

The Influence of Science, Technology, and Society Learning Model on Higher Order Thinking Skills in Grade IV Science Lessons

Sherlin Norma Azzahra, Apri Kartika H.S, Dian Nur Antika Eky
Universitas PGRI Madiun

Corresponding Author: Sherlin : sherlinazzahra25@gmail.com

ARTICLE INFO

Keywords: STS model, HOTS, Science Lessons.

Received : 20, April

Revised : 22, May

Accepted: 25, June

©2024 Azzahra, H.S, Eky (s):
This is an open-access article distributed under the terms of the [Creative Commons Attribution 4.0 International](https://creativecommons.org/licenses/by/4.0/).



ABSTRACT

This study was conducted to examine the effect of the Science, Technology, and Society (STS) learning model on Higher Order Thinking Skills in science lessons in grade IV. This study uses a quantitative approach with a type of quasi experimental research that uses a pre-test and post-test research design. The sampling technique used a probability sampling technique. The sample in this study was 17 students from grade IV at SDN 02 Nambangan Kidul Madiun. The data collection technique is using a test. The results of the data analysis show a significant difference upward as indicated by the mean of the two tests that have been conducted. The average or mean produced in the pre-test is 81.76 and the mean in the post-test is 91.18. The conclusion is Science, Technology and Society learning model influences on the Higher Order Thinking Skills (HOTS) of Science Lessons in Grade IV.

INTRODUCTION

The results of the TIMSS (Trends in International Mathematics and Science Study) international study show that students in Indonesia are ranked low. The low ranking occurs because of the lack of ability: (1) understanding complex information; (2) theory, analysis and problem solving; (3) use of tools, procedures and problem solving; and (4) conducting investigations (Lestari Pratiwi and Akbar, 2022). This is the background in encouraging changes in mindset and ability to solve a problem. The STS (Science, Technology, Society) learning model was chosen as one of the learning models that can help the learning system in Indonesia.

The General Offices of the CPC (Central Committee and the State Council) said their opinions on strengthening ethical governance of science and technology, which laid out a road map for building an ethical system of science and technology and promoting science and technology for good (Wang, Feng and Guo, 2023). The STS Learning Model is essentially Science Technology Society (STS) has the meaning of activities that can connect material with real-life phenomena in the field of science (Fanani and Kusmaharti, 2014). The Science Technology Society (STS) learning model is one of the learning models that activates students in cognitive, affective, and psychomotor activities and helps in applying science in the context of community life which is actually inseparable from technology.

Learners in the 21st century are required to have the ability to think at a high level in learning. The government also expects that the application of HOTS or high-level thinking skills can improve internal competencies. Competencies included in HOTS are critical thinking, creative and innovative, communication skills, collaboration, and confidence. HOTS skills are also still being applied due to the low ranking of the Program for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS) compared to other countries. So that in science learning, HOTS thinking skills are needed (Purba et al., 2022). High-level thinking skills are also a personality trait that must be trained and built in students to successfully solve problems logically.

In previous research, there has not been much study on HOTS and STS. Thus, this type of research requires more references to find the relationship between the application of Science, Technology, Society (STS) learning model and Higher Order Thinking Skills (HOTS).

The Science, Technology, Society learning model has several characteristics, namely Interdisciplinary Thinking, Connecting Science to Society and Global Awareness. Interdisciplinary Thinking is that deals with communication, interaction and integration. Interdisciplinarity provides opportunities for students to engage and interact directly with science study materials (Wang, 2024). Connecting Science to Society is the relationship between science and society. Global Awareness or capacity that combines the attitudes, knowledge and skills necessary for a person to competently accept and carry out the challenges of a globalized world.

HOTS questions are important for students to solve problems that require observation, collaboration, and experimentation. When students often practice

working on HOTS questions, it will facilitate the teaching and learning process in the classroom such as the implementation of daily tests, the implementation of the midterm exam, and the implementation of the final semester exam. (Abraham et al., 2021) explained that Higher Order Thinking Skills (HOTS) are high-level thinking skills that require critical, creative, analytical thinking, on information and data in solving problems. Higher order thinking is a type of thinking that tries to explore several questions about existing knowledge related to issues that cannot be clearly defined and do not have definite answers.

In the Journal of Education & Pedagogy, it is known that higher order thinking or HOTS includes the ability to solve problems, creative thinking, critical thinking, and decision making. Higher Order Thinking Skills can distinguish ideas or ideas clearly, and can provide hypotheses in understanding complex things more clearly (Tasrif, 2022).

