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GUIDED INQUIRY LEARNING MODEL: A STRATEGY TO IMPROVE JUNIOR HIGH SCHOOL STUDENTS' SCIENCE PROCESS SKILLS

MODEL PEMBELAJARAN INKUIRI TERBIMBING: STRATEGI MENINGKATKAN KETERAMPILAN PROSES SAINS SISWA SMP

Theresia Exanthi Boling [1*], An Nuril Maulida Fauziah [1]

[1]Natural Science Education Program, Faculty of Mathematics and Natural Sciences,
Universitas Negeri Surabaya,

Email Koresponden: theresiaexanthi.21027@mhs.unesa.ac.id

DOI: https://doi.org/10.62567/micjo.v2i2.728

Abstract

Science learning is very important in producing quality students, related to the nature of science. In the learning process, we must view science not only as a product such as facts, concepts, theories, or laws, but also as scientific skills and attitudes. Mastery of science process skills (KPS) is much more crucial than just memorizing, because KPS gives students the opportunity to discover and develop facts and concepts, while building attitudes and values through the experiences they experience. KPS is a basic competency that is the main driver in supporting the discovery, development and mastery of scientific concepts by students. This research aims to determine the effect of the guided inquiry model as a solution to improve students' science process skills at one of the state junior high schools in Surabaya. This research uses a pre-experimental type of research and a One Group Pretest – Posttest research design. The research results show that the guided inquiry learning model has a positive effect on improving junior high school students' science process skills with an n-gain of 0.55 which is in the medium category

Keywords : guided inquiry, science process skills

Abstrak

Pembelajaran IPA sangat penting dalam menghasilkan siswa yang berkualitas, terkait dengan hakikat IPA (sains). Dalam proses pembelajaran, kita harus memandang IPA tidak hanya sebagai produk seperti fakta, konsep, teori, atau hukum, tetapi juga sebagai keterampilan dan sikap ilmiah. Penguasaan keterampilan proses sains (KPS) jauh lebih krusial dibandingkan hanya menghafal, karena KPS memberi kesempatan bagi siswa untuk menemukan dan mengembangkan fakta serta konsep, sambil membangun sikap dan nilai melalui pengalaman yang mereka alami. KPS adalah kompetensi dasar yang menjadi penggerak utama dalam mendukung penemuan, pengembangan, dan penguasaan konsep sains oleh siswa. Penelitian ini bertujuan mengetahui pengaruh model inkuiri terbimbing sebagai solusi untuk meningkatkan keterampilan proses sains siswa di salah satu SMP Negeri di Surabaya. Penelitian ini menggunakan jenis penelitian *pre experimental* dan rancangan penelitian *One Group Pretest – Posttest.* Hasil penelitian menunjukkan bahwa model pembelajaran inkuiri terbimbing berpengaruh

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positif untuk meningkatkan keterampilan proses sains siswa SMP dengan *n-gain* sebesar 0,55 yang berkategori sedang.

Kata Kunci : inkuiri terbimbing, keterampilan proses sains

1. INTRODUCTION

Science is a discipline that teaches about the surrounding environment as an object of learning (Fahmi et al., 2021). Science learning has a crucial role, namely to produce quality students by encouraging them to have critical, creative, logistical thinking, and take the initiative when responding to issues that arise due to advances in science and technology (Marhento, 2020). Associated with the nature of science, science learning is not only seen as a product such as facts, concepts, theories, or laws, but also as scientific skills and attitudes (Suja, 2020).

Science learning is considered successful if students master scientific concepts and skills in carrying out scientific processes (Kemendikbudristek, 2022). Science Process Skills enable a person to utilize thoughts, logic, and actions effectively so as to achieve the desired results (Elvanisi et al., 2018). Science process skills include the skills and attitudes possessed by scientists in the process of discovery and development of science, (Ramlawati, Jirana, 2018), so it is mandatory for students to master them to face a world that has mastered science and technology (Jaya et al., 2022). Science process skills must be mastered by students because they are basic competencies that can boost mastery of science concepts (Duda et al., 2019).

However, in reality, students' science process skills are not as expected. This is supported by the results of a global assessment conducted by the Organization for Economic Co-operation and Development (OECD) in the field of science, only around 34% of students can identify the right explanation for scientific phenomena that they already know and use that knowledge to recognize (science proficiency level 2) and almost no students reach levels 5 and 6 in science, which include creativity and independence in applying scientific knowledge in various situations, including those that are not familiar (OCDE, 2024).

