

**Collaborative Learning to Improve Creative and Critical Thinking Skills:  
From Research Design to Data Analysis**

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**Abstract:** This study aims to examine in-depth articles that highlight collaborative learning to improve creative and critical thinking skills, which are published in scientific journals in the field of education in Indonesia. The research conducted includes a type of literature review. The sources of data used in this study were taken from scientific journals accredited by Science and Technology Index (SINTA). The search was limited to articles published from 2017 to 2022. Researchers then reviewed, analyzed, and discussed the content together to evaluate, compile, and refine the reported findings. Among the ten publications, quantitative research with a quasi-experimental design was found to be the most popular. In addition, high school students were chosen the most as research subjects; while the scope of science and mathematics was the most widely used subject, the collaborative model is the most widely applied treatment and is proven to improve students' creative and critical thinking skills; while the test and t-test were the most dominant instruments used for the collection and analysis of research data. The application of research results encourages schools or educational institutions to use collaborative learning models and can be used as evaluation material for various stakeholders who carry out collaborative learning. Several recommendations have been proposed for future research concerning the findings of this study, including the need to increase the diversity of research types that support creative and critical thinking skills as the main focus. It is

necessary to increase the frequency of qualitative research on the development of creative and critical thinking skills. It is recommended that researchers choose a more appropriate data analysis technique.

**Keywords:** collaborative, creative thinking, critical thinking

## 1. Introduction

In this digital era, the tradition of *gotong royong* is getting lost due to the harsh pressures of life and a lifestyle that tends to be individualistic. This condition is certainly contrary to one of the 21st-century skills, namely collaboration and working together. *Gotong Royong* is collaborating to attain the desired outcome. *Gotong royong* is a concrete manifestation that has been carried out by the ancestors of the Indonesian nation for a long time (Siswanto, 2021). Even though collaboration is the cultural heritage of the Indonesian nation and an indispensable 21st-century skill, it has recently become an issue in Indonesia (Rohman, 2021). Collaboration is a need for all humans, whereby by nature, humans as social beings always interact with other humans, work together, and help each other. Likewise, in learning activities, collaboration is a necessity (Koesnandar, 2021). The results of the study indicate that the theoretical-practical consistency of using learning models or methods needs to be prioritized with the best planning and trying to implement them optimally (Wedi, 2016). This indicates the need to select the right learning model to improve the quality of learning. One model that supports improving the quality of learning and is applied in learning is the collaborative model (Nuramalina et al., 2019). This model encourages students to think and actively ask questions so that actual learning activities occur following learning objectives. The learning experiences that occur shape and hone students' skills (Uduafemhe, 2015). Based on this explanation, it is known that the collaborative model provides benefits in learning not only in improving student learning achievement in the cognitive domain but also in improving the affective and psychomotor domains (Nuramalina et al., 2019). The right learning model to improve students' skills, to think critically, creatively, and work together is a collaborative learning model (Mustaji, 2015). The collaborative model provides an opportunity to train students to learn to work together and appreciate the differences that students have from each other, such as backgrounds, experiences, abilities, and points of view (Warsono, 2016).

It is very rational to apply the collaborative model because working together feels lighter than working alone (Nuramalina et al., 2019). This follows the results of a study that showed that collaborative learning had a significant effect on the student learning process. The learning process is more active with collaborative activities such as discussion activities to solve everyday problems. Discussing in groups with different members can encourage students to find various ideas to gain understanding and develop higher-order thinking skills because it involves their thinking processes. Learning together can further build individual courage to express opinions and ask questions because every student is curious about knowledge (Balta & Hamza, 2017).

Collaboration skills and educational challenges in the 21st century. The 21st century is marked by rapid globalization, brought about by very rapid technological advances that have changed fundamental aspects of life (Rohman, 2021). The rapid development of information technology has also accelerated the transition from a manual to a digital workforce, with an emphasis on four factors: (1) easily accessible information; (2) high-speed processing; (3) great automation; and (4) communication with everyone, which can be from anywhere and can be at any time (Mardhiyah et al., 2021).

As a result, students in the 21st century need extra skills to help their learning process, such as: critical thinking skills, creative thinking, collaboration, and communication, which are the four skills needed to survive in the 21st century (Aslamiah et al., 2021). But in reality, 21st-century skills have not been applied thoroughly in the learning process in the classroom (Anneke, 2014). This is obtained based on the results of previous research that found 21st-century skills are less applied in the learning process in the classroom, be it communication, collaboration, critical thinking, or creative skills. Teachers realize that the learning steps have not yet led to the development of 21st-century skills (Anneke, 2014). The same statement also explains that the fading ability of collaboration, especially in the younger generation, needs to be watched out for. When many educators become engrossed in the formal task of teaching, learning loses sight of competence and collaboration (Ansori, 2021).