Based on the background that has been described, this study was conducted with the aim to determine the effect of Science, Technology and Society learning model on Higher Order Thinking Skills. The STS learning model has a significant impact on the higher order thinking skills of grade IV students at Graciano Lopez Jaena Elementary School, Phillipines. Thus, this research is expected to have a similar impact at SDN 02 Nambangan Kidul, Madiun, Indonesia.

LITERATURE REVIEW

Learning Models

Learning model is a description of the learning environment, including the behavior of a teacher to implement a learning itself (Warsono and Hariyanto, 2014). Learning models are based on principles or theories developed by experts based on learning principles, psychological, sociological and system analysis theories. Learning models are also taken from other supporting theories (Khoerunnisa and Aqwal, 2020).

Helmiati (2022), argues that the learning model described from beginning to end has its own characteristics or characteristics by the teacher. This opinion is also in line with (Farias et al., 2019) that the learning model is a plan used as a guide in planning classroom learning. Asyafah (2019), also argues that the learning model is an important component of learning. This statement is evidenced by several reasons, namely: a) an effective learning model helps the learning process to facilitate the achievement of learning objectives; b) learning models provide important information for students in participating in teaching and learning activities; c) variations in learning models provide new enthusiasm for students in the learning process, minimize boredom, increase student interest and motivation in learning; d) a variety of learning models are important because of differences in student characteristics, personalities, and learning habits; e) guidelines for lecturers and professional teachers to motivate and carry out their duties.

It can be concluded in accordance with several expert opinions that the learning model is a series of activities carried out by a teacher from the beginning to the end of learning. The learning model has an important role in the learning

system. Thus, the learning model can be interpreted as a learning design that will be in the classroom or outside the classroom, so that it can run well, is interesting and easy to understand in accordance with existing procedures.

Science, Technology, Society (STS) Learning Model

According to (Poluakan et al., 2020) Science began in the 1900s. Science learning uses a real scientific literature approach that is significantly able to solve socio-scientific problems. This is in line with The Organization for Economic Cooperation and Development (OECD) which states that what is meant by scientific literature is the ability of a person to understand problems related to science, and be able to explain scientific phenomena, design scientific research, and interpret data with scientific evidence.

The STS learning model provides a means to achieve scientific and technological definitions. The emphasis is on making real-time decisions in the real world where science and technology are very important to understand. Because technology is more interesting to most people than science. Technology can indirectly affect humans such as TV, cellphones, transportation, and machinery (Dewi and Atun, 2019). This opinion is in line with the expression of Harlen and Quarter in (Murphy, 2018) which states that science is a creative endeavor that humans do just as much as it need to be. It is taught in a way that encourages questioning, open-mindedness, risk-taking, and enjoyment.

Here is a correlation of how Science, Technology and Society are inseparable.

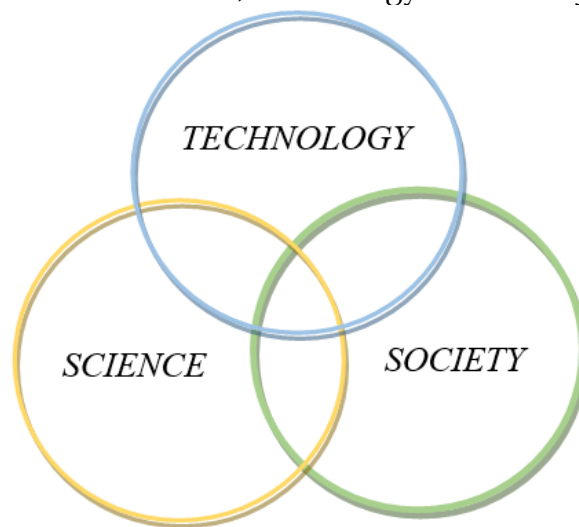


Figure 1. Correlation of Science, Technology, and Society

The picture above explains the relationship between science, technology and society in life. Science is knowledge and the process of discovering knowledge. Technology is a hardware or software used to solve problems to meet human needs.

According to (Santoso et al., 2020) the Science, Technology, and Society learning model has advantages including: 1) forming individuals to form ways of thinking using science and technology; 2) fostering concern for problems in the community environment; 3) using scientific methods which are part of biology learning to conduct experiments and solve problems in the surrounding environment; 4) accommodating students to learn through a series of scientific activities. According to Poedjiadji in (Nugraheni and Wuryandani, 2018) the advantages of the STS learning model are that students have a higher level of creativity; have concern for society and its environment; easily apply the concepts learned to community needs; increase the sense of participation in problem-solving activities in the neighborhood.