From the results of an interview with a teacher at a junior high school in Surabaya, it is known that in science learning, students are less accustomed to applying science process skills. Students never do practical work properly because the laboratory and equipment are inadequate. Teachers only carry out learning activities using textbooks so that students are only accustomed to learning basic science process skills, not integrated. Based on the results of the researcher's observations with students, it is known that students' science process skills appear confused and unfamiliar with these things in the indicators of skills in describing problems/formulating questions, making hypotheses, identifying variables, interpreting data, and concluding. This is supported by the practicum report when the researcher conducted an experiment on other materials which showed that identifying problems, making hypotheses, identifying variables, interpreting data, and concluding students were still low. These obstacles and problems make it difficult for students to practice their science process skills. Therefore, efforts are needed to create students who have good science process skills.

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Teachers need to make efforts and attempts to develop the science skills process, one of which is by presenting materials that can increase students' curiosity, where conditions are needed so that students are able to construct knowledge, skills processes, and scientific attitudes, one of which is through experimental activities (Nugroho & Suliyanah, 2018). Through experimental and observation activities, students can investigate and discover concepts and facts themselves through the science process skills (Shiha & Prabowo, 2014).

The learning model that supports the experiment or trial process is the guided inquiry learning model (Sanjaya, 2006; Wegasanti & Maulida, 2014). hrough its steps, namely orienting the problem, describing the problem, making hypotheses, collecting data, analyzing data, and formulating conclusions, the guided inquiry learning model is able to improve students' science process skills. The guided inquiry learning model aims to train students to have the skills to observe, find problems, formulate problems, hypothesize, and be able to solve problems through independent observation (Jaya et al., 2022; Nafrianti et al., 2016).

Based on the background description above, the author will apply the guided inquiry learning model to improve the science process skills of junior high school students on simple mechine material.

2. RESEARCH METHOD

This study uses a pre-experimental research type and uses a One Group Pretest - Posttest research design. The study was conducted by conducting tests on objects before being given treatment and tests on the same objects after being given treatment.

Table 1. Researh Design

Pretest	***Treatment***	***Posttest***
O_1	X	O_2

(Sukmadinata, 2011)

O_1 = initial results
O_2 = final results
X = learning with guided inquiry

This study used several instruments, including: learning implementation observation sheets, pre-test and post-test questions, and student response questionnaires. The implementation of learning using the guided inquiry learning model was analyzed from the learning implementation observation sheet. The scores for each aspect obtained from the number of meetings that had been conducted were then analyzed using a quantitative descriptive method. Analysis of the results of learning implementation is based on the Guttman scale, namely "Yes" and "No".

Table 2. Guttman Score Scale

Answer	**Score**
Yes	1

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No	0

(Riduwan, 2013)

Calculations for learning implementation in each aspect are analyzed using the following formula:

$$percentage\ (\%) = \frac{total\ score\ yes/no}{maximum\ score} \times 100\%$$

Table 3. Criteria for Assessment of Learning Achievement

Percentage (%)	Kategori
0-20	Very impractical
21-40	Impractical
41-60	Quite impractical
61-80	Practical
81-100	Very practical

Based on these criteria, the implementation of science learning using the guided inquiry learning model is said to be carried out well if the average learning implementation score is ≥61%.

The science process skills test contains questions that are oriented towards indicators of science skills including the ability to formulate problems, create hypotheses, identify problems, create hypotheses, identify variables, interpret data, and make conclusions. The questions have been validated by three validators, namely two Unesa Science Education undergraduate lecturers and one senior science teacher.

Table 4. Science Process Skills Question Indicators

Indicators	Question Code
Formulating questions	1 & 2
Formulating Hypotheses	3 & 4
Identifying and Controlling Variables	5 & 6
Interpreting Data	7 & 8
Conclude	9 & 10

The test was conducted twice, including a pretest conducted before learning and a posttest after the guided inquiry learning model was implemented on simple aircraft material. Each indicator will be assessed according to the assessment rubric. The value or score of students' science process skills can be measured using the formula:

$$Total\ Score = \frac{score\ obtained}{score\ maximum} \times 100$$

The pre-test and post-test value data were tested with a normality test which aims to determine whether the data is normally distributed or not. The normality test carried out was a test developed by Shapiro Wilk because the sample data amounted to >50 and would be calculated using the SPSS application. The sample is declared normally distributed if the sig.>0.05, then it is concluded that H0 is accepted and the data is normally distributed.

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However, if Sig.<0.05, then it is concluded that H0 is rejected and the data is not normally distributed.

If the data is normally distributed, then a paired t-test is performed. However, if it is not normally distributed, then a non-parametric test is performed, namely the Wilcoxon test. The paired t-test is used to test whether or not there is a difference between the average of two variables in one group. Data samples are obtained from pretest and posttest values. The paired t-test can be calculated using the SPSS application. With the criterion of rejecting H0 if t count> t table, then there is a difference between the pretest and posttest values.

