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Analysis of the Improvement of Students' Cognitive Ability in Science Subjects Using the Think-Pair-Share Learning Model at SMP Negeri 2 Gunungsitoli

Debi Rebeka Hulu[1], Natalia Kristiani Lase[2], Novelina Andriani Zega[3], Hardikupatu Gulo[4]
[1, 2, 3, 4] Department of Biology Education, Universitas Nias, Indonesia

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ABSTRACT
The ability to understand science concepts is very important for everyone to have a greater opportunity to adapt in life, especially in terms of mastering reading skills to improve the development of a country. The purpose of this study was to determine the effectiveness of the think-pair-share learning model in improving students' cognitive abilities during the science learning process. This research is quasi-experimental research with matching pretest-posttest control group design conducted at SMP Negeri 2 Gunungsitoli. The average result of cognitive ability in the experimental class was 82.20 which was in the very good category, while the average cognitive ability of students in the experimental class was 68.80 which only increased to a sufficient category. The N-gain result in the control group was 0.36 which was in the moderate category, while the N-gain in the control group was 0.79 which was in the moderate category. After the application of the think-pair-share learning model, it was concluded that the cognitive level of students increased to the C4-analyze level. This research provides an alternative science learning model that is more varied so that science teachers can apply it to the classroom.

Corresponding Author:
Debi Rebeka Hulu
Department of Biology Education, Universitas Nias
Jalan Yos Sudarso No. 118/E-S, Gunungsitoli 22812, Indonesia
Email: rebekadebi@gmail.com

1. INTRODUCTION

Global change is felt so rapidly entering the 21st century that it has an impact on all sectors of development, including the education sector. In the 21st century, Indonesia is getting ready to welcome a promising era by producing students who are in accordance with the demands of the times. This goal can be achieved through education and appropriate learning approaches, strategies, and models, all under the guidance and role of the teacher during the learning process (Dilekçi & Karatay, 2023; Gunadi et al., 2022). Education is a benchmark in determining the progress of a nation. Education today encourages the younger generation to develop their potential by continuing to innovate and work in order to survive in the face of global competition. Education prepares qualified learners who have an awareness of knowledge, values, skills and attitudes (Meyer & Norman, 2020). One of the things that must be done is to develop potential through the field of education. Science is needed in everyday life to fulfil human needs by solving problems that can be identified. Contextual problems related to daily life related to scientific fields can be explained and solved if people have good science literacy.

Science has a great influence on people's personal lives and the global economy. Science is essential for developing the quality of human resources (Li & Guo, 2021). To be successful in this century, learners must have good science literacy and principles for lifelong learning (Fortus et al., 2022; Purnawati, 2024) and thinking skills (Arifiyyati et al., 2023; Putranta & Supahar, 2019). Cognitive abilities in science learning is a scientific knowledge and skills that can be used to make decisions based on scientific facts, research, and phenomena (Harefa & Huang, 2023; Kalkan et al., 2020; Virtič, 2022). Mastering science concept is important for everyone to have a greater opportunity to adapt in life, especially in terms of mastering reading skills in order to improve the development of a country.

The implementation of science content learning at the junior high school (SMP) level is focused on natural science (IPA) subjects. Teaching in science subjects in junior high school must provide direct experience through observation activities using the senses owned by students and a concrete information transfer process for students.

Moreover, science learning is packaged in thematic form, meaning that there is no separation of biology, physics, and chemistry subjects (Lestari et al., 2022). Science learning is carried out in an integrated manner in which the material presented is associated with other concepts through the analysis of the results of a learning plan. Strat et al. (2024) and Wang et al. (2024) suggested that to make learners aware of science content, learners must be assisted through mentoring or collaboration. The activity of learning activities in schools is closely related to the process of seeking learning knowledge. Science learning certainly has an assessment to determine the success of the learning process that has been carried out to determine the success rate of the learning process that has been carried out. Referring to this, science learning requires an authentic assessment to analyze the process used by students in producing a response to the acquisition of skills, attitudes, and knowledge possessed (Aswanti & Isnaeni, 2023). According to research by Maizeli et al. (2020) and Qodar et al. (2018) stated that authentic assessment is obtained through learning to solve a problem. As for the assessment of a problem, it can be analyzed through knowledge (cognitive) assessment.

