

Fostering Critical Thinking Skills Through Innovative Elementary School Science Learning

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Abstract

Contemporary educational frameworks evolve to prepare learners for real-world challenges, so learners are required to have skills and be able to compete in the 21st century era. Critical thinking skills are high-level thinking skills that are very important for learners to have starting from elementary school, but in fact, critical thinking skills in elementary schools are low. The focus of this research is to describe critical thinking skills through innovation in elementary school science learning. This research uses a literature study research method. Data collection is sourced from relevant articles, journals, and books. Research data analysis through four stages 1) data collection, 2) data reduction, 3) data presentation, and 4) conclusion drawing. The results of this study reveal that learning innovation has an important role because it is able to foster critical thinking skills through HOTS questions, appropriate learning models, and media that can foster critical thinking in students. Some things that need to be considered are the utilization of technology that is developing using technology-based media and the use of HOTS questions and learning models is also considered. So it can be concluded that fostering critical thinking skills through learning innovation can be done through HOTS questions, appropriate learning models, and learning media in elementary school science learning.

Keywords: *Critical thinking, innovation, science*

Abstrak

Kerangka pendidikan masa kini berkembang untuk mempersiapkan peserta didik menghadapi tantangan dunia nyata, sehingga peserta didik dituntut memiliki keterampilan dan mampu bersaing di era abad 21. Keterampilan berpikir kritis merupakan keterampilan berpikir tingkat tinggi yang sangat penting dimiliki peserta didik mulai dari sekolah dasar, namun pada kenyataannya kemampuan berpikir kritis di sekolah dasar tergolong rendah. Fokus penelitian ini adalah mendeskripsikan keterampilan berpikir kritis melalui inovasi dalam pembelajaran IPA sekolah dasar. Penelitian ini menggunakan metode penelitian studi literatur. Pengumpulan data bersumber dari artikel, jurnal, dan buku yang relevan. Analisis data penelitian melalui empat tahap 1) pengumpulan data, 2) reduksi data, 3) penyajian data, dan 4) penarikan kesimpulan. Hasil penelitian ini mengungkapkan bahwa inovasi pembelajaran mempunyai peranan penting karena mampu menumbuhkan kemampuan berpikir kritis melalui soal-soal HOTS, model pembelajaran yang tepat, dan media yang dapat menumbuhkan berpikir kritis pada siswa. Beberapa hal yang perlu diperhatikan adalah pemanfaatan teknologi yang berkembang dengan menggunakan media berbasis teknologi dan penggunaan soal dan model pembelajaran HOTS. Jadi dapat disimpulkan bahwa pembinaan kemampuan berpikir kritis melalui inovasi pembelajaran dapat dilakukan melalui soal HOTS, model pembelajaran yang tepat, dan media pembelajaran dalam pembelajaran IPA sekolah dasar.

Kata kunci: *Berpikir kritis, inovasi, sains*

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INTRODUCTION

The paradigm of education in Indonesia has changed marked by the rapid development of science and technology. Education can be said to be dynamic if it involves students in changes in the teaching and learning process and there are also many demands on the skills of students that must be possessed to prepare for the challenges of the 21st century. The 21st century is the century of revolution 4.0 during this era of rapid development of science and technology. Learners are expected to be able to adapt and keep up with developments. The Ministry of Education and Culture has adapted three concepts in the 21st century to advance the curriculum at the elementary, junior high, high school and vocational levels including 21st century skills, scientific approach and authentic assessment. The National Education Association found that 21st century skills consist of "The 4Cs" (Redhana, n.d., 2019) these include critical thinking, creativity, communication, and collaboration. Another opinion was also conveyed by Anies Baswedan (dalam Indraswati et al., 2020) which lists the 4C skills of creativity, critical thinking, communication and collaboration.

