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Development of Critical Thinking and Collaboration Skills in Science Learning at Elementary School: A Case Study

Dita Purwinda Anggrella*
*Madrasah Ibtidaiyah Teacher Education Study Program, Faculty of Tarbiyah and Teacher Training, Universitas Islam Negeri Raden Mas Said Surakarta, Indonesia
E-mail: dita.anggrella@staff.uinsaid.ac.id

Luluk Nurjanah**
**Madrasah Ibtidaiyah Teacher Education Study Program, Faculty of Tarbiyah and Teacher Training, Universitas Islam Negeri Raden Mas Said Surakarta, Indonesia
E-mail: lulukjokam123@gmail.com

Ahmad Kamal Sudrajat***
***Biology Education Study Program, Faculty of Mathematics and Natural Sciences, Universitas Negeri Yogyakarta, Indonesia
E-mail: kamalsudrajat@uny.ac.id

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Abstract

In the era of industry 4.0, students are faced with the complexity of a changing world and the demand to develop relevant skills, one of which is critical thinking and collaboration skills. However, educators face difficulties in developing and integrating these skills into learning practices. This study aims to investigate the difficulties of teachers in developing critical thinking and collaborative skills in science learning. The research method used is a case study. Data collection was conducted at SD Aisyiah Surya Ceria, Karanganyar, Central Java through interviews with thematic teachers of grade III, students, and vice principals of curriculum. The results of the study indicate that the difficulties experienced by teachers in developing critical thinking and collaboration skills are related to student conditions, namely student thinking skills and learning characteristics. While the supporting factors are school policies, facilities, innovative learning models and mastery of information technology for the learning process.

Keywords: *critical thinking skills, collaboration, science learning.*

Abstrak

Di era industri 4.0, siswa dihadapkan pada kompleksitas dunia yang terus berubah dan tuntutan untuk mengembangkan keterampilan yang relevan, salah satunya adalah keterampilan berpikir kritis dan kolaborasi. Namun demikian, para pendidik menghadapi kesulitan dalam mengembangkan dan mengintegrasikan keterampilan tersebut dalam praktik pembelajaran. Penelitian ini bertujuan untuk menginvestigasi kesulitan-kesulitan guru dalam mengembangkan kemampuan berpikir kritis dan kolaboratif dalam pembelajaran IPA. Metode penelitian yang digunakan adalah studi kasus. Pengumpulan data dilakukan di SD Aisyiah Surya Ceria, Karanganyar, Jawa

Tengah melalui wawancara dengan guru tematik kelas III, siswa, dan wakil kepala kurikulum. Hasil penelitian menunjukkan bahwa kesulitan yang dialami guru dalam mengembangkan keterampilan berpikir kritis dan kolaborasi berkaitan dengan kondisi siswa, yaitu kemampuan berpikir dan karakteristik belajar siswa. Sedangkan faktor pendukungnya adalah kebijakan sekolah, fasilitas, model pembelajaran yang inovatif dan penguasaan teknologi informasi untuk proses pembelajaran.

Kata kunci: *keterampilan berpikir kritis, kolaboratif, pembelajaran IPA.*

INTRODUCTION

Knowledge and information move rapidly in the 21st Century (Marburger, 2011). The rate of knowledge covers various fields, one of which is education (Zawacki-Richter et al., 2019). Developments in the 21st Century demand increased students' skills to compete in it. Therefore, skills are needed, which are called 21st-century life skills (Wrahatnolo & Munoto, 2018). Based on the Partnership for 21st Century Skills, 21st-century skills include 4C: Communication, Collaboration, Critical thinking, and Creativity (P21, 2015).

Currently, critical thinking skills and collaboration are the focus of educational goals in many countries (Kusuma et al., 2021). Critical thinking skills are high-level thinking skills (Barnett & Francis, 2012; Ghanizadeh, 2017) that emphasize regular thinking to understand the information in depth (Barnett & Francis, 2012). Critical thinking characteristics include the involvement of knowledge, method recognition, investigation, logical reasoning and the tendency to solve and consider problems wisely (Greenstein, 2012). Based on research by Ghazivakili et al. (2014), critical thinking includes skills in solving problems, analyzing, justifying reasons, evaluating, conducting investigations, and making decisions (Ghazivakili et al., 2014). In addition, critical thinking skills are the skills most needed in the world of work today (Schleicher, 2018). Critical thinking skills must be developed in students because it requires a process to develop them, in another sense it is not a talent that is acquired from birth (Guleker, 2015).