Khan et al. (2023) previously stated that cognitive is a thought process regarding an individual's ability to connect, assess, and consider an event or event. Cognitive ability is one of the activities in the world of education which is a process to achieve learning goals. In cognitive learning theory more emphasis on the mental and internal conditions of learners as explained by Ruiz-Martín & Bybee (2022) that the cognitive psychology approach emphasizes the importance of internal processes, human mentality in the view of cognitive experts, human behaviour that appears cannot be measured and explained without involving mental processes such as: motivation, intentionality, beliefs, and so on. In general, it can be said that the cognitive domain is very influential on the abilities possessed by students. In the teaching and learning process, students are required to be able to implement the knowledge gained from their learning. Winn et al. (2019) explained that the ability of students to learn is strongly influenced by the extent to which the cognitive functions of students can develop optimally through the touch of the educational process.

Based on observations carried out by researchers at SMP Negeri 2 Gunungsitoli during the 2023/2024 academic year, some information was obtained about the implementation of science learning activities. When science learning activities take place in class, there were still students who are less actively involved in learning. When learning activities take place, some students were only silent and listen to the learning material delivered by the teacher, students were not involved in finding tasks to complete the tasks given by the teacher. One of the factors that students are less effective in following the learning process at SMP Negeri 2 Gunungsitoli, namely the lack of subject teacher interaction with students, so that students' curiosity in understanding science learning material is reduced. In the implementation of learning activities, science subject teachers did not use learning strategies and models. As a result, students felt bored following the learning process. The atmosphere of science learning at SMP Negeri 2 Gunungsitoli was still centred on the teacher the teachers are old, have not updated their teaching competencies, and lack information regarding student-based learning; so that, students were less active in understanding the science subject matter delivered by the teacher. From the results of observations, researchers get information that most students get very low learning outcomes between 50-60 from KKM 65, and a small percentage of students' average scores are still at the bad criteria.

These learning outcomes represent the cognitive abilities of students. Basically, each individual has different cognitive abilities and cognitive levels. Anderson & Krathwohl (2001) divided cognitive abilities based on the revision of Bloom's Taxonomy into remembering (C1), understanding (C2), applying (C3), analyzing (C4), evaluating (C5), and making or creating (C6). (Sultan & Hajerina, 2020) stated that cognitive ability is a process that involves mental processes in the form of recognizing in general and is characterized by the representation of an object into a person's mental image in the form of ideas, responses, symbols and values. Therefore, cognitive ability is one of the abilities that plays an important role in the success of the learning process, because most of the learning activities involve thinking and remembering activities. From a process, of course, each individual has their own process which will also affect the results of their cognitive abilities (Harefa & Gulo, 2024).

One of the alternatives to improve students' cognitive abilities is through the use of the think-pair-share type cooperative learning model and it is hoped that students' absorption will increase so that it will have an impact on improving learning outcomes. Mundelsee & Jurkowski (2021) and Ismail et al. (2022) suggest that learning using the think-pair-share model is carried out by first giving students a problem that must be solved individually (think) then the teacher divides students in pairs in groups (pair) and in the group, each student shares opinions or ideas with each member of the group (share). Researchers aim to use this learning model to determine the effectiveness of the think-pair-share learning model in activating students to take part in science learning and see the extent of the increase in students' cognitive abilities after applying the learning model. It is a learning model that provides opportunities for students to think and respond to the material being discussed. In addition, this model can guide students to help each other so that some of these things become strong factors in maximizing and improving students' learning abilities (Mundelsee & Jurkowski, 2021). The think-pair-share learning model is a type of cooperative learning that is effective for making variations in the atmosphere of class discussion patterns with the assumption that all recitation or discussion requires knowledge to control the class as a whole and give students to think more, to respond and help each other so as to increase interaction between teachers and learners.

2. RESEARCH METHOD

This research was a quasi-experimental study using a matching pretest-posttest control group design where there were two classes that are directly selected. The researcher used a simple lottery method to divide the two research groups, then given a pre-test to determine the initial state between the control group and the experimental group, and after being treated, both groups were given a post-test (Creswell, 2017) which is detailed in Table 1. The study population was class IX students at SMP Negeri 2 Gunungsitoli but because there were too many so the researchers used purposive sampling techniques based on considerations of data analysis and time so that the samples used were class IX-1 as an experimental group of 25 people and IX-2 as a control group of 25 people.