As the global perspective continues to shift, contemporary educational frameworks evolve to prepare learners for real-world challenges so that learners are able to compete in the 21st century era, one of the abilities that need to be possessed is critical thinking. Critical thinking focuses on objective evidence, the ability to analyze, intensely understand, connect, interpret, evaluate, and make judgments about information or to find solutions to problems. (Darwin et al., 2022). Critical thinking can be taught and integrated based on the approach of how to think rather than what to think. (Simonovic et al., 2022). Critical thinking skills according to Onoda (2022) critical thinking is a cognitive ability that includes evaluation, analysis, reasoning, inference, and problem solving in addition to facilitating language learning because they help learners cope with new and unexpected experiences. Critical thinking in its improvement can be through subject content, one of which is in science learning which provides an opportunity for each student to hone their curiosity scientifically and is expected to be able to apply it in life. In line with the rapid development of technology globally, science literacy is an important thing to be mastered by the Indonesian generation. However, data from the 2018 PISA report shows that the literacy level of Indonesian students is still lacking. Indonesia ranked 74th out of 79, far behind neighboring countries such as Malaysia, Singapore and Thailand (Sidiq et al., 2021). So the need for an innovation in learning to provide novelty in learning activities to facilitate critical thinking skills. When teachers innovate learning, learning can be said to be meaningful because with these innovations the teacher will automatically understand and have broad insight into the methods, models, media and even questions used that are tailored to existing conditions. In accordance with the opinion Hapsari & Fatimah (2021) which explains that with teachers innovating teachers will become more knowledgeable and have broad insights into new learning methods, teaching techniques, approaches to students and others and improve competencies to become quality teachers. For this reason, special attention needs to be paid to innovation in the learning components used, to improve critical thinking skills, especially in the content of Sciences. Science in elementary schools has mostly implemented an independent curriculum which states that in the curriculum science changes to science and social. The discussion of science and social applies teaching modules to carry out learning by emphasizing students to play an active role during learning. Science provides an opportunity for each learner to hone their curiosity scientifically and is expected to be able to apply it in life. According to Trianto (2013) Science is a systematic collection of theories, its application is generally limited to natural phenomena, born and developed through scientific methods such as observation and experimentation and demands scientific properties such as curiosity, openness, honesty and so on. In essence, science is a science of natural phenomena

that is poured in the form of facts, concepts, principles and laws that are tested for truth and through a series of activities (Alrinda et al., 2017). Science is also defined as mastery of a collection of knowledge in the form of facts, concepts or principles. Concepts in science in elementary schools are still classified as integrated because they have not been separated such as physics, chemistry, and biology. So the teacher refers more to the goals to be achieved. The purpose of science is to understand scientific concepts and students are able to implement them in everyday life. Learning that integrates with conditions in an environment is one of science so that learning is more meaningful. However, integration in elementary schools tends to be less effective when students are asked to connect conditions in an environment because their critical thinking skills have not been facilitated. So as a teacher must be able to provide innovation in various facilities or components in learning so that students are facilitated in their critical thinking skills. For this reason, this research discusses fostering critical thinking skills through innovation in elementary school science learning.

METHOD

The research was conducted with a type or research approach in the form of a literature study. Literature studies are closely related to theoretical studies and other references in accordance with the values, culture, and norms that develop in social situations because research cannot be separated from scientific literature (Sugiyono, 2021). Data collection techniques by identifying discourse from various reference books, articles and journals related to "Fostering Critical Thinking Skills Through Elementary School Science Learning Innovations". The stages of the research include 1) data collection, 2) data reduction, 3) data presentation, and 4) conclusion drawing. Based on the data from the references that have been collected by reading, reviewing, studying, and recording literature that is related to "Growing Critical Thinking Skills Through Elementary School Science Learning Innovations" then get the appropriate conclusions.

RESULTS AND DISCUSSION

One of the skills that is very important and necessary to be able to face the challenges of the 21st century is critical thinking. This critical thinking skill has become one of the targeted and prioritized skills in education systems around the world (Kawuryan et al., 2022). Critical thinking focuses on objective evidence, the ability to analyze, intensely understand, connect, interpret, evaluate, and make judgments about information or to find solutions to problems (Darwin et al., 2022). In line with the opinion of Fitriani et al. (2020) which explains that critical thinking is an intellectual process in finding, analyzing, and evaluating some information obtained from observations or experiences that are used as decisions or judgments in making decisions. Critical thinking skills certainly need to be cultivated early on when students are in elementary school so that students are trained and trained to become critical young citizens so that they are successful in the future. However, in reality the PISA results show that Indonesia is ranked 74 out of 79 countries so that it is said that the level of science literacy in Indonesia is lacking and lagging behind neighboring countries. Based on this, one of the efforts that can be made to foster critical thinking skills is to make an innovation in the learning process.

