can study independently or in groups to solve problems given (Juairiah & Djufri, 2014; Kristyowati & Agung, 2019). This is similar to research conducted in Indonesia, which states that in applying strategies in this model, students have been taught to form their learning concepts (Yusuf, 2018). In addition, other studies that were also conducted in Indonesia stated that has a positive influence on students so that teachers can apply it as an alternative way of learning that can improve students' critical thinking skills (Novika et al., 2019), and through guided inquiry learning and carousel, feedback students will be trained in their thinking skills and play an active role in the process (MR, Yuliati, & Qohar, 2018).

Therefore, through cooperative learning with environmental insight, students connect the knowledge they have and its implementation in everyday life by utilising the environment as a learning resource. Through cooperative learning with environmental insight, students construct their knowledge, analyse the findings, and present the findings in group discussions. Students who actively discuss in groups can express opinions, respond quickly to questions, and can solve problems. According to Paul & Elder (2007), critical thinking skills are structured cognitive processes that require active and skilled involvement in problem-solving, formulating concepts, applications, reasoning, analysis, synthesis, observation, data collection and evaluation, reflection, and communication. Similarly, research that has been conducted in Taiwan states that a collaborative game-based learning environment developed by integrating grid-based thinking tools can help students organise knowledge and engage them in higher-order thinking (Sung & Hwang, 2013), and students also state that learning by Educational card games can help them to acquire scientific knowledge and that game-based learning methods increase their interest in modes of transportation and energy (Liu & Chen, 2013).

4. CONCLUSION

Cooperative learning models can improve and generate students' knowledge and critical thinking skills in science learning through game-based learning, role-playing, TGT, STAD, jigsaw, and learning together. The relevant scientific studies impact students' personal and social constructivism to build students' knowledge and high-order thinking skills. The main principles of cooperative learning can be integrated with environmental insight and contribute to students' critical thinking skills both independently (personal constructivism) and in groups (social constructivism) in building students' understanding, students' ability to argue, ask questions, analyse, synthesise, draw conclusions, evaluate, and solve problems. The novelty of this study is that the focus of the study on previous research has not been the cooperative learning model, which shows results related to environmental insights, especially in science learning, so this research will examine various journals of environmentally friendly cooperative learning models taking into account the SDGs theme. This research is limited to the study of cooperative learning models with an environmental perspective in

improving students' critical thinking skills. This research can be used as a reference for further research related to cooperative learning with an environmental perspective on students' critical thinking skills that have not been studied or explored for information in this study.

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