Table 1. Research design using matching pretest-posttest control group.

Type of group	Pre-test	Type of treatment	Post-test
Control group	O	X_1	O
Experimental group	O	X_2	O

Information:
X_1 : Treatment with the implementation of direct instruction learning model
X_2 : Treatment with the implementation of think-pair-share learning model
O : Multiple choice question test to measure cognitive ability

The parameters measured in this study are the cognitive abilities of students. Science learning materials vary greatly so that to conduct this research, researchers chose human reproductive system material. Cognitive abilities were measured using 20 multiple choice questions integrated with indicators of cognitive abilities including C1-remember, C2-understand, C3-apply, C4-analyze, C5-evaluate, and C6-create. The test results were analyzed using a percentage formula with HOTS category adjustments, namely very good (score 80-100), good (score 70-79), fair (score 60-69), poor (score 40-59), and very poor (0-39) (Yin & Samat, 2023).Researchers assume that there are differences in cognitive abilities between students taught using direct instruction learning models and think-pair-share learning models. Data will be processed through the Microsoft Excel program and SPSS version 25.0 to process and present research results in the form of tables and figures.

3. RESULT AND DISCUSSION

This study analyzes the improvement of cognitive abilities of class IX students of SMP Negeri 2 Gunungsitoli in science learning with the selected topic is the reproductive system which is divided into control and experimental classes. This study used 20 multiple choice questions that had passed the item instrument test, namely the validity test (all questions were declared valid), the reliability test (the questions were declared reliable because the Cronbach's alpha value was 0.723> 0.6), the difficulty test (all questions were well accepted to be a test tool for cognitive abilities), and the differentiator test (all questions used could differentiate the ability of students). The Shapiro-Wilk normality test presented in Table 2 shows that the value of Sig. > 0.05 so it can be stated that the research data is normally distributed. Based on the results of statistical analysis, it was found that the value of Sig. (based on mean) of 0.497 and the results of this value are greater than 0.05 so it can be stated that the samples used during the pre-test and post-test came from a population that has the same variance.

Table 2. Shapiro-Wilk normality test results.

Type of group	Statistic	df	Sig.
Control group pre-test	0,922	25	0,071
Control group post-test	0,918	25	0,067
Experimental group pre-test	0,927	25	0,078
Experimental group post-test	0,931	25	0,095

Before the implementation of the learning model, students were given a pre-test to obtain information on the level of cognitive abilities of students in solving science problems. Based on the pre-test results presented in Figure 1, it shows that the highest score, lowest score, and average score are 75.00, 30.00, and 51.20 in the control group, respectively. In the experimental group, it was found that the highest score, lowest score, and average score for the pre-test results were 80.00, 35.00, and 56.20, respectively. The standard deviation of the pre-test results for the control group and the experimental group was 12.75 and 12.84, indicating that there was a tendency for the mastery of knowledge of reproductive system material to vary greatly between students in the two groups.

The results of this pre-test also show the division of categories of ability to work on questions where in the control group there are 8.00% of students in the good category, 20.00% of students are in the sufficient category, 60.00% are in the bad category, and 12.00% are in the very bad category; while in the experimental group there are 4.00% of students in the very good category, 20.00% of students are in the good category, 32.00% are in the sufficient category, 40.00% are in the bad category, and 4.00% are in the very bad category. This result shows that both in the control group and experimental group, the average cognitive ability of students in solving reproductive system problems is in the poor category. The findings of this study also reemphasize the results of PISA 2022 which show that the achievement of science literacy achieved by Indonesian students is getting lower. In general, the ability of Indonesian students is very low in integrating information, generalizing case by case into general solutions, formulating real-world problems into science subject concepts and conducting investigations (Harefa, 2023; Herlina & Abidin, 2024)