The improvement of students' science process skills is measured by the pretest posttest score calculated using the n-gain formula, namely: The improvement of students' science process skills is measured by the pretest posttest score calculated using the n-gain formula, namely:

$$g = \frac{posttest\ score - pretest\ score}{maximal\ score - \ pretest\ score}$$

g = gain score

Table 5. Gain Score Criteria Indicator

Gain Score	Criteria
g>0,7	High
0,7≥g≥0,3	Medium
g≤0,3	Low

3. RESULTS AND DISCUSSION

Guided Inquiry Learning Implementation

Table 6. Learning Implementation Observation Sheet Results

Obser-ver	Class sessions	Score (Aspec code) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Final score	Percen-tage
A	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14	100%
B	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14	100%
C	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14	100%
A	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14	100%
B	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14	100%
C	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14	100%

The study was conducted in two meetings. The first meeting studied the sub-chapter of levers, while the second meeting studied the sub-chapter of inclined planes. Each meeting contains one learning cycle in accordance with the steps of guided inquiry learning. This means that in one meeting, preliminary activities, core activities including guided inquiry syntax, and closing are carried out.

It is known that the percentage of learning implementation from the three observers shows the implementation of learning in the first and second meetings. The preliminary phase

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obtained a percentage of 100% in the first and second meetings, which means it has been implemented well. The core phase consists of guided inquiry syntax, including problem identification, making hypotheses, collecting data, analyzing data, and drawing conclusions. The core phase obtained a percentage of 100% in the first and second meetings. This can be interpreted that learning has been implemented in accordance with the syntax of guided inquiry. The closing phase obtained a percentage of 100% in the first and second meetings, which means it has been implemented well. Overall, the average percentage of learning implementation in meetings 1 and 2 was 100%, so it can be concluded that the implementation of learning by implementing the guided inquiry learning model is included in the very good category.

The core learning activity begins with the problem identification stage. In the learning process, especially at the problem identification stage, the teacher as a facilitator actively provides questions, constructive feedback and organizes learning clearly (Hattie, 2008; Lailatul Inayah et al., 2024). Guiding questions given by the teacher help students to interpret the problem according to the problem formulation that the teacher means and expects (Daga, 2021). Providing clear and appropriate instructional questions and feedback has an impact on learning outcomes (Hattie, 2008). Students' enthusiastic responses to questions from the teacher show positive indications, where students are motivated to think logically and innovatively to answer questions asked by the teacher (Kau, 2017).

After the problem identification stage, it is continued with the problem formulation stage. Students formulate their own questions according to the problems they get from the problem identification stage. After that, the problem formulation that has been prepared by the students will be corrected by the teacher so that all groups have the same problem formulation.

The next stage is the hypothesis formulation stage. This stage provides an opportunity to formulate a hypothesis or temporary assumption from the problem formulation that has been prepared. The first and second meetings did not show any significant differences. Students only had more courage to express their opinions in the second meeting because they were more familiar with the activity of formulating hypotheses.

In the first meeting at the problem formulation and hypothesis stage, students tended to actively ask questions to the teacher. Based on the results of the interview, this happened because they felt confused about constructing their own sentences. They understand the context that they want to discuss, but find it difficult to translate it into a sentence. For example, at the stage of formulating the problem and hypothesis, students have difficulty formulating questions and statements. Meanwhile, at the second meeting, students no longer ask questions and discuss more with their group members. However, there are still some who ask questions just to confirm their answers. The change that occurs is that students are more confident in formulating their own answers (Lailatul Inayah et al., 2024). In addition, this opinion is also supported by Hattie, who says that students' skills will develop when students are given clear examples and instructions (Hattie, 2008).

Next, enter the data collection stage. This stage consists of several activities, including identifying variables and their operational definitions, identifying tools and materials used in

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the experiment, compiling work steps, and conducting experiments to test the hypothesis. In these activities, students actively discuss with their group members and find out through other sources such as the internet.

In the data collection and data analysis stages, students are required to find out for themselves, starting from identifying variables, choosing tools and materials, compiling work steps, conducting experiments, to creating their own data tables. In the beginning, students often make mistakes and do a lot of trial and error in the process. They try to understand the parts of a simple machine, such as the load arm, power arm, height, fulcrum, and so on. However, it is precisely from these challenges that they discuss more often with their group members and become more aware of the concept of simple machines.

The last stage is the concluding stage. The teacher directs students to provide conclusions from the experimental activities that have been carried out. The teacher appoints representatives from two groups to present the results of their experiments in front of the class. The teacher gives appreciation and feedback on the results of the students' experiments. The teacher also provides reinforcement of the material and reflection on learning. Finally, the teacher closed the lesson with prayer and greetings.