Critical thinking skills are important to develop in the learning process because they can help students solve problems critically by considering various things logically (Rene & Jose, Ocampo, 2018). Critical thinking skills can also encourage students to select the information they get (Barnett & Francis, 2012). Critical thinking skills allow students to solve problems more accurately by associating several relevant concepts (Rene & Jose, Ocampo, 2018). Critical thinking skills can help students face various challenges that arise along with the development of science (Schleicher, 2018). Developing critical thinking skills can be done with habituation activities in a class by stimulating students to think critically (Changwong et al., 2018). Apart from critical thinking skills, another essential skill to develop is collaboration skills.

Collaboration skills are one of the four life skills that need to be mastered by 21st-century students (Naila et al., 2019). Collaboration skills are more than just collaborating with others, but learning to plan, cooperate, consider diverse thoughts, and participate in discourse by contributing, listening, and supporting others (Greenstein, 2012). Collaboration skills include contribution, problem-solving, working effectively with diverse members, and managing projects (Naila et al., 2019).

Collaboration skills can train students to synergize, cooperate and be responsible for themselves or others (P21, 2015). Collaboration skills can improve thinking skills (Mahoney

& Harris-Reeves, 2019). Collaboration skills can improve critical thinking, creative and communication skills (Gokhale, 1995; Mahoney & Harris-Reeves, 2019). Collaboration skills can develop other higher-order thinking skills, such as creativity and critical thinking (Gokhale, 2012; Johnson et al., 2007; Rahman et al., 2022). However, these two skills are still low among Indonesian students (Aufa et al., 2021; Kusuma et al., 2021; Ramdiah et al., 2019). The causative factor for this case is that students are not trained enough to use higher order thinking in their daily lives (Ramdiah et al., 2019). In addition, this condition can also occur because students do not get the opportunity to empower their thinking skills both in the learning process and in other ways, there are also indications that the use of inappropriate learning models is less able to empower students' thinking skills.

According to Tan et al. (2017), developing critical thinking skills needs to be optimized in education. The way to develop critical thinking skills and collaboration in education is to apply various methods, models, and learning strategies (Goldstein, 2016; Susilo & Sudrajat, 2018). Other than that, using problem-based questions can improve student skills. The effectiveness of developing 21st century skills in learning has been proven by various studies (Handajani et al., 2018). Project-based learning (Devkota et al., 2017), project-based learning (Saputro et al., 2019), and discovery learning(Kurniawati et al., 2021) are effective in developing students' 21st century skills. Based on previous research conducted by Sudrajat et al. (2020), the development of critical thinking and collaboration skills is determined by classroom learning that involves teachers and students (Sudrajat et al., 2020). Lack of critical thinking skills can come from students, teachers and aspects related to learning (Arif et al., 2019; Berjamai & Davidi, 2020).

Based on these problems, it is crucial to conduct further research on teachers' difficulties and supporting factors in developing students' critical thinking skills and collaboration in schools. Previous research on the analysis of difficulties in developing critical thinking skills and collaboration has been carried out, but this research was limited to high school teachers (Sudrajat et al., 2020). Research on the difficulties of developing critical thinking skills in elementary school education has not been carried out. Therefore, this research aims to analyze the difficulties and supporting factors of elementary school teachers in developing students' critical thinking and collaboration skills. This research is expected to improve the education and learning system so that teachers can create alternatives to optimize students' critical thinking skills and collaboration.

METHODS

This type of research is a case study. Case studies are chosen to obtain more in-depth data so that more detailed phenomena can be found (L. Cohen et al., 2018). The cases observed in this study focus on factors that hinder and support the development of critical thinking and collaboration skills in elementary schools.

The research was conducted at 'Aisyiah Surya Ceria Karanganyar Elementary School. A total of 16 third-grade students participated in this study. Confirmation of the findings was carried out by conducting interviews with third-grade thematic teachers and the deputy head of curriculum.

The techniques used are interviews, observation, and lesson plan analysis. Interviews were conducted with Interviews were conducted to find information about students'

conditions, school policies, facilities, learning methods and models, as well as Information and Technology (IT) knowledge for teaching and learning activities. Interviews were conducted using a semi-structured interview instrument. Observations were made by observing obstacles and developing students' critical thinking skills and collaboration. In addition, an analysis of the learning design documents used by the teacher when teaching was also carried out.

Data analysis uses a qualitative approach with the content analysis method. The steps for content analysis include: 1) defining the research questions to be addressed, 2) identifying the population from which text units will be sampled, 3) selecting the sample to be included, 4) determining the context in which the document was created, 5) specifying the units of analysis, 6) deciding on the codes to be used, 7) constructing the cate- gories for analysis, 8) conducting the coding and categorizing of the data, 9) performing data analysis, 10) summarizing the findings, and 11) making speculative inferences (L. Cohen et al., 2018).

