Journal of Ultimate Research and Trends in Education

ISSN: 2685-4252 (Online) and ISSN: 2685-0540 (Print)
Vol. 4, No. 2, July 2022, pp: 135 ─ 145
DOI: https://doi.org/10.31849/utamax.v4i2.9981

Further insight into Student Learning Outcomes of Derivative Materials: Numbered Head Together and Expository Learning Model

Jitu Halomoan Lumbantoruan
Universitas Kristen Indonesia, Jakarta Timur, Indonesia
Jituhalomoan.lumbantoruan@gmail.com

ARTICLE HISTORY

Received : 2022-04-21
Revised : 2022-07-21
Accepted : 2022-07-22

KEYWORDS

Learning outcomes
Numbered head together
Expository learning model
Derivative materials
Non-equivalent CGD
Good thinking concepts

ABSTRACT

This study aims to determine the effect of the Numbered Head Together (NHT) and Expository Learning Model (ELM) learning models on student learning outcomes in derived mathematics. The method used in this research is quasi-experimental, namely the Nonequaivalent Control Group Design. The experimental class was given a Numbered Head Together (NHT). The NHT model for class XI SMA IPA 5 and XI, SMA IPA 1 as conventional classes, is given in the form of the ELM model. Data analysis used the t-test, where the results showed: 1) there was a significant increase in student learning outcomes in derived material using the Learning Numbered Head Together (NHT) model, 2) student learning outcomes in mathematics were higher using the Learning Numbered Head Together model. (NHT) then the learning outcomes were obtained with the Expository Learning Model (ELM) model. This can be seen from the test results with the t. Test, mark Tcount = 89,12 And value ofT'_{table} = 1,67 so that $T_{Count}t > T'_{table}$ = 89,2>1,67, so H_0 rejected and H_1 accepted. In conclusion, students who are taught mathematics using the NHT model understand much more and have very good results compared to the ELM model. Suggestions, in implementing mathematics material, it is expected that educators use the NTH learning model to improve learning outcomes and produce good thinking concepts in mathematics.
.

1. Introduction

Introduction to education with the fact that, (Animasaun & Abegunrin, 2017) describe education as a tool to achieve human development, as well as national interests and goals. A curriculum is defined as “to run courses” to achieve those goals. In the process of transforming knowledge students to in obtaining good thinking results, understanding, and inhabiting skills, appropriate models, methods and strategies are needed (Makafui et al., 2021). Educators must be aware that a well-planned effort can be realized during the learning process, which aims to actively develop the potential that exists in a child (Dong et al., 2020).

Students who are equipped with knowledge that has been planned must have the power of knowledge of religion, self-control, attitude, intelligence, good behaviour, and sufficient skills to develop themselves and benefit society (Aiman, 2020). Education is an interaction between teachers and students, with the aim of the teacher helping students develop all the potential within themselves and according to their characteristics in a positive direction (Smutny & Schreiberova, 2020). The regulations that have been regulated in Law No. 20 in 2003 talked about the development of knowledge which aims to create an interactive, inspiring, fun, challenging, and motivating learning process for students to participate actively, provide a place for the initiative, creativity, and independence according to their talents, interests, and psychology Students (Linder & Svedberg, 2019). It must be admitted that the learning outcomes obtained by students are influenced by the effectiveness of the learning process provided by the teacher. However, effective learning must involve effective students in every learning process (Lapitan, et al., 2021). However, the theory does not match reality.

This study conducted initial observations at SMA Space 1 in Halim East Jakarta. This study observes the learning process. The teacher still uses conventional learning models and strategies where students only receive material from the teacher and do not get it from other sources in the learning process. Conventional learning processes are generally formal, and the main strategy used by teachers in teaching is lecturing. In the conventional mathematics learning process, the teacher seems to dominate learning and

students are more passive in accepting the mathematics material provided, meaning that students are still less active in learning activities. As a result, the activities carried out by students are only listening, taking notes, rarely asking questions, giving opinions, no group discussions are seen, and student interaction with students is still lacking. Because this incident has a visible impact, many students do not focus on learning mathematics material, feel bored with the material provided, become busy with their own activities and have difficulty understanding mathematical concepts optimally. The researcher discussed with the teacher and asked about the students' interest in mathematics. The teacher is of the opinion that in every learning process of mathematics material which is carried out twice a week, there are still many students who are less active and tend to be passive in each material given. Based on this teacher's opinion, the researcher aims to prove it by teaching one of the materials that are considered difficult for students to accept.

The researcher saw and proved when the researcher entered the class and gave a difficult math material that the teacher had taught. Many students were silent, seemed to just listen, and did not ask any questions. Furthermore, the researcher allowed students to ask questions. Of the 35 students in the class, only 7 to 8 were active and willing to ask questions, and the rest tended to be passive. Researchers see that conventional learning models are inappropriate or inappropriate for use in high school material. The researcher also asked the teacher about the learning outcomes of the students obtained from the final test. The teacher believes that 80% of students score below the KKM that has been determined at the school, with a KKM of 75. This becomes pressure on the teacher and, at the same time, becomes an increasing burden to re-explain and carry out follow-up or remedial exams continuously until the students graduate. And can go to class. The burden that the teacher bears makes it difficult for the teacher to continue with other materials.

In contrast, the learning model outlined in the 2013 curriculum is Student Center Leaning (SCL) which contains many good and tested learning strategies. Mathematics teachers often use two learning strategies in conveying the concept of mathematical material: the Numbered Head Together Learning Strategy and the Expository Strategy. Ali, Mz, & Vebrianto (2021) argues that the NHT learning strategy is used to teach mathematics materials that are considered difficult at all levels, from elementary school to university level. NHT focuses on material that is considered difficult by forming discussion groups among students with the aim that students can solve math problems that are considered difficult Purwanto, Jatmiko, & Pahrudin, (2020). The opinion of the NHT strategy is that it can improve mathematics learning outcomes significantly. Still, the NHT learning strategy cannot increase children's thinking ability who have entered the cognitively capable category. Kristine, Eker, Ringstad, Andreassen, & Lugo (2021) believe that the expository learning model can also improve student learning outcomes. However, expository learning strategies cannot equate knowledge, concepts and ways of thinking from the material obtained by students. Expository is more about developing students' ways of thinking where students already have the power of basic concepts in mathematics. In this case, the opinion gap exists between one study and the reality in the field. The problems in SMA Space 1 must be resolved by choosing models and learning strategies that develop and can improve student learning outcomes in mathematics. The two proven models, NHT and Expository, which can improve learning outcomes, can be used in SMA Space schools. It is necessary to ascertain which strategy is more appropriate to use to teach mathematics in the high school.