Especially during the COVID-19 pandemic, where *online* and *physical distancing* are the main protocols in carrying out teaching and learning activities in schools, collaboration is no longer taken into account in the implementation of learning (Ansori, 2021). This results in a decrease in students' creative thinking skills because learning is only dominated by lectures. This condition hampers

students' creative thinking skills because they are used to only following the teacher's way of solving problems. The low ability to think creatively occurs because the learning process is still dominated by the orientation of giving knowledge, not exploring knowledge (Widiarta et al., 2017). Whereas the development of a student's creative thinking skills is very necessary. Collaborative learning is learning that can improve students' creative thinking skills because it gives freedom to students and their groups to find new concepts. This is supported by the results of research that shows collaborative learning can improve student achievement. Improved learning outcomes occur because collaborative learning can encourage students to be more attentive and motivated in their learning. Students who get high learning outcomes certainly have good creative thinking skills (Widiarta et al., 2017). The use of collaborative learning models can also build students' critical thinking skills (Anwar et al., 2017).

This is supported by the results of previous studies that found the collaborative model is one of the learning activities that can improve critical thinking skills (Psycharis, 2008). Collaborative learning can improve critical thinking skills through discussion, clarification of ideas, and evaluation of other people's ideas (Gokhale, 1995). Critical thinking skills can be improved by using collaborative learning. Collaborative learning makes it easier for students to learn and work together, share thoughts, and be responsible for achieving learning outcomes in groups and individually (Zubaidah, 2010).

Based on the above background, the researchers conducted a *literature review*. This research is very important because it can explain the background of research on a topic, show why a topic is important to study, identify the relationship between the study or research idea, identify the main themes, concepts, and researchers on a topic, identify major gaps, and discuss further research (Garrard, 2016).

This research is different from previous research. This study uses content analysis in several scientific journals in the field of education published in Indonesia. This research focuses on articles published from 2017 to 2022, and all of them are accredited by the *Science and Technology Index* (SINTA). In this study, an in-depth study was conducted of articles that highlight collaborative learning to improve creative and critical thinking skills in Indonesia. It is hoped that the results of this literature study can encourage schools or educational institutions to use collaborative learning models and can be used as evaluation material for various stakeholders who are interested in learning. We will conduct

collaborative learning, and the results of this research can later be used as a reference for similar research in the future.

## 2. Methods

The research conducted is included in the literature review. The sources of data used in this study were collected from scientific journals in the field of education accredited by the Science and Technology Index (SINTA).

SINTA can be accessed via <https://sinta.kemdikbud.go.id/>. SINTA is a platform to measure the development of science and technology designed and developed by the Ministry of Research, Technology, and Higher Education of the Republic of Indonesia (Susetyarini & Fauzi, 2020). The search was restricted to articles published between 2017 and 2022 that used keywords related to the topic at hand, namely collaborative, creative, and critical thinking. And to focus more on the main issues selected, inclusion and exclusion criteria should be defined to limit and narrow the search results of publications.

From the number of articles found ( $N = 26$ ), the researcher chose 10 articles ( $N = 10$ ) that were relevant to the purpose of the literature study. Several eligibility criteria were determined from the articles to be studied in this study, including: (1) empirical, because most of the articles found seemed to be theoretical; (2) having a clear collaborative learning scenario; (3) collaborative learning at the education level of medium and high; and (4) providing easy-to-understand quantitative results.

The researchers then reviewed, analyzed, and discussed the content together to evaluate, compile, and refine the findings reported below.

## 3. Results and Discussion

The findings of the articles used in this study are as follows:

**Table 1. Overview of the studies reviewed**

Author	Research Title	Research Journal
(Anwar et al., 2017)	The Effect of Collaborative Learning with Jumping Task Techniques on Critical Thinking Skills and Student Learning Outcomes	Jurnal Pembelajaran Sains
(Widiarta et al.,	The Effectiveness of Collaborative	Jurnal Pendidikan