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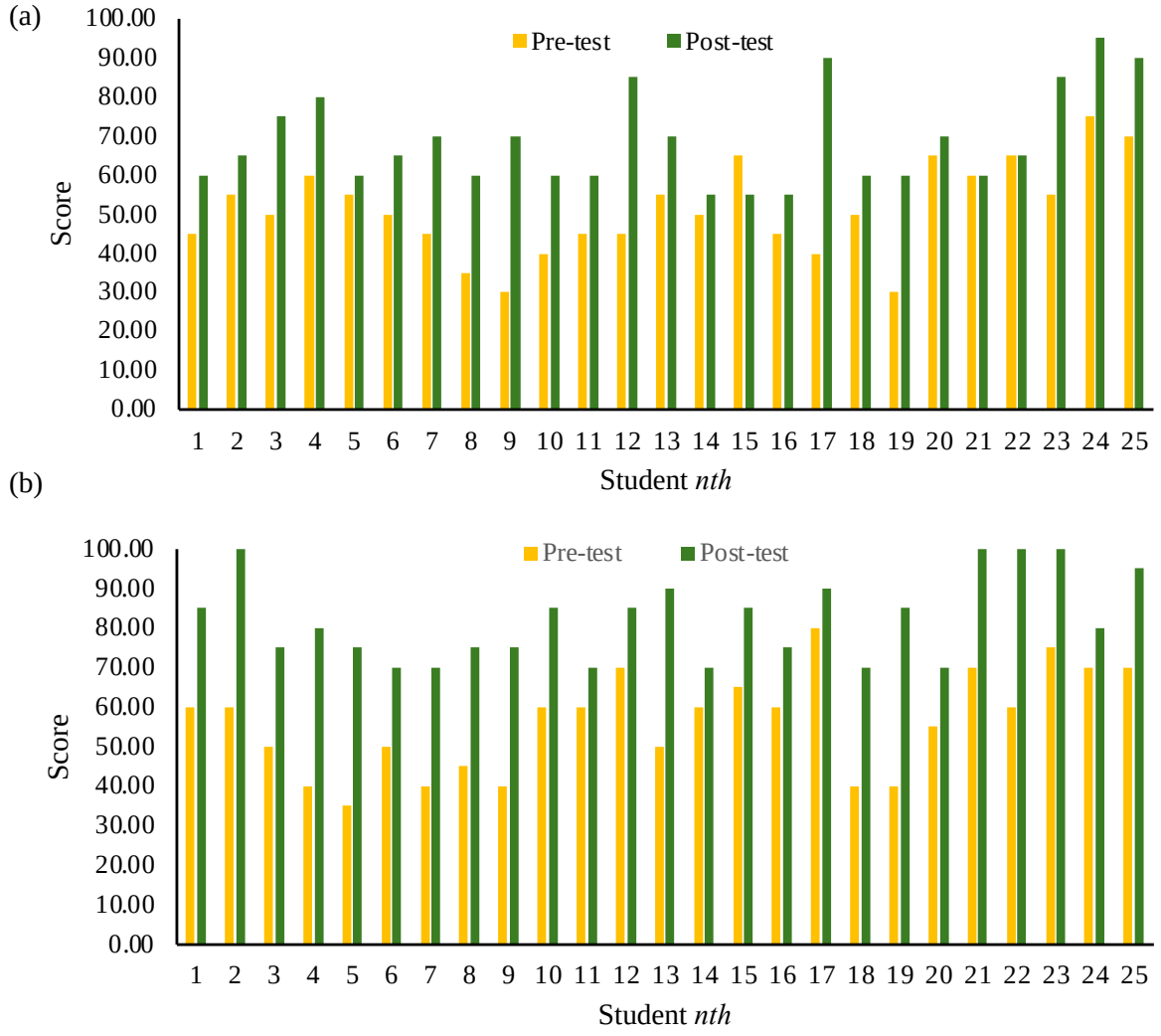

Figure 1. Students' pre-test and post-test results in (a) control group and (b) experimental group.