RESULTS AND DISCUSSION

Based on the research results found inhibiting factors and supporting factors in the development of student's critical thinking skills and collaboration. The inhibiting factors found included students' different thinking skills and learning characteristics. In contrast, the supporting factors were innovative learning methods and models, school policies, facilities, and mastery of IT in the learning process. The results of this study are generally shown in Table 1. In more detail, the results will be described in the description below.

Table 1. Outline of Research Results

Factor	Variable	Supporting Statement
Obstacle	Student Condition	"*Students are not yet fluent in reading…*" "*Barriers for third-grade are still happy to play…*"
Supporting	Innovative teaching and learning	"*… teacher's ability to create creative and innovative learning*." "*... I let them study with friends, form study groups, give quizzes, pictures, experiment and observation activities outside the classroom...*"
	School Policy	"*This school uses the 2013 curriculum, elevates explorative class programs …*" "*… curriculum, exploratory class programs, application of class work and experiments in learning, and teacher workgroup discussion programs …*"
	Facility	"*The school provides facilities such as LCDs for almost every existing class, audio, classrooms, funds …*"
	IT mastery by Teacher	"*Usually, before the practicum, we play the video in class…, I also use audio ...*"

The Obstacles Factor to the Development of Students Critical Thinking and Collaboration Skills

Student Condition

The condition of students has not yet supported the development of critical thinking skills. Some students have not mastered basic skills such as reading, composing words, and understanding sentences. In addition, students also do not have a coherent mindset. This condition is shown based on the results of the following thematic teacher interviews:

"Students are not yet fluent in reading, so it is difficult to arrange words into sentences, understand sentences and express ideas."

In addition, the condition of students does not support the development of collaboration skills. Some students have not shown independence and responsibility for group assignments. This result is shown based on the results of the following thematic teacher interviews:

"Barriers for third-grade are still happy to play. I have difficulty adjusting the material to the learning characteristics of students. If the material presented attracts high student enthusiasm for learning, if the material presented does not attract the enthusiasm for learning is low."

This answer agrees with the statement of third-grade students who stated:

"I have difficulty writing words or sentences in making assignment reports from the teacher. If I get group assignments, I prefer it if my group workmates are smart, and I find it difficult if I get less productive friends in one group."

Figure 1. Student collaboration activities

Based on the results of these interviews, it can be seen that the teacher's difficulties in developing critical thinking skills and collaboration in learning in elementary schools are related to the conditions of students, including the ability to think and the character of student learning. The condition of students is one of the teacher's difficulties in developing critical thinking and collaboration skills. This result is in line with the research of Susilo & Sudrajat (2018), which shows that difficulties in developing critical thinking and collaboration skills are related to the conditions of students, teachers, facilities, and existing policies.

Another difficulty for teachers in developing critical thinking skills is that students' reading skills are still low. Based on teacher interviews, information was obtained that students were not fluent in reading, so it was challenging to arrange words into sentences, understand sentences and concluding ideas. Some students do not have basic skills such as reading, composing words and understanding sentences. This finding is supported by Konopko's research (2015), which shows that students' reading skills will affect other skills. This statement is supported by research of Anugrah & Pujiastuti (2020), which shows that students' low thinking skills can be caused by many student mistakes in understanding and answering the questions given. Another study by Zubaidah (2014) shows that reading ability can affect the ability to find ideas. This problem can be solved by giving assignments that train students to read, such as reading books, reading stories, and analyzing readings (Ambarita et al., 2021; Hubbard & Dunbar, 2017). In addition, students' interest in reading can also be increased through reading literacy (Wulanjani & Anggraeni, 2019).

Based on the results of interviews, the teacher's difficulties in developing collaboration skills include: students still like to play and it is still difficult to adjust the material to student learning characteristics. If the material presented is interesting, the enthusiasm of students to learn is high. If the material presented does not attract students' their enthusiasm for learning will be low. This finding is supported by the research of Fitriani et al., (2019); Mahanal et al., (2019) showed that students' thinking abilities were influenced by interactions between learning models, academic abilities and student discussions. Difficulties in developing collaboration skills can be overcome by using innovative and creative learning according to the learning character of elementary school students. Fun learning activities will increase student motivation and learning outcomes. This statement is supported by research by Permana et al., (2019), which shows that the acquisition of good thinking skills is caused by high learning motivation.