Meanwhile, the shortcomings of the STS learning model according to (Herrera Villanueva, 2020) the Science, Technology and Society (STS) learning model has advantages and disadvantages. The disadvantages of the STS learning model are 1) teachers must have broad insight, high creativity and reliable methodological skills; 2) students must be active and must not be passive; 3) the curriculum used must be broad and oriented towards achieving student understanding. In line with this statement (Khasanah, 2023) explained that the STS learning model requires teachers to be knowledgeable, have cohesiveness in learning in order to achieve the desired learning objectives. Students in a passive classroom will make it difficult for teachers to transfer information because there is no reciprocity.

Science Lesson

According to (Purbosari, 2016) science is the study of natural phenomena and all forms of beauty as well as things that exist in the universe. In line with the opinion of Trowbridge and Bybee in (Santiawati, 2021), it is said that science is a representation of a dynamic relationship that has three main factors, namely "the extent body of scientific knowledge, the values of science and the methods and processes of science". Science is a product and process, which contains values. Science is the result of an interpretation of the natural world that is used as a method in the process of thinking, attitude and measurement to experimentation. Based on the description of some experts, it can be concluded that science is the study of natural phenomena that contain natural processes and values. Science trains us to formulate concepts based on conditions in the field. IPA or science combines products based on direct observation so as to produce a series of activities to make students have sensitivity, accuracy and experimental experience.

Higher Order Thinking Skills

Higher Order Thinking Skill (HOTS) is the thinking skills of students to solve problems through higher order thinking (Arafah et al., 2021). This is very

necessary because most students in Indonesia still have difficulty in solving some HOTS questions in classroom learning. This is in line with the statement from (Abosalem, 2016) saying that Based on PISA reported by the Organization for Economic Cooperation and Development, Indonesia is at 64th rank out of 65 countries with most of Indonesian students still have low ability if it is seen from a cognitive aspect (knowing, applying and reasoning).

HOTS is higher order thinking that uses the mind broadly to discover and solve new challenges. High challenge thinking requires one to apply new information and technology. It is also possible to get an answer in a new situation (Heong et al., 2021). By applying HOTS thinking, students can develop the knowledge and skills they develop during learning in new contexts (Brookhart, 2020). In line with this statement, (Abraham et al., 2021) said that higher order thinking skills manipulate information and ideas in a certain way by providing new understanding and implications. HOTS or high-level thinking skills require students to change information or ideas to be explained again using their own language more clearly and easily understood.

The characteristics contained in the context of HOTS are 1) transferring one concept to another, 2) processing and applying the information obtained, 3) finding relationships from different information, 4) using information to solve problems, and 5) examining ideas and information appropriately and critically (Ismafitri et al., 2022). Based on the description above, Higher Order Thinking Skill (HOTS) have characteristics not only remembering and receiving learning. However, it also analyzes, solves problems, examines ideas, and retells the information obtained. Thus, the thinking of students who have HOTS skills is better prepared to face several problems that require analysis and decisions.

Meanwhile, higher-order thinking skills have several indicators including:

NO.	INDICATOR	DESCRIPTION
1.	Critical Thinking	Student's ability to analyze information carefully, evaluate arguments, and conclude good results based on existing facts.
2.	Creative and Innovative	Student's ability to generate original ideas and create solutions that have not been thought of.
3.	Communication Skills	Student's ability to convey ideas and information with clear, effective, and confident speech.
4.	Collaboration Skills	Student's ability to cooperate with others effectively to achieve goals and objectives.
5.	Self-Confidence	Student's abilities are positive beliefs in their own abilities, skills, and values.

Table 1. Indicator of Higher Order Thinking Skills

Higher-order thinking skills have several advantages. The following are the advantages of HOTS thinking, namely: 1) train students to think broadly, 2) measure students to what extent they understand the material presented by the teacher, 3) analyze several problems, 4) interpret something that has been obtained, 5) provide clear conclusions (Purbaningrum, 2017). In line with this statement (Purba et al., 2022) explained that the advantages of Higher Order Thinking Skills or HOTS are that they can solve complex problems, decipher materials, conclude materials, build representations, analyze relationships by involving mental activity. HOTS thinking skills also train students to be ready with various forms of problems that require reasoning and problem solving.