After the data obtained from the pre-test results, the researchers gave treatment in the form of direct instruction learning models in the control group and think-pair-share learning models in the experimental group to determine whether there was an increase in cognitive abilities after and after treatment. Figure 1 also shows that the implementation of the post-test in the control group obtained the highest value, the lowest value, and the average value are 95.00, 55.00, and 68.80, respectively. In the experimental group, it was found that the highest score, lowest score, and mean score for the post-test results were 100.00, 70.00, and 82.20, respectively. The standard deviation of the post-test results for the control group was 10.71 with a decrease of 2.34 while in the experimental group it was 9.23 with a decrease of 3.61 which shows that there is a good effect after the application of the learning model. The results of this post-test showed that the ability of students in solving science problems increased significantly where in the control group there were 24.00% students in the very good category, 20.00%

students in the good category, 44.00% students in the fair category, and 12.00% were in the bad category; while in the experimental group there were 56.00% students in the very good category and 44.00% students in the good category. When compared with the average results of the test work, it can be stated that the think-pair-share learning model increases the cognitive abilities of students to a very good category, while the average cognitive abilities of students who use direct instruction learning models only increase to a fair category. This indicates that the think-pair-share learning model has a significant effect on improving students' cognitive abilities because during the application of this model it encourages students to reflect on their work and clarify their ideas. When learners are communicatively involved in working on science problems, they will immediately think of ideas or discuss and listen to other learners to find solutions to these problems Samsuriadi & Imron (2019)

Figure 2 presents the average acquisition of pre-test and post-test results of cognitive abilities owned by all students in the control group and experimental group. When viewed from the mastery of cognitive levels starting from C1-C6, it shows that the cognitive level possessed by students at the time of the pre-test tends to be at the C1-C3 levels or this is included in the lower-order thinking skills (LOTS) level and it can also be seen that the highest score for the pre-test in the control group was 59.67 and the experimental group was 62.00, both of which were at the C1-remember cognitive ability level. Furthermore, after applying the direct instruction learning model to the control group and the think-pair-share learning model to the experimental group, there was a shift in the level of cognitive abilities. Figure 2 shows that the highest post-test score in the control group was 78.00 which shifted to the C3-apply cognitive ability level, while the highest post-test score in the experimental group was 86.00 which shifted to the C4-analyze cognitive ability level. Additionally, Figure 2 shows that students in grade IX of SMP Negeri 2 Gunungsitoli in working on reproductive system problems still have not optimally reached the C5-C6 levels and similar results are also shown from the research of Adawiyah (2019) and Husein et al. (2022) which found that C5-C6 abilities tend to require cognitive abilities that have been familiarized with the right learning model and science questions that make students able to think at a high level so that the role of teachers in science learning is needed. Overall, the post-test results showed an increase in scores at each C1-C6 levels. However, based on the average comparison results at each level of cognitive ability, the think-pair-share learning model increases the cognitive ability of students to a very good category and even the ability of students to increase in higher-order thinking skills (HOTS), while the average cognitive ability of students who use direct instruction learning models only increases to a sufficient category.