To overcome the problems above, it is necessary to research to ensure that teachers should use which model is more appropriate. Nevertheless, this goal can achieve learning activities effectively and efficiently (Supriadi, 2022). Student learning styles include 1) Visual, students with this style easily understand learning how to see or observe, 2) auditory, this type of student easily understands learning by listening, 3) kinesthetic, students with this type learn by doing. The teacher must realize that knowing the type of student learning helps implement the right learning model for students. If the teacher can find a suitable learning model for students, it will help them achieve optimal learning outcomes and be active in the learning process (Lwande et al., 2021). The learning model used by all schools is student-centred learning. This learning model adopts the 2013 curriculum. In student-centred learning, it is a learning strategy that emphasizes collaboration (Willgerodt et al., 2021). Cooperative is a learning strategy that emphasizes shared behaviour, teamwork and helping each other. This strategy regularly works in groups of two or more people. Problems seen and observed are the absence of cooperation, exchange of views, and giving each other opinions among students. Whereas in success, good cooperation is needed, cooperation is strongly influenced by the involvement of each group member so that this cooperative learning model emphasizes students' activeness in learning (Albay, 2019).

Research Purposes, This study aims to find out how significant the increase in student learning outcomes in mathematics at SMA Space 1 is with the help of the Numbered Head Together (NHT) model and the Expository Learning Model (ELM). The Numbered Head Together (NHT) Cooperative learning model helps students actively work in teams groups and be responsible for the tasks given by the

teacher. The application of the NHT learning model is to divide students into several heterogeneous groups, and each student gets a number of math questions that must be done. The teacher gives assignments to each group, the group discusses each individual's answer and determines which answer is correct. The teacher calls one of the student numbers to present the results of their discussion. Positive emphasis is that each student prepares himself at any time the teacher calls randomly based on the number of questions that have been determined (Albay, 2019). This research is to find the most appropriate learning model to deliver mathematics material at the high school level.

2. Literature Review

In essence, Cognitive in mathematics includes intellectual mathematical aspects such as knowledge and skills needed to manipulate thinking in mathematics (Primi et al., 2010). The indicators in the study include several mathematical abilities, namely reasoning, the activity of how the mind works are developed continuously. Learners need mathematical reasoning. At the unit level of education, mathematical reasoning and communication skills must be mastered by students. The learning process framework with a scientific approach adopted in the 2013 Curriculum describes teachers and students as active actors (Fouad et al., 2021). Rijt, Swart, Wijnands, & Coppen, (2019) Conceptual understanding is that students can find ways to express these conceptions and explore related possibilities.

A student is said to have already the ability to understand mathematically if he can do the following (Lumbantoruan & Uly, 2021) 1) able to explain mathematical concepts and facts, 2) can make logical connections between these different concepts and facts, 3) use old material with new material, 4) identify mathematical principles. Problem-solving finds a clearly understood end goal (Journal et al., 2021). Solving a problem means that someone finds a solution. Problem-solving is a process carried out to overcome an issue that has an unclear answer. Students are directed to give opinions to each other through discussion and think critically to get the right answer (Science et al., 2020). Mathematics has its communication for students to understand. Mathematical communication is the ability to read, interpret, interpret, and use correct mathematical concepts in conveying arguments orally and in writing (Huu et al., 2021). Mathematical communication is the ability to explain a problem-solving in good and correct language, construct and explain the study of questions in the form of diagrams, graphs, words or sentences, and table equations (Huu et al., 2021). Mathematics is a collection of knowledge, skills, and procedures that can describe, illustrate, and interpret patterns and relationships in numbers, algebra, shape and space, measures, and data in various ways (Animasaun, 2021). Mathematical communication has three points, namely using accurate language in solving, mathematical representation in an accurate way and completion in a well-structured manner (Sovacool et al., 2020).

2.1 Cooperative Learning Model

Cooperative learning is an approach that emphasizes the work of groups of students or teams formed to solve a problem. Cooperative learning is a learning strategy that explores and provokes a group's attitude or behaviour to provide opinions, views and thoughts on a job by educators. There are several characteristics of cooperative learning strategies that must be known, namely, the learning process in groups or teams requires willingness, seriousness and cooperation with each other between students and other students (Sailer et al., 2021). Four steps must be taken before implementing a cooperative learning strategy, namely participants or educators forming groups or teams, dividing the implementation or dividing their respective tasks, students must work together with each other in solving problems, and some competencies must be achieved by students groups that have been determined by the teacher at the beginning of the material given (Veldman et al., 2020.

One of the learning strategies developed in cooperatives is the Numbered Head Together (NHT) learning strategy. NHT is also a cooperative learning model that educators widely use to deliver mathematics material to students. In this strategy, students are made into heterogeneous groups, and each student has a certain number that is easy for the teacher to control (Liebech-lien, 2021). This NHT learning strategy has advantages and is in accordance with the 2013 curriculum and is very in line with the concept of online application. Interaction between students, students benefit through the activation process, work cooperatively in discussing the material provided by the teacher, have sufficient time to ask questions and always have the opportunity to demonstrate general skills and special skills in one case discussed in mathematics material. Discussion groups are more flexible, and students can develop leadership talents (Purwanto et al., 2020).

2.2 Expository Learning Model

The expository learning strategy emphasizes the process of verbally delivering material from an educator to students (Albay & Eisma, 2021). In the case of mathematics lessons, expository learning strategies are not appropriate. This is because mathematics material requires the transfer of conceptual knowledge, proof of formulas, explaining how to work on problems, and understanding one material with another. The concept of mathematical material cannot only be conveyed orally but must show facts and processes (Kristine et al., 2021). (Moreno-guerrero et al., 2020) the purpose of the teacher using an expository strategy is that students can understand the basic concepts of a material that

has just been studied and master the mathematics subject matter in a structured and intact manner. But in fact, the expository learning strategy in the process has the same drawbacks as the problems faced by students in the background, namely 1) The process of learning mathematics using expository strategies can only be done to students who have high independence, good listening willingness and fluent two-way communication between teachers and students, 2) expository learning strategies are not suitable for students who have heterogeneous abilities in the classroom, meaning that teachers in using this learning strategy cannot use these learning strategies for students who have different grasping abilities of different knowledge. differences, interests, and talents, as well as the existence of different learning styles, 3) this strategy only relies on lecture capital from the teacher, centered on the teacher through lectures, 4) the success of students depends on pedagogic competence, professional competence, social competence and Personal Competence from an educator, 5) in the expository of the learning process there is only one direction of communication, namely from the educator.