Learning innovation is a novelty from various components needed to deliver subject matter with the aim of improving the quality of education. The learning process in students that is designed, developed, and managed creatively and applies various approaches in a better direction to create an atmosphere and learning process that is conducive to students is called learning innovation (Hapsari & Fatimah, 2021). Innovation linked to better educational outcomes will provide a major boost in international educational knowledge (Vincent-Lancrin et al., 2019). When the teacher

innovates learning, learning can be said to be meaningful because with this innovation the teacher will automatically understand and have broad insight into the methods, models, media and even the questions used which are adjusted to the existing conditions. In accordance with the opinion Hapsari & Fatimah (2021) In addition, it is important to understand that the teacher's innovation will make the teacher more knowledgeable and have broad insights into new learning methods, teaching techniques, approaches to students and others and improve the competence of becoming a quality teacher. The purpose of learning innovation is not only to improve learning outcomes, but also to improve teaching experience as an opportunity to develop transversal skills (Kwangmuang et al., 2021) because teachers have a very influential role in learning. One of the subject contents with science literacy and able to foster critical thinking skills is natural science, whose knowledge is systematically arranged to produce a new discovery and tested for truth through the scientific method. Science learning has the aim of mastering students in understanding science in a broad context, especially those related to everyday life. Reinforced by the opinion of Yeni et al. (2020) that the purpose of learning science in elementary school is a subject content that has educational values that can shape the child's personality as a whole, through which students can develop knowledge and understanding of science concepts that are useful and can be applied in everyday life. According to (Sulthon, 2016: 50) The purpose of science is to improve the quality of science learning, interest and motivation, mastery of science learning competencies including understanding, skills, scientific attitudes and provision of science knowledge and develop the substance of science. Based on this, fostering critical thinking skills in science learning is needed in order to achieve science goals by making innovations in learning. Learning innovations can be made in various components in learning such as Higher Order Thinking Skills (HOTS) based questions, learning models that are tailored to the material, and learning media.

Fostering critical thinking skills through HOTS questions

Critical thinking skills allow individuals to think deeply, ask a lot of questions, look for various relevant information, because in the context critical thinking does not take information for granted. Meanwhile, in the learning that is still applied, teachers are accustomed to using traditional learning methods, resulting in a lack of student activity which causes low learning outcomes (Safira et al., 2020), so that the learning emphasizes low-level thinking. Therefore, in order to encourage students to think deeply, it is necessary to give Higher Order Thinking Skills (HOTS) based questions. HOTS-based questions are a complex thinking process to describe material, conclude, build representations, analyze and build relationships by involving activities that can be used to improve students' critical thinking skills. This can be done through learning innovations with several approaches such as based on students' experiences, social modeling, social persuasion, and students' physical and emotional conditions (Syarifah et al., 2019). According to research conducted by Dahlan et al. (2020) stated that Higher Order Thinking Questions can train high thinking skills that lead to mastery of students' critical thinking skills. In line with the results of research conducted by which shows that there is a significant difference between the pretest and posttest scores of students obtained from the results of learning HOTS-based questions, HOTS-based questions get an effective category for developing critical thinking skills of students in elementary schools so it is concluded from this study that HOTS questions can improve critical thinking skills in elementary school students (Sidiq et al., 2021).