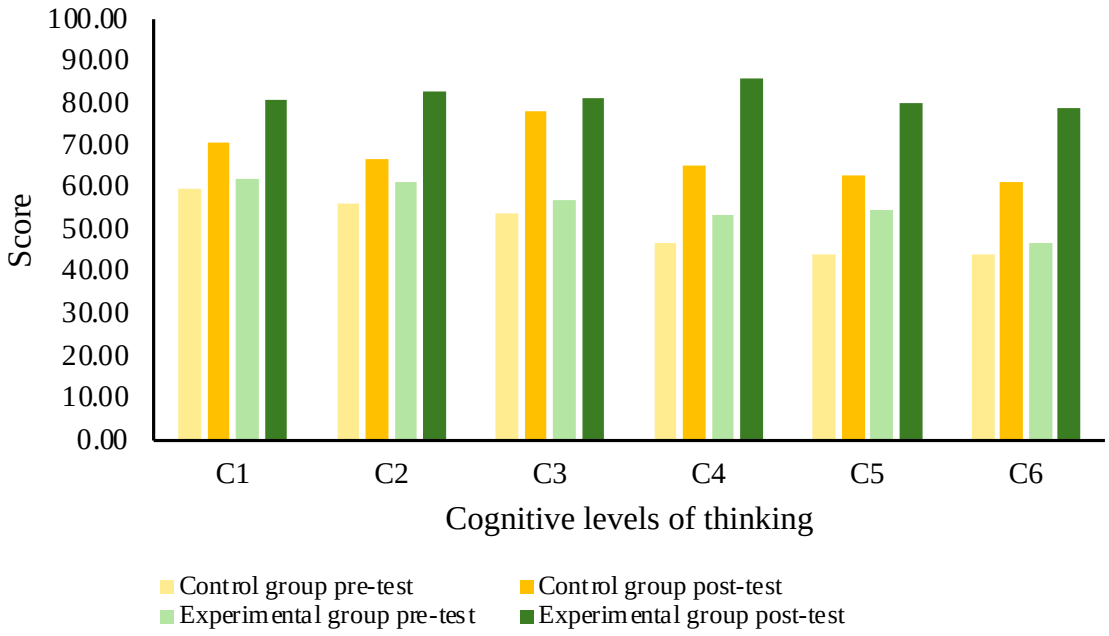

Figure 2. The average pre-test and post-test results of cognitive abilities owned by all students in the control group and experimental group.

The learning process using the think-pair-share model shows a significant impact on the increased cognitive abilities of students. It is hoped that learning science will no longer be a boring lesson and in the form of reciting material alone but will make students more active in participating in learning, easier to understand learning material and can make students more motivated in participating in learning. In the think-pair-share learning model there are steps that require students to be able to work together as a team so that students are required to have tolerance for their peers. In addition, they must be able to respect their friends' opinions and be

able to accept gracefully if the answer is not used in the group so that it can make it easier for students to learn the material. This is obtained from the results of learning observations to students. According to Nguyen et al. (2021) learning outcomes were when someone has learned there will be changes in behavior in that person, for example from not knowing to knowing and from not understanding to understanding. Activeness in learning can also be interpreted as being active in doing something, when equated with learning, it means that someone is active in carrying out learning. Learning activeness is a very important factor in learning, because if students are not active in learning, learning is less conducive and tends to be silent a lot and only rely on one person. With the activeness in learning, students have the potential to learn and can be realized if given many opportunities to think for themselves. Cooper et al. (2021) emphasized that the think-pair-share learning model is one of the structural approaches in cooperative learning that groups students in pairs which aims to streamline the group learning process. The general purpose of this learning model is to improve academic mastery and teach social skills. The proper delivery of material using this think-pair-share learning model will increase students' learning activeness because in this learning model students are required to think critically through the material they will learn.

Furthermore, researchers calculated the N-gain in the control group of 0.36 which was in the moderate category, while the N-gain in the control group was 0.79 which was in the moderate category so that it was found that there was an increase of 0.43. The results of the independent t-test test found that the Sig. value was 0.000 and this result was smaller than 0.05 so that it could be stated that there were differences in cognitive abilities between students taught using the direct instruction learning model and the think-pair-share learning model. The improvement of high-level cognitive abilities (HOTS) for students is to present a natural way of conceptual understanding and scientific literacy, which is in accordance with contextual and interconnected levels of application (Lase & Harefa, 2022). On the other hand, what is needed is for learners with low-level cognitive abilities (LOTS) to transfer their potential pool by enhancing higher understanding by designing flexible assessment instruments. The ability to understand concepts in absorbing a concept has different levels, there are those whose understanding ability is fast, moderate and even slow (Lase & Lase, 2020). In high-level cognitive learners are challenged to interpret, analyze or manipulate information both by expanding incomplete arguments and rearranging information to affect new interpretations by moving through a series of interconnected steps.

4. CONCLUSION

Based on the explanation above, it can be concluded that there are significant differences in the results in the use of the two learning models, namely where the experimental group is given a think-pair-share learning model and the control group is given direct instruction learning. The average result of cognitive ability in the experimental class was 82.20 which was in the very good category, while the average cognitive ability of students in the experimental class was 68.80 which only increased to a sufficient category. The N-gain result in the control group was 0.36 which was in the moderate category, while the N-gain in the control group was 0.79 which was in the moderate category. After the application of the think-pair-share learning model, it was concluded that the cognitive level of class IX students of SMP Negeri 2 Gunungsitoli increased to the C4-analyze level. This research provides an alternative science learning model that is more varied so that science teachers can apply it to the classroom and prepare students to face high-level cognitive ability questions so that the C5-evaluate and C6-create levels can be achieved more optimally in the future.

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