2017)	Learning in Improving the Creative Thinking Abilities of High School Students	Fisika Undiksha
(Sipayung et al., 2019)	The Influence of the Collaborative Inquiry Learning Model on the 4C Skills of Students in High School	Jurnal Pendidikan Fisika
(Muzakki et al., 2020)	Use of Collaborative Creativity Learning Model to Improve Students' Creative Thinking Ability on Environmental Pollution Materials	Jurnal Pendidikan Biologi
(Fauzi & Roza Linda, 2021)	The Effectiveness of Collaborative Learning Techniques on Group Investigation and Think Pair Share Students' Critical Thinking Ability on Chemical Equilibrium Material	Journal of Educational Sciences
(Wawan & Setiawan, 2021)	The Effectiveness of Online-Based Collaborative Learning Integrated E-Academic towards Critical Thinking Ability and Attitude towards Mathematics	Jurnal Teknologi Pembelajaran (JTeP)
(Larasanti & Prihatnani, 2021)	Improve Learning Outcomes and Creativity Through Online Learning Using the 3CM Collaborative Model and Peer Tutors	Scholaria: Jurnal Pendidikan dan Kebudayaan
(Zuhriyah, 2022)	Collaborative Learning Model Problem Solving Techniques To	Jurnal Ilmu Pendidikan

	Improve Students' Mathematical Thinking Creativity Ability	STKIP Kusuma Negara
(Jumadi et al., 2021)	The impact of a collaborative model assisted by Google Classroom to improve students' creative thinking skills	International Journal of Evaluation and Research in Education (IJERE)
(Hadiansah et al., 2021)	Collaborative Learning (CL) Model in Learning to Write Explanatory Texts to Improve Critical Thinking in Class VIII Students of SMP Nugraha Bandung City	Jurnal Onoma: Pendidikan, Bahasa dan Sastra

### a. Research Designs

The research focus is determined by the type and design of the research. Based on Table 2 below, the most dominant type of research used by researchers to investigate collaborative learning to improve creative and critical thinking skills is quantitative research. The higher number of quantitative studies compared to other types of research is in line with several previous studies which reported that researchers prefer quantitative research designs to conduct research in education rather than qualitative research.

**Table 2. Research Design Overview**

Author	Research Designs
(Anwar et al., 2017)	Quasi-experimental research
(Widiarta et al., 2017)	Pre-experimental research
(Sipayung et al., 2019)	Quasi-experimental research
(Muzakki et al., 2020)	Quasi-experimental with pre-experimental research
(Fauzi & Roza Linda, 2021)	Quasi-experimental research
(Wawan & Setiawan, 2021)	Quasi-experimental research
(Larasanti & Prihatnani, 2021)	Classroom action research with the MCTaggart model

(Zuhriyah, 2022)	Experimental research
(Jumadi et al., 2021)	Quasi-experimental research
(Hadiansah et al., 2021)	Quasi-experimental research

This type of quantitative research is widely used because the results of research analysis have relatively high accuracy and are following the rules. This is supported by the statement that researchers use a quantitative approach by considering the general nature of quantitative research, including: (a) clarity of elements: objectives, subjects, and data sources; stable and detailed from the start; (b) can use samples; (c) clarity of research design; and (d) data analysis is carried out after all data is collected (Arikunto, 2006).

The quasi-experimental design is the most common experimental design in collaborative learning for creative and critical thinking skills, according to Table 2. The higher frequency of using quasi-experimental research designs than other experimental research designs explains why researchers should choose the one that best fits their educational concerns (Randler & Bogner, 2008). Compared to other experimental designs, the pre-experimental design was the least used and was found in only two publications. On the other hand, experimental designs and CAR are found in publications that highlight creative thinking skills.

In a quasi-experimental study, the researchers tried to compare which treatment was most effective in improving creative and critical thinking skills. The most prominent characteristic of this type of quasi-experimental research is that the researcher is allowed to use the entire class as the control group while assigning another group of students to another (or more) class as the experimental group. By applying different treatments and formulating hypotheses, the researchers can conclude which treatment in collaborative learning is best for improving students' creative and critical thinking skills.

Researchers do not need to consider real experimental designs in this type of research as it requires them to meet certain requirements, such as selecting and assigning participants at random (Martella et al., 2013). The real experimental design is not suitable to be applied in this study because most educational institutions in Indonesia must have placed their students into several classes, and therefore, researchers are only allowed to choose which classes need to be involved. Furthermore, the researcher cannot re-



select students and randomly assign them to different classes (Susetyarini & Fauzi, 2020). Based on information about the type of research, the quasi-experimental design is the most widely used design by researchers. This shows that, in general, researchers try to compare some of the best treatments in collaborative learning to improve students' creative and critical thinking skills.