The use of HOTS-based questions using the HOTS stimulation model is a new learning based on inquiry learning which is the basis for teaching skills to students with this critical thinking skills are effectively improved through Stim-HOTS activities (Cahya Saputri et al., 2019). HOTS can be improved through professional science teacher programs on how to use the curriculum to instill an understanding of scientific concepts

and applications in everyday life so that learners are able to grow their critical thinking skills (Mohammed Saido et al., 2015). Basically, good questions to measure critical thinking skills are questions that hone a person's higher order thinking skills (S. P. Sari & Siregar, 2020). For this reason, HOTS-based questions are a process of thinking deeply about processing information in solving complex problems, HOTS questions used with innovation using everyday problems so that students have basic concepts to solve problems (Yulitya et al., 2021). According to Muhibbuddin et al. (2023) The form of HOTS-based exercise questions has influenced the critical thinking aspects of students who can improve critical thinking skills in science learning with various levels of subjects. So it can be synthesized that the use of HOTS-based questions is able to foster critical thinking skills through various innovations in these questions such as the use of HOTS stimulation models, approaches, linked to experience, scientific concepts and application in everyday life.

Growing critical thinking skills through learning models

The learning model is an action plan carried out by educators to prepare learning in accordance with the way students learn in learning. The model applied by educators is able to help students get information, ideas, skills, ways of thinking, and expressing their own ideas. The types of learning models include *Problem Based Learning* (PBL), *Discovery Learning*, *Project Based Learning* (PjBL), *Cooperative Learning*, *Contextual Teaching and Learning* (CTL), *Pembelajaran Langsung*, *Problem Solving*, *Teams Games Tournament* (TGT), STAD, Jigsaw, SAVI, dan lain sebagainya. Application in science learning certainly requires a learning model to support the process of learning activities and achieve the expected goals, especially those that support students' critical thinking skills. The learning model that is usually used to improve critical thinking is a learning model that emphasizes a problem that raises activities in learning such as PBL, PjBL, CTL, dan Discovery Learning. There are two learning models that are often used in learning to foster critical thinking skills, namely Discovery Learning and Problem Based Learning (PBL). This model is a type of learning model that is often called problem-based learning.

Science learning emphasizes a discovery so that students will indirectly think critically. However, one of the problems that exist in science learning is the use of textbooks when learning so that students feel they have to memorize material. (Wardani et al., 2023), causing a lack of interest and motivation in learning so that in honing their critical thinking skills are not facilitated. Teachers in their application are less fluent and less effective in learning models or methods, this is supported by research Safira et al. (2020) which states that teachers are accustomed to using traditional learning methods, resulting in a lack of student activity which causes low learning outcomes. For this reason, teachers need to use an appropriate learning model to facilitate science material in the concept of discovery, one of which is the Discovery Learning model. The application of the Discovery Learning method in the learning process is able to train students' critical thinking skills, because what is found in the search process will be easier to remember and easy to form an understanding (Setiadi & Elmawati, 2019) because this model emphasizes direct experience so that students are able to understand the structure or ideas in a discipline through direct involvement of students in learning. Research conducted by (Kurniawati et al., 2021) stated that in the critical thinking process with the Discovery Learning model, students have the freedom to express their own ideas and opinions with the results of their investigations, so that this model is combined with the investigation process to foster critical thinking. In addition, the use of the Discovery Learning model facilitates and provides direct experience for both students and teachers, so that learning will be more meaningful in accordance with the material that has been taught to students in this model there is a description of learning objectives, students and their groups can work together, exchange ideas to solve problems, present the results of discussions and

lead to conclusions (Mustikaningrum & Mediatati, 2021). So it can be said that the use of the Discovery Learning model is considered practical and effective in improving critical thinking skills (Putri et al., 2020). The application of the Discovery Learning model to teaching is necessary because students should have more time to engage in student-centered activities. (Komariyah & Karimah, 2019). So it is synthesized that the Discovery Learning learning model an interesting model to use because this model emphasizes the discovery of a problem that creates students play an active role in learning and are able to think critically, especially in learning, one of which is in science subjects.