2.3 Learning Process Implementation

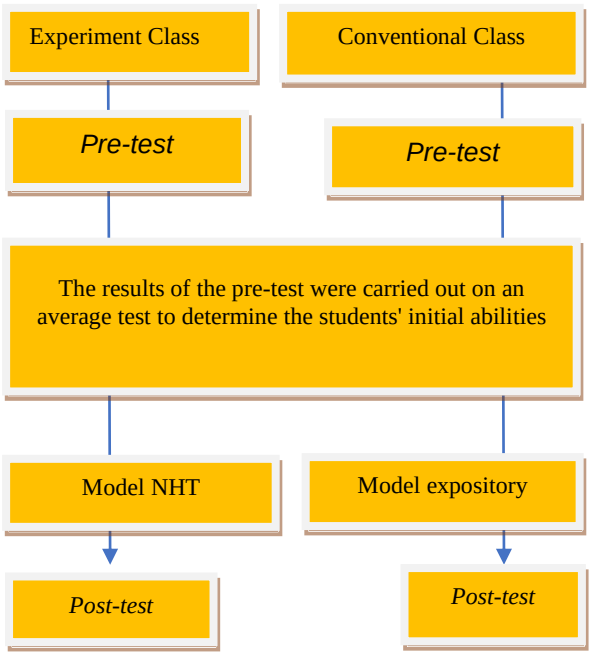

Figure 1. Flow with NHT and Expository Strategies

In the process of implementing learning. There are two classes used. One class uses an expository learning strategy, and another class uses NHT. The material taught to both classes is Derivative material in Class XI SMA. The most basic reason for choosing this title is in accordance with the problems that exist in the background of the low learning outcomes of students in certain materials using conventional learning models. The first step in the implementation process is to give both classes a pre-test.

Furthermore, both classes were taught mathematics derivative material, with the experimental class using the NHT strategy and the control class using the expository strategy. The duration of time in teaching derivative material is the same, namely three meetings for one class. After finishing, the researcher conducted an exam in derived material and selected the learning outcomes and improvements through post-test.

3. Method

Design in the form of a true experimental design. This type of research is quantitative a Quasi-Experimental (Miller et al., 2020). The design has a control class, but it does not control the external variables that affect the experiment. In Quasi-Experimental Design, there is a Non-Equivalent (Sung et al., 2019).

Table 1. Design Experimental

Group		Pre-test	Treatment	Post-test
Experiment	NHT	O_1	X_1	O_2
	ELM	O_3	X_2	O_4

Information:

O_1 = Pre-test score in the experimental class NHT

O_2 = Post-test scores in the experimental NHT

O_3 = Pre-test score in the experimental class ELM

O_4 = Post-test scores in the experimental ELM

X_1 = Treatment model type NHT

X_2 = Expository learning model treatment

The population in this study were all students in SMA Space 1 Halim Jakarta, class XI, totalling 127 people with seven classes, five science classes and two social studies classes, where the derived material was in the science and social studies major. At the same time, the sample taken is simple random sampling. Random means taking two classes from 7 classes. The experiment class is IPA 5 with 30 students. Science class 5 is taught derivative material using the Cooperative Numbered Head Together (NHT) learning strategy, the control class is science class 1 with 30 students, the science class 1 is taught using the expository learning strategy. Before carrying out the learning process in the two classes with different strategies, the researcher conducted an initial ability test or pre-test. After the learning process was completed, the two classes carried out a final test of derived material or a post-test (Albay & Eisma, 2021).

In this study, the data collection technique was by observing, distributing instruments and the next stage in giving the test (Verity et al., 2020). Instruments

that are arranged to find out or get student responses in assessing the learning process and learning strategies that are carried out. This instrument is given not only to students but to class teachers who teach in science class 1 and class 5, two sources (Mikalef et al., 2019).

Descriptive quantitative methods are used to analyse data obtained from sources. (Eliyana & Ma, 2019). namely by using the frequency distribution, looking for the mean, median, mode, standard deviation, normality test, and homogeneity test using the following criteria (Krachler et al., 2019). With the frequency distribution, looking for the mean, median, mode, standard deviation, normality test, and homogeneity test using the following criteria (Spurk et al., 2020): F count is greater than F table, then H_0 is accepted. With homogeneous data, F count more than Ha is rejected. With inhomogeneous data, t-test and F test. The hypothesis of learning outcomes, H_0 = There is no increase in the use of the Numbered Head Together Cooperative Learning Model on the Mathematics Learning Ability and Outcomes of Class XI students of SMA Space 1, and H_a = There is an increase in the use of the Cooperative Learning Model Numbered Head Together on the ability and improvement of Mathematics learning outcomes of Class XI students of SMA Space 1.

Then the results of the observations are analyzed by presenting the data, reducing and drawing conclusions. The results of the observations are aligned with the results of the student's responses to the distributed instruments. Then analyze the test scores from the post-test. The last step is to draw conclusions based on the results of instrument analysis and learning outcomes from the post-test.

4. Findings

The results of the analysis and research process that have been obtained and this research answer the background of the problem at the beginning, where there are still many doubts that educators use the most appropriate learning model to teach mathematics material. Educators are still debating between the two models, namely the NHT model and the ELM model.

There is also a disagreement between one researcher and other researchers about the most appropriate model to use in teaching mathematics, especially material considered difficult, such as derived material which is a problem among students at the 2nd-grade high school level. The most appropriate model for teaching mathematics at all levels, especially high school students. The following are the research results from the two models, namely the NHT model and the ELM model: Numbered Head Together (NHT) Pre-Test.