## b. Research Subjects

**Table 3: Research Subjects Overview**

Author	Research Subjects
(Anwar et al., 2017)	7th grade junior high school students
(Widiarta et al., 2017)	10th grade senior high school students
(Sipayung et al., 2019)	10th grade senior high school students
(Muzakki et al., 2020)	10th grade senior high school students
(Fauzi & Roza Linda, 2021)	11th grade senior high school students
(Wawan & Setiawan, 2021)	University students
(Larasanti & Prihatnani, 2021)	9th grade junior high school students
(Zuhriyah, 2022)	10th grade senior high school students
(Jumadi et al., 2021)	11th grade senior high school students
(Hadiansah et al., 2021)	8th grade junior high school students

In conducting research, researchers need research subjects to test their hypotheses. Based on Table 3, high school students are the most widely used research subject. The 7th, 8th, and 9th-grade junior high school students were also the research subjects. Meanwhile, senior high school students are the most widely used research subjects because students' thinking forms the basis for their ability to face and solve various problems and difficulties in the future. It is possible to build a tendency to think creatively and critically in students from high school. High school students

already have more mature thoughts, so they can be motivated to accept new ideas. High school-age students can already be instilled that every problem can be solved in an easier and better way. For this reason, the ability to think creatively and critically is very important and must be developed as early as possible so that people are better prepared to face their work or society (Universitas KH. A. Wahab Hasbullah, 2022).

According to previous research, this phenomenon is in line with the tendency of most selective schools to permit researchers to conduct research at the 3rd level of junior high school or senior high school because of the tight schedule of preparation for the national exam (Susetyarini & Fauzi, 2020).

### **c. Research Topics**

The scope of science and mathematics is the most dominant topic in collaborative learning to improve students' creative and critical thinking skills. The results showed that physics is a contextual lesson in which the word is used as a medium to communicate a learning material to offer a realistic picture of a topic. Students' creative thinking skills must be developed through contextual learning because it will make it easier for them to understand a subject (Kuspriyanto & Siagian, 2013).

Creative thinking skills are needed in learning physics, especially since this subject requires in-depth analysis. Physics lessons are not just about memorizing laws, formulas, or terms. Physics lessons also connect formulas, analyze a problem, and design a practicum. But in reality, students are still memorizing and have not been able to empower their thinking skills to find a new concept. Therefore, many students have difficulty learning physics (Widiarta et al., 2017).

According to the National Education Standards Agency, mathematics should be taught to all children at all levels of school to educate students to improve their rational, analytical, methodical, critical, and creative thinking skills, as well as their ability to collaborate (Larasanti & Prihatnani, 2021). The following reasons support this: The role of mathematics is to equip students to deal with changing conditions in their lives by teaching them how to think mathematically. Students cannot be separated from the questions that are required to answer problems when learning mathematics. Since mathematics cannot always be handled in the

same way as before, students must develop creative thinking skills so that they can solve the challenges included in the problems they face with creative solutions. It also motivates students in their daily lives; because they are taught to think creatively, they will be able to solve problems that arise in society (Zuhriyah, 2022).

Furthermore, the research findings show that science is one of the subjects that contribute to the development of students' critical thinking skills. The idea of finding, using critical thinking, asking questions, and solving problems are one of the core principles of science and technology. Science will direct the process of scientific work in the discovery of scientific concepts as a working procedure for a scientist. Anwar et al. (2017) explain that science education prepares students to use critical thinking skills in the areas of discovery and exploration of knowledge as well as concluding (Anwar et al., 2017).

It is also possible to use a collaborative learning approach to improve students' critical thinking skills on chemical equilibrium material. Because chemistry includes many abstract ideas such as symbols, structures, reactions, and structured chemical processes, students still have difficulty analysing problems that arise in everyday life. Furthermore, chemistry provides various challenges that require higher-order thinking, so it requires students to understand the topics being taught. Researchers suggest that teachers in the field of chemistry apply collaborative learning with think-pair-share as an alternative learning method to develop students' critical thinking skills (Susetyarini & Fauzi, 2020). Biology is a scientific course covering a wide range of topics. Some topics are considered simple, while others remain challenging for students. On the other hand, a study found that when students learn about the environment, learning activities that improve critical thinking skills become important (Susetyarini & Fauzi, 2020).

Finally, writing skills are very important because they are related to critical thinking, and critical thinking skills are associated with 21st-century skills (Hadiansah et al., 2021). Writing, according to Tarigan, is an expression of higher-order thinking activities. This thinking task ranges from conceptualizing, pouring, and making something out of what is in the mind to thinking deeply, thoroughly, and critically. After that, one can write as an embodiment of critical thinking (Tarigan, 2008). Students'

thinking processes can be radiated through writing. According to Tarigan, writing skills are important in education because they make it easier for students to think, help students think critically, make it easier for students to feel and enjoy relationships, deepen responsiveness or perception, solve problems, organize sequences for students to learn, and help explain thinking. Another concept states that the cognitive state of students will be represented in writing (Tarigan, 2008).