Meanwhile, Higher Order Thinking Skills have disadvantages, namely requiring a long time because students have different thinking abilities; focus on progress-oriented assessment and higher order thinking; require the role of teachers who are always monitoring students to continue to motivate them in learning (Indriyana et al., 2019). In line with this statement (Mufit and Wrahatnolo, 2020) explained that students are not ready to follow the learning process if they use HOTS type questions. This is due to the low initiative of students in participating in learning activities, and the lack of seriousness of students in participating in teaching and learning activities.

Framework

Based on the explanation of the theoretical study that has been explained, this research will focus on the effect of the Science, Technology, and Society (STS) learning model on higher order thinking skills (HOTS) in grade IV. The STS learning model will help students in solving science problems in IPAS grade IV subjects by using higher order thinking skills or HOTS. In this learning, students will be invited to be active in participating in teaching and learning activities in the classroom which will use technology as a tool to convey material.

In this study, only one class was used as the experimental class. In the early stages, researchers will give a pre-test. The pre-test conducted will show the results of students' higher order thinking skills to solve science problems in Chapter IV "Changing Forms of Energy" with HOTS question levels (C4, C5 and C6). C4 is the cognitive domain for the ability to analyze, C5 is the cognitive domain for the ability to evaluate, and C6 is the cognitive domain for the ability to create. After the pre-test, students were given a treatment, namely the application of the Science, Technology, and Society (STS) learning model. Furthermore, students are given an action called a post-test to determine the effect of the STS learning model on higher order thinking skills (HOTS).

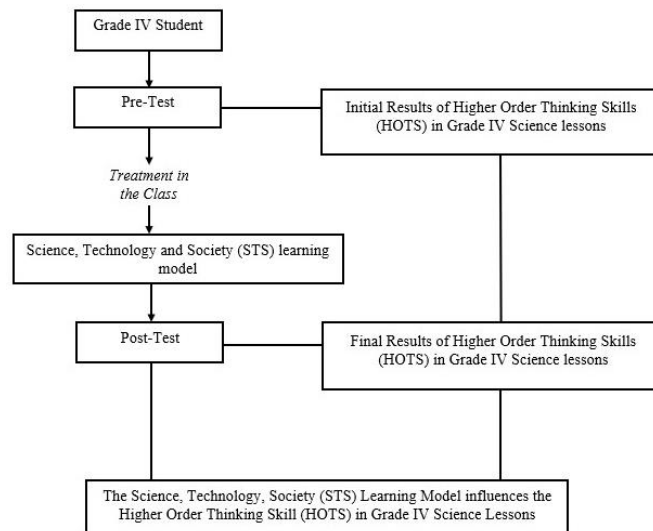


Figure 2. Actual Framework

Hypothesis

The research hypothesis is a temporary answer to the formulation of research problems which is not necessarily true. Based on the theoretical study and framework, the research hypothesis is “the STS (Science, Technology, Society) learning model has an effect on Higher Order Thinking Skill (HOTS) in Grade IV Science lessons”.

METHODOLOGY

Provides a clear and concise version of the method of execution of the analysis tool. This research uses a quantitative approach because the observation results are converted into numerical data. Data on the effect of the student learning model is included in the interval measurement scale. Interval measurement is used because the values obtained after treatment cannot be compared.

This research uses a quasi-experimental method. The quasi-experimental method is experimental research carried out on only one group called the experimental group without a control group or group that is not included in the experimental group.

The researcher will analyze the problem, design the treatment in one class that serves as the control class and the experimental class. The data generated from before the treatment is categorized in the control class, while the data generated from after the treatment is categorized in the experimental class.

The research design used is one group pre-test and post-test design, which is experimental research that will be carried out only on one group that is randomly selected and does not test the stability and clarity of the group's condition before being given treatment. The research design of one group pre-test and post-test design can be measured using a pre test conducted before being given treatment and a post test conducted after being given treatment for the selected learning. This was done to determine the effect of the STS learning model on HOTS thinking in science lessons.

The scheme of one group pre-test and post-test design is explained as follows:

Group	<i>Pre Test</i>	<i>Treatment</i>	<i>Post Test</i>
Experiment	T1	X	T2

Table 2. Scheme of one group pre-test and post-test design

Description:

T1 : The initial test value (Pre Test) of the experimental group

T2 : The final test score (Post Test) of the experimental group

X : Treatment or treatment

The population in this study were students of SDN 02 Nambangan Kidul, Madiun. The sample of this study were fourth grade students of SDN 02 Nambangan Kidul, totaling 17 students. The technique used in this research is the chance sample technique. While the technique used in data collection is using the test method.