Table 2. Pre-Test NHT Learning Model

No	Interval	(fi)	xi	f. xi	Xi^2	f. xi^2
1	25-34	1	29,5	29,5	870	870,25
2	35-44	4	39,5	158	1560	6241
3	45-54	2	49,5	99	2450	4900,5
4	55-64	2	59,5	119	3540	7080,5
5	65-74	5	69,5	34,5	4830	24151,2
6	75-84	16	78,5	1256	6320	101124
Amount		30	327	2009	19573	144367,5

Post-Test Frequency Distribution Using Cooperative Learning Model Numbered Head Together

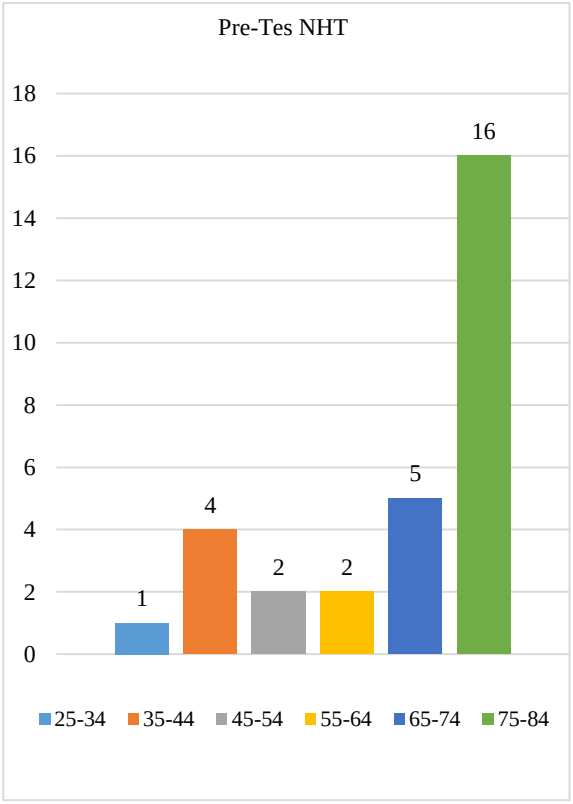

Figure 1. Histogram of Pre-test Model NHT

Table 3. Pos-Test NHT Learning Model

No	Interval Class	f	xi	$f.xi$	xi^2	$f.xi^2$
1	75-78	2	76,5	153	585	23409
2	79-82	2	80,5	161	6480	25921
3	83-86	4	84,5	338	7140	114244
4	87-90	6	88,5	531	7832	281961
5	91-94	7	92,5	647,5	8556	419256,3
6	95-98	9	96,5	868,5	9312	754292,3
Amount		30	519	2699	45173	1619084

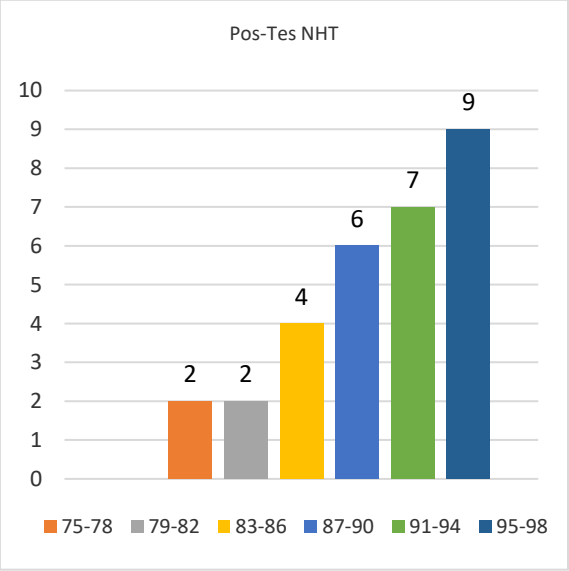

Figure 2. Histogram Post-Test Model NHT

Distribution of Pre-Test Expository Learning Model. Frequency distribution uses the student's expository learning model as follows:

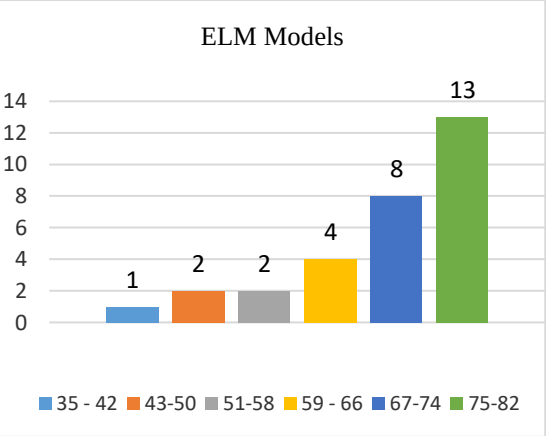

Figure 3. ELM Models Pre-test Histogram

Table 4. Distribusi Frekuensi *Post-Test* ELM Models

No	Interval Class	f	xi	f.xi	xi^2	$f.xi^2$
1	65 – 69	1	67	67	4489	4489
2	70 – 74	2	72	144	5184	10368
3	75 – 79	6	77	462	5929	35574
4	80 – 84	5	82	410	6724	33620
5	85 –89	6	87	522	7569	45414
6	90 – 94	10	92	920	8464	84640
Amount		30	477	2525	38359	214105

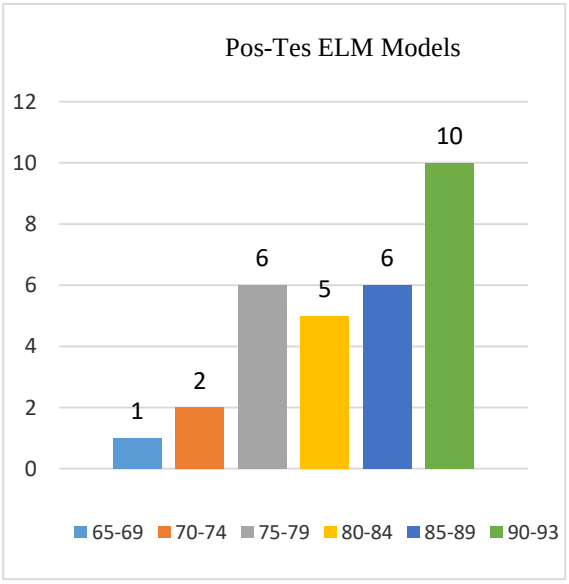

Figure 4. Histogram *Post-Test* ELM Models

Statistical Hypothesis Testing. Using Numbered Head Together (NHT) Cooperative Learning Model and Expository Learning Model with Normal and Homogeneous distribution. Then the statistical test that will be used to test the hypothesis is the t-test—a calculation of statistical tests using a one-way hypothesis test for the right side (right table). The criteria for testing the hypothesis are as follows: $T_{count} > T_{table}$ so, H_0 accepted, and H_1 rejected $T_{count} > T_{table,}$ so H_1 accepted and H_0 rejected. Hypothesis testing using a significant level $\alpha = 0,05$ for T_{table} under the condition $dk = (N_1 + N_2 - 2)$ so that it is obtained $\alpha = 0,05$, $dk = (30 + 30 - 2) = 58$ then we get the value $T_{table} = 1,67$.