#### **d. Data Collection Instruments**

Researchers need instruments to assist them in collecting data when conducting research. The following are various research instruments developed by previous researchers that are used to measure students' creative and critical thinking skills. There are various kinds of tests used to measure students' creative and critical thinking skills. Based on the results of the analysis, the test became the most dominant instrument used to collect data on creative and critical thinking skills. In essence, creative and critical thinking skills are ways of thinking that can be accessed or assessed based on students' answers to high-level questions. In addition, data collection through tests is considered more objective than interviews, questionnaires, and observations.

#### **e. Data Analysis Methods**

The accuracy of the selection of data analysis methods will determine the level of validity of a study. Based on the results of the study, the t-test was mostly used to analyze research data on collaborative learning to improve students' creative and critical thinking skills.

The collected data were analyzed statistically using a t-test. The results showed that there were differences in critical thinking skills and cognitive learning outcomes between students who were taught using collaborative learning using the jumping task technique and students who were taught using collaborative learning only. The critical thinking ability and learning outcomes of students who learn to use collaborative learning are lower than those of students who learn to use collaborative learning by jumping task techniques. This is due to the use of jumping task techniques, which increase collaborative activities in solving joint problems (Anwar et al., 2017).

Collaborative learning is very effective in improving students' creative thinking skills. All aspects of creative thinking can be developed through collaborative learning. The increase in the highest average value occurred in the original thinking aspect of 43.2, and the lowest in the fluent thinking aspect of 35.35. Aspects of flexible thinking have increased the average value to 36.30, and aspects of elaborative thinking have increased the average value to 36.06. Student retention on the concept of effort and energy is high because the retention percentage is 85.24%, meaning that collaborative learning is effective for strengthening students' memory because 85.24% of students' creative thinking skills in the post-test results are still remembered (Widiarta et al., 2017).

Furthermore, in the study conducted by Hani Diana Sipayung et al., the data was analyzed using a one-sided t-test. The results showed that the 4C skills of students with the collaborative inquiry learning model were better than the 4C skills of students with conventional learning (Sipayung et al., 2019).

Judging from the Paired Sample T-Test test value of 0.00 0.05, it can be concluded that there is a difference in the average value between the pretest and post-test. This shows that the use of the Collaborative Creativity learning model can improve students' creative thinking skills. The syntax of the Collaborative Creativity learning model is well implemented. This is indicated by the activities of teachers and students as a whole. The syntax of the Collaborative Creativity learning model has been able to be implemented (Muzakki et al., 2020).

Furthermore, based on the results of the Univariate Test conducted by Wawan & Agus Setiawan, it is known that for the critical thinking ability variable, the value of Sig. of 0.05. Because it is smaller than 0.05, it can be decided that  $H_0$  is rejected, so it can be concluded that there is a difference in influence between the online-based collaborative learning model and the online-based direct learning model. Because the marginal mean of the online-based collaborative learning model is higher than the online-based direct learning model, it can be concluded that the online-based collaborative learning model provides better critical thinking skills than the online-based direct learning model (Wawan & Setiawan, 2021).

Furthermore, for the comparison of the three learning models in Jumadi et al.'s research, based on the partial eta square test, the mixed

design ANOVA demonstration model can increase students' creative thinking skills by 34.2%, the PjCM model = 33.9%, and the PjCM-GC model = 58.2%. The results showed that the PjCM-GC model was better able to improve students' creative thinking skills compared to the demonstration model and PjCM (Jumadi et al., 2021).

#### **4. Conclusion**

In this study, an in-depth study was conducted of articles highlighting collaborative learning to improve creative and critical thinking skills, which were published in scientific journals in the field of education in Indonesia from 2017 to 2022. Among the ten publications, quantitative research with a quasi-experimental design was found most widely. In addition, high school students were chosen the most as research subjects; while the scope of science and mathematics was the most widely used research topic, the collaborative model is the most widely applied treatment, and it is proven that collaborative learning can improve students' creative and critical thinking skills; while the test and t-test were the most dominant instruments used for the collection and analysis of research data.

Several recommendations have been made for future research concerning the findings of this study. The recommendations include the need to increase the diversity of types of research that support creative and critical thinking skills as the main focus. It is necessary to increase the frequency of qualitative research on the development of creative and critical thinking skills. It is recommended that researchers choose a more appropriate data analysis technique.

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