Motivation, an essential aspect of learning, can come from teachers, friends, family and the environment. In addition, the use of effective learning models can also improve student skills. This statement is reinforced by research by Kempa (2006), which shows that the cause of low student skills is a mismatch that occurs because the teaching strategy used by the teacher conflicts with student learning styles. So teachers need to recognize the learning styles of elementary school students and use appropriate learning strategies to make learning more effective in the future.

Supporting Factors to the Development of Students Critical Thinking and Collaboration Skills

Innovative teaching and learning

Supporting factors in developing critical thinking and collaboration skills come from teachers' innovative learning methods and models. This result is shown based on interviews with the vice principal as follows:

"The biggest supporting factor for the critical thinking and collaboration skills program is the teacher's ability to create creative and innovative learning."

In addition, learning methods and models are also used to overcome teacher difficulties related to students' thinking abilities and learning characteristics. This result is shown based on the thematic teacher interviews as follows:

"What supports me in learning in class are the learning steps. I usually bring children less able to read closer to more intelligent children. I let them study with friends, form study groups, give quizzes, pictures, experiment and observation activities outside the classroom."

This result is also supported by students' opinions regarding the learning process, which state that:

"*Science learning is enjoyable because we do experiments that we have never done before, the teacher gives us the freedom to observe and use experimental tools and materials to experiment according to the teacher's instructions, we work in groups, together we can complete experiments in a fun way, sometimes we also learn outside the classroom.*"

Figure 2. Science learning activities

Teacher creativity in managing learning is essential for developing critical thinking and collaboration skills (Tang et al., 2020). Based on the results of the interviews, the teacher had difficulty overcoming the character of students who still like to play. In addition, teachers also have difficulty adjusting the material to the character of student learning. Teachers overcame these difficulties by bringing less capable children closer to more intelligent children, giving quizzes taken outside the student handbook, using pictures, conducting experiments, doing work, and learning outside the classroom. Reseach by Konopko (2015) supports this finding, which shows that facilitating groups with peer-to-peer learning and peer feedback can improve students' critical thinking skills. This method can be enhanced with project-based pedagogical approaches and experiential learning that will help students work together to solve problems.

Teacher difficulties related to student learning characteristics can be overcome by using innovative and creative learning according to the learning character of elementary school students. Through fun learning activities and following the learning characteristics of elementary school students, learning can increase student motivation and learning outcomes. This result is supported by research by Permana et al. (2019b), which shows that good thinking skills are caused by high learning motivation (Krisgiyanti & Pratama, 2023; Permana et al., 2019; Purba et al., 2023). High motivation to learn can come from teachers, friends, family and the environment. In addition, using an effective learning model can improve student skills.

Based on research by Cargas et al. (2017); Nabilah & Syamsurizal (2024); Ulger (2018), the application of problem-based learning can provide experiences for students to develop critical thinking and collaboration skills. This statement is supported by research showing that problem-based learning models can influence students' critical thinking skills and collaboration (Birgili et al., 2015; Karantzas et al., 2013; McCrum, 2017; Nyet Moi Siew, 2016). Learning that encourages students to learn directly can improve students' critical thinking skills and collaboration. Research by Dafrita (2017); Haryanti et al. (2022) shows that thinking skills will increase if the learning process provides student experiences such as discovery learning. Other studies stated that choosing a suitable learning model, such as the problem-based learning model (Birgili et al., 2015; Ulger, 2018). The inquiry learning model can be an alternative to developing students' critical thinking and collaboration skills (Tindangen, 2018).

School Policy to the Development of Students Critical Thinking and Collaboration Skills

School policy is one of the supporters of the development of critical thinking skills, and student collaboration, the deputy head of the school for curriculum interviews indicated this:

"This school uses the 2013 curriculum, elevates explorative class programs that optimize scientific-based learning containing experimental activities and works to support student skills."

School policy as a supporting factor for the development of critical thinking and collaboration skills was also pointed out by teachers in interviews:

"One of my supporters for developing critical thinking and collaboration skills is school programs such as curriculum, exploratory class programs, application of class work and experiments in learning, and teacher workgroup discussion programs to plan and solve difficulties in learning."

This opinion is in line with the results of interviews with students stating that:

"At school, there are activities that allow us to explore doing teacher-directed experiments, we do some experiments, and sometimes we also study outside the classroom."

Figure 3. Explorative class program activities

Based on the analysis, the deputy head of school in the field of curriculum and teachers stated that factors supporting the development of critical thinking skills and student collaboration were school policies such as curriculum, exploratory class programs, works and

experiments, besides that there was a Teacher Working Group program to plan and solve problems in learning.