The hypothesis that will be used in the one-way t' test (right side of the table) is as follows: $H_0 : \mu_1 - \mu_2 \leq 0$ and $H_0 : \mu_1 - \mu_2 > 0$. H_0 = There is no effect of the Numbered Head Together (NHT) model on student learning outcomes in class XI MIA SMA Space 1.

H_1=There is an effect of the Numbered Head Together (NHT) Cooperative learning model on students' learning outcomes in class XI MIA SMA Space 1. μ_1 = the average ability of students who use the Numbered Head Together (NHT) Cooperative learning model. μ_2 = the average ability of students who use the Expository learning model. Based on the calculations that have been carried out using the one-way t' test for the right side (right table), the value of is obtained T_{count} = 3,48 > Ttable = 1,67, so H_0 rejected and H_a accepted. Because H_1 accepted, it can be concluded that there is an effect of the Numbered Head Together Type of Cooperative learning model on the learning outcomes of class XI MIA students at SMA Space 1 Perdanakusuma.

Researchers also get results from observations of the mathematics learning process of derived material. Researchers see that students assisted by the NHT learning strategy are much easier to understand derived material than those who use expository learning strategies. Students freely convey, ask questions, and admit weaknesses and difficulties to their group mates. This is proven and in line with the theory that the NHT strategy opens space for students to openly admit their weaknesses and difficulties to their group mates compared to teachers who use expository learning strategies (Purwanto et al., 2020). During the learning process, researchers observed the activity of asking, answering, and spelling questions. Of these three components, the IPA 5 class that uses the NHT learning strategy has a higher score than the IPA 1 class that uses the expository. In this study, it is proven, and in line with the theory put forward, that in the implementation of mathematics material both online and face-to-face, it is much better to use the NHT learning model compared to other learning models (Ridwan, 2022)

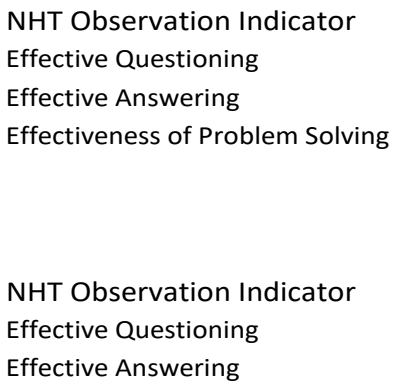

Figure 5. Effective Students Using NHT

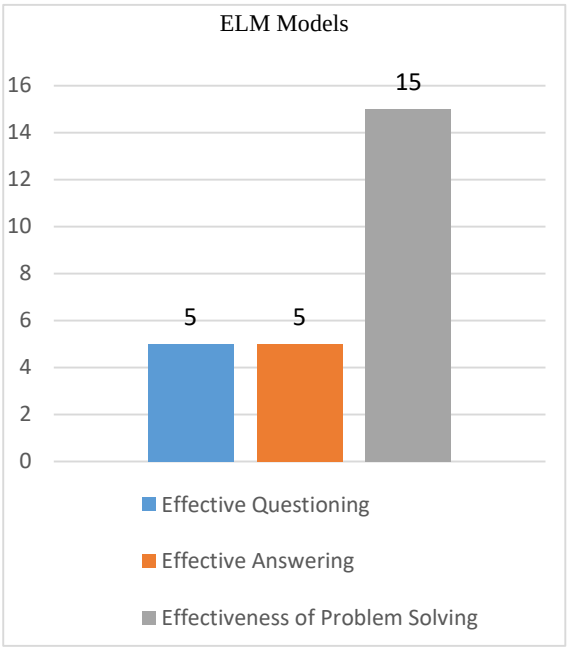

Figure 6. Effective Students Using ELM

The results of the student's assessment of the two strategies used when students assessed teaching by giving a score to the instrument given by the researcher. From the results of the distributed instruments, it can be seen that the learning strategies used have different opinions. NHT learning strategy assessment is better than the Expository strategy. The comparison of the two strategies is shown in Figure 7 and Figure 8 below.