RESEARCH RESULT

Data Analysis

1. Validity test

The validity test was carried out by giving the instrument sheet that had been made by the researcher to two validators who were experts in their fields. Furthermore, the validator will examine and assess according to the instructions on the instrument validation sheet.

2. Reliability Test

		N	%
Cases	Valid	28	100.0
	Excluded ^a	0	.0
	Total	28	100.0

a. Listwise deletion based on all variables in the procedure.

Cronbach's	
Alpha	N of Items
.794	10

Table. 3 Reliability Test

From the results above, it can be seen that the results of the reliability test show a number of 0.794, where these results can be included in the high category and it can be concluded that the question instrument made to test students can be applied to conduct research. The reliability test interpretation table is as follows.

Correlation Coefficient	Reliability Criteria
$0,80 < r \leq 1,00$	Very High
$0,60 < r \leq 0,80$	High
$0,40 < r \leq 0,60$	Simply
$0,20 < r \leq 0,40$	Low
$0,00 < r \leq 0,20$	Very Low

Table 4. Reliability Criteria

3. Normality Test (Kolmogorov-Smirnov)



	Tests of Normality					
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PRETEST	.277	17	.001	.809	17	.003
POSTTEST	.273	17	.002	.809	17	.003

Table 5. Normality Test

Based on this data, it can be seen that the p-value on the pre-test and post-test is less than 0.05. so the resulting test decision is H0 rejected. Thus, the data is declared not normally distributed. The requirement for normally distributed data is if the resulting p-value is more than 0.05.

4. Hypothesis Test (Wilcoxon)

Test Statistics^a

	POSTTEST - PRETEST
Z	-3.176 ^b
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

Table 6. Wilcoxon Test

Based on the results above, the distribution of student scores on the pre-test and post- test shows a p-value of $0.001 < 0.05$, resulting in the H0 test decision being rejected. So that the resulting hypothesis is that the STS learning model has an effect on high- level thinking skills/ HOTS in Class IV science lessons.

DISCUSSION

The data collected were students' pre and post tests in the form of high-level thinking skills or HOTS using the Science, Technology and Society (STS) learning model. The instrument test data was applied to class IV which amounted to 17 students. The test was conducted in one class. The class before treatment is named the control class and the class after treatment is named the experimental class. The following are the results of the research that has been done:

1. Description of data on higher order thinking skills / HOTS before learning

The results of the higher order thinking skills test before learning or pre-test were obtained from tests conducted in the control class. The results of the pre-test stated that there was no significant output from the existence of higher order thinking skills to fourth grade students in science lessons. Proven by the Mean obtained which is 81.76. The results of the ability of high-level thinking skills / HOTS before getting treatment or pre-test are written in the table.

Class	N	Mean	Median	Mode	Variance	Standar Deviation
IV	17	81,76	80,00	90	90,441	9,510

Table 7. Result of HOTS before learning

The science lesson test results on the learning outcomes of identifying sources and forms of energy and explaining the process of changing forms of energy in daily life obtained from the pre-test and compiled using learning indicators or in the Merdeka Curriculum referred to as learning objectives. There are 2 learning objectives, namely those included in C4 analyzing various information on energy transformation in everyday life and C5 concluding the process of changing the form of motion energy into sound in everyday life.

The description of the pre-test results can be explained in the graph.

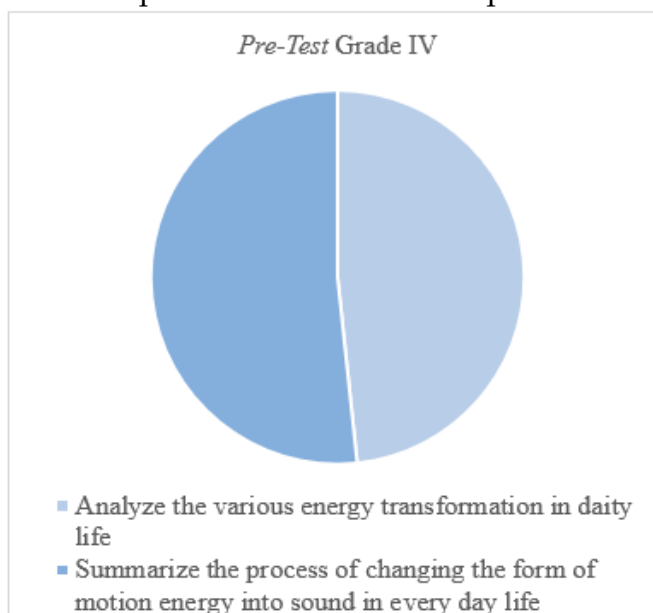


Figure 3. Pre-test Result by the Indicator

2. Description of data on higher order thinking skills/ HOTS after learning

The results of the higher order thinking skills test after learning or post-test were obtained from tests conducted in the experimental class. The results of the post- test stated that there was a significant output of higher order thinking skills for fourth grade students in science lessons. Proven by the Mean obtained which is 91.18. The results of the ability of higher order thinking skills / HOTS after getting treatment or post-test are written in the table.