The school program is one of the supporters of the development of critical thinking skills and collaboration. Based on interview results, school policies such as curriculum, exploratory class programs, works and experiments are the supporting factors for developing students' critical thinking skills and collaboration. Besides that, there is a Teacher Working Group program to plan and solve problems in learning. Research by Imron (2023) & Tam (2015) supports this finding, which shows that teachers' difficulties in carrying out teaching and learning activities can be overcome by forming a professional teacher group. The type of study group used to solve problems in teaching, and learning is the teacher workgroup (Susilo & Sudrajat, 2018). In addition, based on research by Muti'ah et al. (2021) & Sudrajat (2017), problems in scientific learning can be handled with lesson study, which provides a process for collaborating on teaching plans, and evaluating the success of teaching methods that have been implemented. With this activity, the teacher can exchange ideas and improve learning according to the expectations of the 2013 curriculum.

Facility to Support the Students Critical Thinking and Collaboration Skills

Facilities that support critical thinking skills and collaboration are learning tools and learning tools such as audio, LCD, classrooms, and educational aids. In addition, the school provides funds for practicum activities. This result is shown by the interview with the vice principal in the field of curriculum as follows:

"The school provides facilities such as LCDs for almost every existing class, audio, classrooms, funds for carrying out practicum activities, and educational aids."

Based on the analysis of the interviews, it shows that the supporting factors for developing critical thinking skills and student collaboration are the availability of adequate learning facilities like LCD, audio, classrooms, funds for practicum activities, and teaching tools to be practised in learning.

Learning facilities are supporting factors in the teaching and learning process (D. K. Cohen & Bhatt, 2012). Based on interviews, the infrastructure used to support the development of critical thinking skills and student collaboration is LCD, Audio, funding for practicum and work activities, and educational aids. This result is supported by research by Asaaju (2012) in Nigeria, showing that the availability and quality of school infrastructure can affect the quality of learning, and the quality of learning carried out also affects the results of developing student skills. Another study by Hariyanto et al. (2021) shows that facilities as learning resources will positively affect student learning motivation and success. In addition, the completeness of school facilities will make students more motivated to learn to influence student learning success.

The success of learning in schools depends on the available resources. This statement is supported by Ayeni & Adelabu (2011), the quality of buildings, school furnishings, and the provision of learning resources that facilitate teachers in the teaching and learning process can determine the success of task performance and student learning outcomes. Adequate infrastructure completeness can support optimal efficiency and effectiveness in the teaching and learning process to improve the quality of education and the competitiveness of schools (Kasma, 2019).

IT Mastery by Teacher

Developing critical thinking and collaboration skills requires mastery of IT in teaching and learning. The use of IT in supporting the development of critical thinking skills and collaboration in the form of videos played in class to assist teachers and students in the teaching and learning process so that learning objectives can be achieved optimally. In addition, the use of audio is used to stimulate students' curiosity in song rhythm patterns. This result is shown based on the following thematic teacher interviews:

"Usually, before the practicum, we play the video in class, so the children understand what they will learn and practice tomorrow. In the lesson about the rhythm pattern of a song, I also use audio so that students are enthusiastic about learning and increase students' curiosity."

IT mastery for teaching and learning is essential for developing students' critical thinking and collaboration skills. Based on the interview results, the teacher's way of overcoming student learning difficulties is by using IT to support teaching and learning. Kasma (2019) argues that using information technology aims to help teachers and students in the teaching and learning process so that learning effectiveness and efficiency can be achieved optimally.

IT can support the development of critical thinking and collaboration skills. Research by Peck & Dorricott (2006) shows that modern technologies such as video, animation and computers have a great appeal that can encourage student motivation in learning. The videos shown can motivate learning. Mastery of IT for teaching can stimulate students to be more motivated to learn. Educational technology in teaching and learning provides better interaction with students. Educational technology makes students more motivated to learn and work because technology such as video and audio can provide better information reception. After all, students receive visual, auditory and kinesthetic knowledge simultaneously (Stošić, 2015).

CONCLUSION

Developing critical thinking skills and collaboration requires readiness from various sectors, both from teaching staff, schools, infrastructure, or from the students themselves. The difficulties of elementary school teachers in developing critical thinking and collaboration skills are related to students' conditions, including thinking skills and learning characteristics. While supporting factors for developing critical thinking and collaboration skills include school policies, facilities, innovative teaching and learning methods and models and mastery of IT for teaching and learning. Teachers need to recognize student's learning styles and use appropriate strategies to make learning more effective and optimal.

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