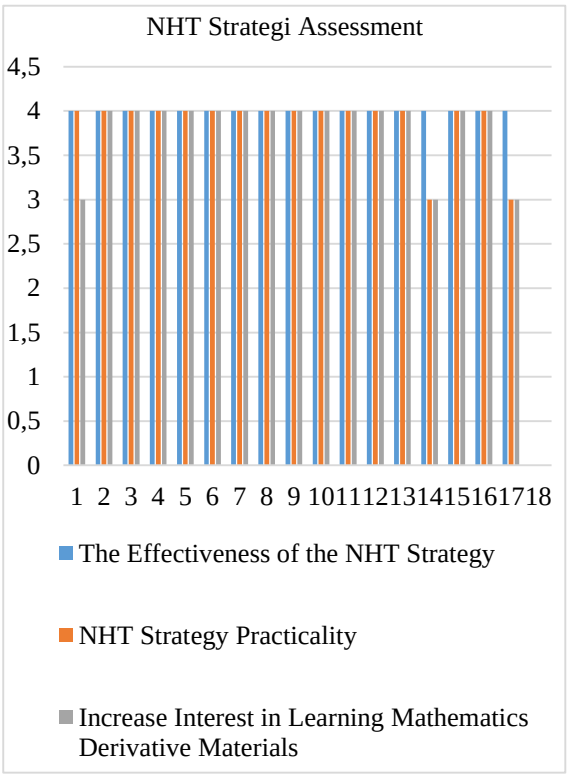

Figure 7. Student Assessment of NHT

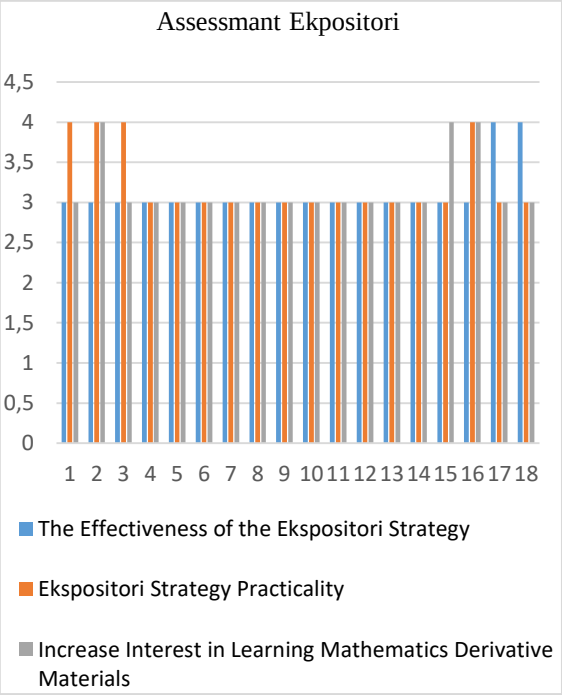

Figure 8. Student Assessment of ELM

5. Discussion

This study reveals the facts and concludes the most appropriate learning model for educators to use in teaching mathematics at the high school level, especially in difficult materials such as derivative materials. Students' mathematical ability in the cooperative learning strategy of the Numbered Head Together (NHT) type shows an effect on increasing student learning outcomes. Class XI IPA 5 is the experimental class, and XI IPA 1 is the control class. The learning outcomes of students in science class 5 showed a very significant increase when taught using the Cooperative Learning Numbered Head Together (NHT) learning strategy. In the early stages, the researchers saw the pre-test results compared to the post-test. In this case, it is in line with the theory put forward by (Hwang et al., 2021) that to see the most appropriate learning model and learning strategy used in teaching mathematics material that is considered difficult, the students' initial ability in the material is first tested.

The results of the pre-test of students in derived material mathematics were obtained for class XI IPA 5, the average was 67.07, and the results of the pre-test of students with the same material, namely mathematics, derived material for the average, and were obtained by class XI IPA. 1 is 68.90. Judging from the results of the two classes that received pre-test results, the average learning outcomes of both classes were still below the Minimum Learning Completeness Criteria (KKM). Whereas previously, as this study revealed in the background, the Minimum Learning Completeness Criteria (KKM) at SMA Space 1 for mathematics lessons was 78. Researchers also found that the average comparison between the experimental and control classes was lower. In this case, the average pre-test score for students is low. Using a model in the learning process assisted by the Numbered Head Together (NHT) cooperative learning strategy can improve student learning outcomes in mathematics, which are considered difficult materials such as derivatives. The NHT learning strategy is used to assist the process of implementing learning and achieving better mathematics learning outcomes. The results showed that students could demonstrate their ability and teamwork with their friends in groups that had been formed together with the teacher. This proved to be in line with the theory (Veldman et al., 2020b). The findings of researchers with the results of improving mathematics learning outcomes by using NHT align with those in theory (Aiman, 2020).

This study reveals the results of the post-test of students obtained from testing the results of the final ability of students in class XI IPA 5 using the NHT model and the expository model for IPA 1, it is known that the data is normally distributed. At the learning stage, it is implemented to students and provides mathematics material, namely Derivatives, with the help of NHT learning strategies in IPA 5. The learning ends with the researcher giving questions in the form of tests that aim to see students' abilities and learning outcomes with the help of the model used. The results of this post-test with the overall average value of class XI IPA 5 is 90, 37. Meanwhile, for the control class, the expository learning strategy or the control class did not experience a significant change of 83, 60. To ensure the data obtained by the researcher was correct, the researcher also tested the data obtained by means of normality and homogeneity.

Then the normally distributed data were continued with the post-test data homogeneity test. The test data found that the data on student learning outcomes with the Numbered Head Together and Expository learning strategies were homogeneously distributed. Data on student learning outcomes using the Numbered Head Together and Expository learning strategies are homogeneously distributed. In this case, this study found that hypothesis testing can be done by t' test because the data are normally distributed and homogeneous. From the statistical test data, the hypothesis shows that the Numbered Head Together (NHT) Cooperative learning model affects student learning outcomes. In this case T_{count} = 3,48 so at a significant level 5 % and DK = 58 and earned value so that T_{count} =3,48, Ttable = 1,67, so H_0 rejected, and H_1 accepted. The Cooperative NHT Together learning model applied in the experimental class XI IPA1 is in the category that teachers rarely use in helping to deliver math material to students. However, with the findings in this study, students tried to adjust and get used to understanding the steps involved in the

learning process. NHT learning model. The researchers consider this finding as a way to convey mathematical material using the NHT model.

This finding can be seen from the average post-test score in the experimental class using the NHT learning model with an average score that is higher and better than students in the control class with NHT, which is 90, 37 and the highest score. 98 and the lowest 75. Meanwhile, students who use the Expository model have an average of 80.60 and the highest and lowest scores are 95 and 65, respectively. In the N-Gain test, it can be concluded that the test results of students assisted by the Numbered Head Together Cooperative model are higher than those with the Expository learning model C_{ount} = 89,12 > T_{able} = 1,67. This proves, in theory that the NHT learning strategy is much better than the expository learning strategy in delivering math material that is considered difficult (Ali et al., 2021).

From the observational data, the researchers showed that students were more effective in asking, answering and working on derived material math problems distributed by the teacher to discuss with students in their group. The desire to know how to solve the problem can be seen in all students who discuss in science class 5 using the NHT strategy. This difference, researchers feel, when carrying out the learning process in science class 1 using expository learning strategies, only a few students ask questions and tend not to ask questions. The most prominent thing in researchers' observations is students' activeness when asking questions. In the NHT strategy, 25 people effectively ask other people in the same group and actively ask the teacher. As for the expository, only five active students asked the teacher. Regarding the effectiveness of answering, 20 students used the NHT strategy and only five used the expository strategy. Meanwhile, in terms of the effectiveness of the process of working on the questions, only 15 students used the NHT strategy, and 15 students used the expository strategy. From this observational data, the researcher's findings coincide with the test result data, where the use of the NHT learning strategy is much better than the expository strategy.