Class	N	Mean	Median	Mode	Variance	Standar Deviation
IV	17	91,18	90,00	90	48,529	6,966

The science lesson test results on the learning outcomes of identifying sources and forms of energy and explaining the process of changing forms of energy in everyday life obtained from the post-test and compiled using learning indicators or in the Merdeka Curriculum referred to as learning objectives. There are 2 learning objectives, namely those included in C4 analyzing various information on energy transformation in everyday life and C5 concluding the process of changing the form of motion energy into sound in everyday life. The post-test results show that the mean student scores increased and there was a significantly higher output than before.

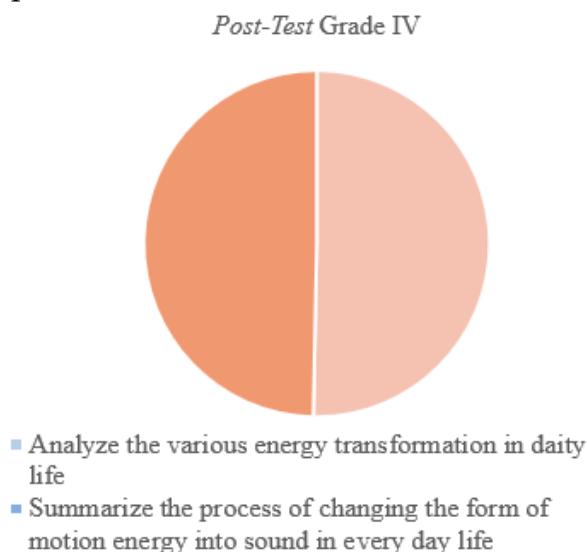


Figure 4. Post-test Result by the Indicator

Hypothesis Testing Results

1. Normality Test

The normality test is carried out to determine whether the research data has a normal distribution of data or not. The results of the normality test on the pre-test and post-test were not normally distributed as evidenced by the p-value on the pre-test of 0.001 and the p-value on the post-test of 0.002. From both results between pre-test and post-test, it can be seen that the p-value ≤ 0.05 . The results of the normality test can be seen in table.

Value Data	N	<i>p-value</i>	Significance Level	Test Decision
<i>Pre-Test</i>	17	0,001	0,05	H ₀ rejected
<i>Post-Test</i>	17	0,002	0,05	H ₀ rejected

Table 7. Table Normality Test Analysis Results

2. Science Lesson Test Result after Learning

Learning outcomes of science lesson on learning outcomes after learning is carried out based on the results of hypothesis testing obtained that there is a significant difference between science lesson outcomes in Class IV. The significant difference occurs when learning is done with the Science, Technology and Society (STS) model towards higher order thinking skills (HOTS). Significant differences can be seen based on the average data (mean) of student scores in the pre-test and post-test. The mean in the pre-test showed a result of 81.76 and post-test 91.18. The hypothesis test results show that the $p\text{-value} < 0.05$ so that H₀ is rejected. So, the hypothesis test decision in this study is that the Science, Technology and Society learning model has an effect on high-level thinking skills in Class IV IPAS lessons. The results of the analysis that has been done can be seen in table.

Value Data	p-value	Significant Level	Test Decision
<i>Pre-test vs Post-test</i>	0.001	0.05	H ₀ Rejected

Table 8. Analysis of Science Lessons Outcomes after Learning

3. Discussion

The results of the research that has been conducted show that learning using the Science, Technology, Society learning model has an effect on the high-level thinking skills of grade IV science lessons at SDN 02 Nambangan Kidul Madiun City. The results of the pre test and post test of students using the Science, Technology, Society learning model show significant results and show an increase in the pre test and post test questions that have been given to students. The standard questions given use learning outcomes that are adjusted to the C4 and C5 cognitive levels which are included in the higher order thinking level. The data obtained is the average or mean value of the post-test showing the result of 91.18 where before in the pre-test results showed the result of 81.76. There is a difference of 9.42 higher than the previous results. Science / IPA has an influence on higher order thinking skills. This is in line with the opinion of (Yulianti, 2013) that the results of the analysis of control classes that have low academic ability can improve their thinking skills if given stimulation in the form of science.