This learning places learners in a problem to stimulate children to think about conducting an investigation. Supported by research conducted by Dianawati (2016) which states that the application of the Problem Based Learning model students are active in seeking their own knowledge when solving the problems faced so that this affects the students' critical thinking skills. It is also reinforced by research conducted by Ejin (2016) which proves that learning using Problem Based Learning gives a positive response to students' mastery of concepts and critical thinking skills so that it is feasible to use in learning activities. According to Muslimin Problem Based Learning model that emphasizes students to develop critical thinking and problem solving skills and become independent learners (Nurdin & Andriaton, 2016). The Problem Based Learning models is an effective model when applied during learning at a high level thinking process, it can help and facilitate the process of students when searching and processing information in their minds in order to be able to analyze knowledge through observation and investigation by participants (Prasetyo & Nisa, 2018). There are other opinions that state that the application of the Problem Based Learning models tends to be higher in critical thinking skills than the application of other learning models (N. Sari et al., 2021). In addition, the opinion of Setyawan & Dewi Koeswanti (2021) explained that the application of the Problem Based Learning models had an influence on students' critical thinking skills. The Problem Based Learning models is an interesting model to use because this model emphasizes problem solving where students play an active role in learning and are able to think critically to solve existing problems, especially in learning, one of which is in science subjects. So it is synthesized that the Discovery Learning and Problem Based Learning learning models are able to foster critical thinking skills with innovation in learning.

Fostering critical thinking skills through learning media

Critical thinking skills certainly need to be facilitated early on because they prepare for the challenges of the 21st century. But in reality there are still problems that arise such as the material is too dense, feeling that you have to memorize material, limited learning facilities, difficulty understanding the material because without access to media, teachers dominate in learning, mastery of concepts is weak and too monotonous (Wardani et al., 2023). To overcome this as a teacher can make innovations in learning, namely by using learning media that is tailored to the subject matter. Media can increase knowledge which basically school-age children are more likely to prefer learning while playing with the media because school-age children will more easily capture the message or material taught without experiencing continuous boredom (Siagian et al., 2021). The use of media in learning certainly creates interaction between teachers and students. In this case, what was previously teacher-centered learning becomes student-centered. This is in accordance with the opinion Yaumi (2021: 7) which states that learning media are all forms of physical equipment that are designed in a planned manner to convey information and build interactions designed according to learning needs and objectives. In addition, the use of learning media can make it easier for teachers to explain learning and interesting designs can make students think more critically (Febaliza et al., 2023). Attractive design can certainly be supported by the rapid development of technology.

The development of technology certainly makes it easier for teachers to deliver material such as through learning videos such as research conducted by (Jannah et al., 2023) There is a significant effect of using video as learning media on students' critical thinking skills, because the media attracts students' interest and increases student motivation and understanding of the material so that students are actively involved in learning and the teacher acts as a facilitator. Other research was also submitted by (Yusuf et al., 2022) that the application of the Problem Based Learning model and IBL collaboration model using video can improve students' critical thinking skills so that in this case video media can foster critical thinking skills. There are other studies related to android-based science learning media with an inquiry approach that can provide an increase in the critical thinking skills of grade IV students on force material (Asani et al., 2023). In addition, there is a technology-based learning media, namely the application of Augmented Reality to increase learning motivation and improve student achievement because Augmented Reality technology and games help facilitate student understanding of the material presented by teachers in learning (Chen, 2020). In accordance with the rapid development of technology, there are several problems from various aspects both from cost and accessibility. So that the research carried out with the use of Augmented Reality presents 3D digital content that results in an increase in test performance and has a positive impact on learning activities to be interesting and interactivity of Augmented Reality (Reeves et al., 2021). Chou et al. (2022) explains that Augmented Reality provides a positive influence seen from effective learning where children have high learning motivation and good performance during learning activities. So it is synthesized that learning media is able to foster critical thinking skills with innovation in its learning media components.

CONCLUSION

Fostering critical thinking skills early on is one way to prepare for the challenges of the 21st century. Based on the results of the literature study, fostering critical thinking skills in science learning can be through various learning innovations including HOTS-based questions, appropriate learning models, and learning media. Innovations made through HOTS questions can be through the use of stimulation models, approaches, linking to experience, scientific concepts, habituation using HOTS questions and application in everyday life. While innovations made through the Discovery Learning learning model are associated with discovery and Problem Based Learning which is associated with a problem so that it can foster critical thinking skills with learning innovations in it. In addition, innovations can be made by using learning media that can foster critical thinking skills through the use of technology-based learning media.

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