In the results of the instrument given to students to assess the learning strategies used in the mathematics learning process, it is seen that the NHT learning strategy got a score of 97.50%. Meanwhile, the expository learning strategy scored 83, 20%. By looking at the scores given by students, the NHT learning strategy is still higher than the expository. These results show the intersection of test result data and safety and assessment instruments that measure the learning process of mathematics material.

6. Conclusions

Based on the findings in the study, the post-test data was C_{ount} = 3,48 > T_{able} = 1,67**.** In this case, H_0 rejected and H_1 received. In this case, it can be concluded that there is an increase in students' mathematics learning outcomes with mathematics material using the Numbered Head Together (NHT) model. In statistical analysis, it was found that T_{ount} = 89, 12 > T_{table} = 1, 67 with understanding H_0 rejected and H_1 accepted which means that the learning process using the NHT model is compared to the espository by looking at the students' test results that the use of the Numbered Head Together Cooperative model to teach mathematics is much better than using the expository learning model. The learning outcomes of students obtained with the help of the Expository learning model are not better than those of NHT students.

7. Recommendations

Based on the results and discussion of this research, it is suggested that all mathematics educators use the Numbered Head Together (NHT) learning model in implementing the material to be taught in class. This has been proven by this research that the facts show that the use of the Numbered Head Together (NHT) learning model is much higher in the learning outcomes obtained by students compared to the Expository Learning Model (ELM) model, especially in material that is considered difficult by students such as derivative material. This study also suggests that each material to be designed is adapted to the Numbered Head Together (NHT) model, such as designing questions that can be divided into groups to be discussed together. This is considered necessary to make it easier for educators to implement material with the NHT model

8. Acknowledgement

I thank anonymous reviewers who provide direction and input on the completeness of the data in this article. With excellent and constructive feedback, this article is easily understood by readers and can be implemented in the community. I have no conflict of interest**.**

References

Aiman, U., Hasyda, S., & Uslan. (2020). The influence of process oriented guided inquiry learning (pogil) model assisted by realia media to improve scientific literacy and critical thinking skill of primary school students. *European Journal of Educational Research*, 9(4), 1635-1647. https://doi.org/10.12973/eu-jer.9.4.1635

Albay, E. M. (2019). Analyzing the effects of the problem solving approach to the performance and attitude of first year university students.

Social Sciences & Humanities Open, 1(1), 1-7, 100006. https://doi.org/10.1016/j.ssaho.2019.100006

Albay, E. M., & Eisma, D. V. (2021). Performance task assessment supported by the design thinking process: Results from true experimental research. *Social Sciences & Humanities Open*, 3(1), 1-9 100116. https://doi.org/10.1016/j.ssaho.2021.100116

Ali, D., Mz, Z. A., & Vebrianto, R. (2021). Literature Review : Mathematical creative thinking ability , and students ' self regulated learning to use an open ended approach. *MJML*. 4(1), 52–61. https://doi.org/10.29103/mjml.v4i1.3095

Animasaun, I. L. (2021). Significance of offering further mathematics and personal interest in mathematics on some variables common to secondary school students. *International Journal of Learning and Change*, 13(6). 640 - 655.

Animasaun, I. L., & Abegunrin, O. A. (2017). Gender difference, self-efficacy, active learning strategies and academic achievement of undergraduate students in the Department of Mathematical Sciences, Federal University of Technology, Akure, Nigeria. *International Journal of Teaching and Case Studies*, 8(4), 255-280. https://doi.org/10.1504/ijtcs.2017.10009869

Boso, C. M., van der Merwe, A. S., & Gross, J. (2021). Students' and educators' experiences with instructional activities towards critical thinking skills acquisition in a nursing school. *International Journal of Africa Nursing Sciences*, *14*, 100293.

Dong, C., Cao, S., & Li, H. (2020). Children and youth services review young children's online learning during COVID-19 pandemic : Chinese parents ' beliefs and attitudes. *Children and Youth Services Review*, 118(August), 105440.1-9. https://doi.org/10.1016/j.childyouth.2020.105440

Eliyana, A., & Ma, S. (2019). Job satisfaction and organizational commitment effect in the transformational leadership towards employee performance. *European Research on Management and Business Economics*, 25(3), 144–150. https://doi.org/10.1016/j.iedeen.2019.05.001

Fouad, L., Al, J., & Majeed, B. H. (2021). The impact of CATs on mathematical thinking and logical thinking among fourth-class scientific students. *International Journal of Emerging Technologies in Learning*, *16*(10).194-211 https://doi.org/10.3991/ijet.v16i10.22515

Grønlien, H. K., Christoffersen, T. E., Ringstad, Ø., Andreassen, M., & Lugo, R. G. (2021). A blended learning teaching strategy strengthens the nursing students' performance and self-reported learning outcome achievement in an anatomy, physiology and biochemistry course–A quasi-experimental study. *Nurse Education in Practice*, *52*, 1-6. https://doi.org/10.1016/j.nepr.2021.103046

https://doi.org/10.1016/j.ijans.2021.100293

Hwang, G. J., Wang, S. Y., & Lai, C. L. (2021). Effects of a social regulation-based online learning framework on students' learning achievements and behaviors in mathematics. *Computers and Education*, 160, 104031.1-5 https://doi.org/10.1016/j.compedu.2020.104031

Krachler, M., Varga, Z., Nicholl, A., & Mayer, K. (2019). Analytical considerations in the determination of uranium isotope ratios in solid uranium materials using laser ablation multi-collector. *Analytica Chimica Acta: X*, 2, 100018.1-9. https://doi.org/10.1016/j.acax.2019.100018

Lapitan Jr, L. D., Tiangco, C. E., Sumalinog, D. A. G., Sabarillo, N. S., & Diaz, J. M. (2021). An effective blended online teaching and learning strategy during the COVID-19 pandemic. *Education for Chemical Engineers*, *35*, 116-131. https://doi.org/10.1016/j.ece.2021.01.012

Liebech-lien, B. (2021). Teacher teams e A support or a barrier to practising cooperative learning ? *Teaching and Teacher Education*, 106, 103453.1-9 https://doi.org/10.1016/j.tate.2021.103453