The results of the research that has been carried out state that H₀ is rejected, which means that the Science, Technology, Society learning model has an effect on students' high-level thinking skills in grade IV science lessons. Science and

STS can collaborate to produce an increase in HOTS thinking skills. This is in line with research from (Jariyah, 2017) which says that developing learning will continue to follow the direction of technology. In the context of the 21st century, it allows the development of scientific thinking skills, the development of "science of inquiry" and the ability to think creatively, innovatively with a high level.

Learning using the STS model shows evidence of improving students' understanding of higher order thinking concepts and assisting in the transfer of knowledge (Setiadi et al., 2014). Science related to nature or science has developed so rapidly. Scientific development has been recognized by knowledge in the fields of science and technology since the 1970s and experienced controversy that turned into an important methodological tool for understanding key processes that are not usually seen in science (Pinch and Leuenberger, 2016).

CONCLUSIONS

The results of data analysis and discussion in the study as well as the formulation of the problem are known that the Science, Technology, Society learning model has an effect on higher order thinking skills in IPAS Class IV lessons. Student test results on IPAS Class IV learning with the topic of energy transformation using the Science, Technology, Society learning model show significant mean results upwards. These results were obtained based on the results of hypothesis testing using the Wilcoxon test with the mean of the pre-test question of 81.76 and the mean of the post-test question of 91.18. Based on this value there is a significant difference of 9.42. This proves that the Science, Technology, Society learning model has a significant upward effect on students' higher-level thinking skills in Science Lesson Grade IV.

REFERENCES

Abosalem, Y. (2016) 'Assessment Techniques and Students Higher Order Thinking Skills'.

International Journal of Secondary Education, 4(1), pp. 1-11.

Abraham, I., Tjalla, A. and Indrajit, R.E. (2021) 'HOTS (High Order Thinking Skill) in Critical Paedagogics', *JISIP (Journal of Social Science and Education)*, 5(3), pp. 419-426.

Agus Purnomo, Maria kanusta, F. (2022) *Model, Learning, and Learning Model*. Green Dome, Bagu, Pringgarata, Central Lombok: Hamjah Diha Foundation.

Arafah, K. *et al.* (2021) 'The Development of Higher Order-Thinking Skills (HOTS) Instrument Assessment in Physics Study', *Journal of Physics: Conference Series*, 1899(1), pp. 1-7.

Arianti, N.N. and Darmayanti, N.W.S. (2023) 'Analysis of Students' Needs for the 4th Grade Science Practicum Module at Sd N 1 Cempaga', *Journal of Basic Education Rare Pustaka*, 5(1), pp. 42-45.

Asyafah, A. (2019) 'REVIEWING LEARNING MODELS (A Theoretical-Critical Study of Learning Models in Islamic Education)', *TARBAWY : Indonesian Journal of Islamic Education*, 6(1), pp. 19-32.

Brookhart, S.M. (2020) 'How to Assess High-er Order Thinking Skills in Your Class-room', *Alexandria: ASCD*, 9(2), pp. 11-16.

Dewi, N.P.L.C. and Atun, S. (2019) 'the Effect of Science Technology Society (Sts) Learningon Students' Science Process Skills', *Peuradeun Scientific Journal*, 7(1), pp. 113-124.

Fanani, A. and Kusmaharti, D. (2014) 'Development of HOTS (Higher Order Thinking Skill) Based Learning in Primary School Grade V', *Journal of Primary Education*, 1(9), pp. 1-11.

Farias, R.L.S., Ramos, R.O. and da Silva, L.A. (2019) *Numerical solutions for non-Markovian stochastic equations of motion*, *Computer Physics Communications*.

Helmiati (2022) *Learning Model | Dr. Hj. Helmiati, M.Ag. | download, Aswaja Pressindo*.

Heong, Y. M., Othman, W.D., Md Yunos, J., Kiong, T.T., Hassan, R., & Mohamad, M.. (2021) 'The Level of Marzano Higher Order Thinking Skills Among Technical Education Students', *International Journal of Social and Humanity*, 1(2), pp. 121-125.

Herrera Villanueva, E. (2020) 'The Effect of Science, Environment, Technology and Society (SETS) Approach on Student Learning Outcomes', *Ar Raniry Repository*, 2017(1), pp. 13-15.

Indriyana, B. S., & Kuswandono, P. (2019) 'Developing Students Higher Order Thinking Skills (HOTS) in Reading: English Teachers Strategies in Selected Junior High Schools', *Journal of English Teaching*, 5(3), p. 204.