Linder, A., & Svedberg, W. (2019). Review of average sized male and female occupant models in European regulatory safety assessment tests and European laws: Gaps and bridging suggestions. *Accident Analysis & Prevention*, *127*, 156-162 https://doi.org/10.1016/j.aap.2019.02.030

Lumbantoruan, J. H. (2022). Description of Difficulty of Semester VII Students of Mathematics Education Study Program in Complex Analysis Course. *Journal of Education and Learning Mathematics Research (JELMaR)*, *3*(1), 1-13. https://doi.org/10.37303/jelmar.v3i1.65

Lwande, C., Muchemi, L., & Oboko, R. (2021). Identifying learning styles and cognitive traits in a learning management system. *Heliyon*, *7*(8), e07701. https://doi.org/10.1016/j.heliyon.2021.e07701

Mikalef, P., Boura, M., Lekakos, G., & Krogstie, J. (2019). Big data analytics and firm performance: Findings from a mixed-method approach. *Journal of Business Research*, *98*,

261-276. https://doi.org/10.1016/j.jbusres.2019.01.044

Miller, C. J., Smith, S. N., & Pugatch, M. (2020). Experimental and quasi-experimental designs in implementation research. *Psychiatry Research*, *283*, 112452. https://doi.org/10.1016/j.psychres.2019.06.027

Moreno-Guerrero, A. J., Rodríguez-Jiménez, C., Gómez-García, G., & Ramos Navas-Parejo, M. (2020). Educational innovation in higher education: Use of role playing and educational video in future teachers' training. *Sustainability*, *12*(6), 2558. https://doi.org/10.3390/su12062558

Nasution, A. I., & Tristiana, D. W. (2021). modification of the model problem solving learning with the approach of offline in class x private SMK Az Zahra Sonomartani. *International Journal Of Humanities Education and Social Sciences (IJHESS)*, *1*(2). 7-12. https://doi.org/10.55227/ijhess.v1i2.40

Primi, R., Ferrão, M. E., & Almeida, L. S. (2010). Fluid intelligence as a predictor of learning: A longitudinal multilevel approach applied to math. *Learning and Individual Differences*, *20*(5), 446-451. https://doi.org/10.1016/j.lindif.2010.05.001

Purwanto, B., Jatmiko, A., Pahrudin, A., Munifah, M., wWardhani, S., Purnama, S., & Joemsittiprasert, w. (2020). The implementation of cooperative learning to developed management of language learning system. *Journal for the Education of Gifted Young Scientists*, *8*(1), 379-392. https://doi.org/10.17478/jegys.675251

Ridwan, M. R., & Samsul, H. A. D. İ. A meta-analysis study on the effectiveness of a cooperative learning model on vocational high school students' mathematics learning outcomes. *Participatory Educational Research*, *9*(4), 396-421. https://doi.org/10.17275/per.22.97.9.4

Sailer, M., Schultz-Pernice, F., & Fischer, F. (2021). Contextual facilitators for learning activities involving technology in higher education: The Cь-model. *Computers in Human Behavior*, *121*, 106794. https://doi.org/10.1016/j.chb.2021.106794

Smutny, P., & Schreiberova, P. (2020). Chatbots for learning: A review of educational chatbots for the Facebook Messenger. *Computers & Education*, *151*, 103862. https://doi.org/10.1016/j.compedu.2020.103862

Sovacool, B. K., Axsen, J., & Sorrell, S. (2018). Promoting novelty, rigor, and style in energy social science: Towards codes of practice for appropriate methods and research design. *Energy Research & Social Science*, *45*, 12-42. https://doi.org/10.1016/j.erss.2018.07.007

Spurk, D., Hirschi, A., Wang, M., Valero, D., & Kauffeld, S. (2020). Latent profile analysis: A review and "how to" guide of its application within vocational behavior research. *Journal of Vocational Behavior*, *120*, 103445. . https://doi.org/10.1016/j.jvb.2020.103445

Sung, Y. T., Lee, H. Y., Yang, J. M., & Chang, K. E. (2019). The quality of experimental designs in mobile learning research: A systemic review and self-improvement tool. *Educational Research Review*, *28*, 100279. https://doi.org/10.1016/j.edurev.2019.05.001

Supriadi, U., Supriyadi, T., Abdussalam, A., & Rahman, A. A. (2022). A decade of value education model: a bibliometric study of scopus database in 2011-2020. European Journal of Educational Research, 11(1), 557-571. https://doi.org/10.12973/eu-jer.11.1.557

Tong, D. H., Uyen, B. P., & Quoc, N. V. A. (2021). The improvement of 10th students' mathematical communication skills through learning ellipse topics. *Heliyon*, *7*(11), e08282. https://doi.org/10.1016/j.heliyon.2021.e08282

van Rijt, J. H., de Swart, P. J., Wijnands, A., & Coppen, P. A. J. (2019). When students tackle grammatical problems: Exploring linguistic reasoning with linguistic metaconcepts in L1 grammar education. *Linguistics and Education*, *52*, 78-88. https://doi.org/10.1016/j.linged.2019.06.004

Veldman, M. A., Doolaard, S., Bosker, R. J., & Snijders, T. A. B. (2020). Young children working together. Cooperative learning effects on group work of children in Grade 1 of primary education. *Learning and instruction*, *67*, 101308. https://doi.org/10.1016/j.learninstruc.2020.101308

Verity, R., Okell, L. C., Dorigatti, I., Winskill, P., Whittaker, C., Imai, N., & Ferguson, N. M. (2020). Estimates of the severity of coronavirus disease 2019: a model-based analysis. *The Lancet infectious diseases*, *20*(6), 669-677. https://doi.org/10.1016/S1473-3099(20)30243-7

Willgerodt, M. A., Walsh, E., & Maloy, C. (2021). A scoping review of the whole school, whole community, whole child model. *The Journal of School Nursing*, *37*(1), 61-68. https://doi.org/10.1177/1059840520974346

Yousefpour, A., Jahanshahi, H., & Bekiros, S. (2020). Optimal policies for control of the novel coronavirus disease (COVID-19) outbreak. *Chaos, Solitons & Fractals*, *136*, 109883. https://doi.org/10.1016/j.chaos.2020.109883