Ismafitri, R., Alfian, M. and Kusumaningrum, S.R. (2022) 'Characteristics of HOTS (High Order Thinking Skills) and their Relationship with Numeracy Literacy Skills in Elementary Schools', *Journal of Educational Intervention Research*, 4(1), pp. 49-55.

Jariyah, I.A. (2017) 'The effect of inquiry combined science-technology-society (STS) learning to enhance critical thinking skills on science', *JPBI (Indonesian Journal of Biology Education)*, 3(1), pp. 1-9.

Khasanah (2023) 'Application of the SETS Approach (Science, Environment, Technology, Society) on Oxidation Reduction Reaction Learning', *Journal of Science Education Innovation*, 5(1),p. 8.

Khoerunnisa, P. and Aqwal, S.M. (2020) 'Analysis of learning models', *Fondatia*, 4(1), pp. 1-27

Lestari Pratiwi, G. and Akbar, B. (2022) 'The Effect of Problem Based Learning Model on Mathematical Computational Thinking Skills of Students of Class Iv Sdn Kebon Bawang 03 Jakarta', *Didactics: Scientific Journal of PGSD STKIP Subang*, 8(1), pp. 375-385.

Mufit, M. and Wrahatnolo, T. (2020) 'Factors that Influence and Ways to Improve Higher Level Thinking Skills of Vocational Students in TITL Expertise Competency', *Electrical Engineering Education*, 9(2), pp. 411-418.

Murphy, C.M. (2018) *The importance of teaching about the nature of science in the primary classroom*, Dublin City University.

Nugraheni, A.A. and Wuryandani, W. (2018) 'the Effect of Science Technology and Society Models on Science Process Skills', *Information*, 48(2), pp. 213-227.

Pinch, T. and Leuenberger, C. (2016) 'Studying Scientific Controversy from the STS Perspective', *EASTS Conference 'Science, Controversy and Democracy'*, 2(3), pp. 3-4.

Poluakan, C. et al. (2020) 'Use of the Science Technology and Society (STS) model with the help of Facebook in science learning for junior high school students', *Journal of Physics: Conference Series*, 1567(4), pp. 2-7.

Purba, P.B. et al. (2022) 'Higher Level Thinking Skills', *Ministry of Education, Culture, Research and Technology*, 20(7), pp. 65-80.

Purbaningrum, K.A. (2017) 'Junior High School Students' Higher Level Thinking Ability in Mathematics Problem Solving in View of Learning Style', *Journal of Mathematics Research and Learning*, 10(02), pp. 40-49.

Purbosari, P.M. (2016) 'Project-based learning to create a natural science encyclopedia to improve academic skills in students', *Scholaria: Journal of Education and Culture*, 6(3), p.231

Ramadhani, A.I., Herlina, H. and Nova, T.L. (2019) 'Application of Science, Technology and Society Learning Model to Improve Students' Process Skills in Natural Science Subjects in Class IV Madrasah Ibtidaiyah Al-Hanin Tualang District, Siak Regency', *el-Ibtidaiy: Journal of Primary Education*, 2(1), p. 18.

Santiawati, S. (2021) 'Integration of Inquiry Learning Model and Jigsaw Type Cooperative to Increase Student Understanding and Participation', *Pedagogia: Scientific Journal of Education*, 13(1), pp. 23-28.

Santoso, A.M., Sajidan, S. and Sudarisman, S. (2020) 'Application of Science Technology Society Model through Field Experiment and Laboratory Experiment in View of Students' Environmental Care Attitude and Verbal Creativity', *INKUIRI: Journal of Science Education*, 2(03), pp. 79-99.

Setiadi, H.W., Nyoman, D. and I Nyoman, T. (2014) 'The Effect of Science Technology Society (STM) Learning Model on Science Learning Outcomes in View of Critical Thinking Ability in Fifth Grade Students of SD Muhammadiyah 2 Denpasar', *Journal of Education*, 4(4), pp. 1- 10.

Tasrif, T. (2022) 'Higher Order Thinking Skills (HOTS) in learning social studies in senior high school', *Journal of Educational Development: Foundations and Applications*, 10(1), pp. 50-61.

Viera Valencia, L.F. and Garcia Giraldo, D. (2019) 'Data Description', *Angewandte Chemie International Edition*, 6(11), 951-952., 2, pp. 54-77.

Wang, C.C. (2024) 'Using design thinking for interdisciplinary curriculum design and teaching: a case study in higher education',