The learning process that has been described is closely related to Piaget and Vygotsky's constructivism theory, as well as Bruner's cognitive theory. Piaget argued that learning is an active process in which students construct their own understanding gradually and regularly (Saksono et al., 2023). At the first meeting, students found it difficult to construct sentences because they were still in the assimilation stage, where they tried to connect new information with the knowledge they already had. However, after going through discussions and direct experiences at the next meeting, they began to be more confident in constructing their own answers. This shows that they have experienced accommodation, which is the process of adjusting their thinking schemes in order to understand new concepts. During the data collection process, students who initially often tried to understand the concept of simple machines were finally able to connect their experiences with the theories they had learned. This reflects the equilibration process, which is students' efforts to achieve a balance between old knowledge and new information through exploration and interaction (Lailatul Inayah et al., 2024).

Science Process Skills

To train KPS, it is necessary to actively involve students in the learning process (Wegasanti & Maulida, 2017). In the research, through a series of steps in the guided inquiry learning model consisting of problem identification and problem classification, making hypotheses, collecting data, analyzing data, and drawing conclusions, students are required to actively carry out learning activities, so that students are able to solve problems and determine choices. (Jaya et al., 2022). That is what makes learning with a guided inquiry model more impactful in improving science process skills (Pujiningrum & Admoko, 2017).

Table 7. Normality Test Results

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Test	***Shapiro-Wilk***	
	df	***Sig.***
Pretest	24	<0,001
Posttest	24	0,361

The pretest significance value is >0.05 so it is known that the pretest data is not normally distributed. While the posttest significance value is greater than 0.05 so it is known that the data is normally distributed. It can be concluded that H0 is rejected and Ha is accepted.

Data that is not normally distributed does not meet the requirements for the paired t-test (parametric test). Therefore, a non-parametric test is needed to test the hypothesis, namely the Wilcoxon test.

Table 8. Wilcoxon Signed Ranks Test Results

		N	***Mean Rank***	***Sum of Ranks***
Posttest - pretest	*Negative Ranks*	0[a]	0,00	0,00
	Positive Ranks	24[b]	12,50	300,00
	Ties	0[c]		
	Total	24		

a. *Post Test < Pre Test*
b. *Post Test > Pre Test*
c. *Post Test = Pre Test*

The results of the data analysis show that learning with a guided inquiry model is related to and has a positive impact on increasing KPS. This is seen from the results of the Wilcoxon test, where the pretest and posttest scores of students in this study obtained positive ranks, which means that the scores increased.

Table 9. Wilcoxon Signed Ranks Statistic Test Results

Test	**Uji Wilcoxon**
	Post Test – Pre Test
Asymp. Sig. (2-*tailed*)	< 0,001

Based on the test results shown in table 4.3, the Asymp. Sig. (2-tailed) score is <0.001 (<0.05). The result is less than 0.05 so it can be seen that there is a difference in the average pretest and posttest scores obtained by students. So it can be concluded that H0 is rejected and Ha is accepted.

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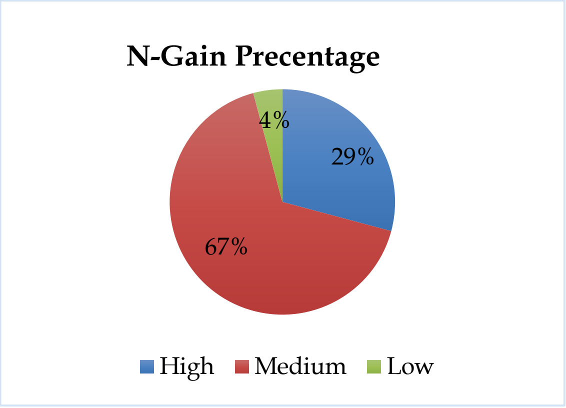
Table 10. N-Gain Test Results

Student Number	Pretest score	Posttest score	n gain	Category
1	8	36	0,30	Medium
2	8	90	0,89	High
3	6	75	0,73	High
5	6	80	0,79	High
6	8	57	0,53	Medium
7	6	66	0,64	Medium
8	4	6	0,27	Low
9	6	39	0,60	Medium
12	6	12	0,36	Medium
13	11	28	0,33	Medium
15	8	87	0,86	High
14	6	82	0,81	High
16	6	28	0,44	Medium
18	8	33	0,58	Medium
19	10	60	0,56	Medium
21	6	44	0,40	Medium
22	10	49	0,43	Medium
23	40	62	0,70	Medium
28	6	72	0,70	Medium
29	28	62	0,54	Medium
25	8	39	0,34	Medium
31	4	42	0,40	Medium
33	12	64	0,59	Medium
34	6	23	0,47	Medium



Picture 1. N-Gain Criteria Percentage Diagram

The aim of implementing guided inquiry is that students are expected to increase their interest in learning so that learning objectives, in this case students' science process skills, can be achieved (Putri, 2016). Student involvement, persistence, and hard work demonstrate students' interest in learning (Metaputri & Garminah, 2016). In the learning process, student activity influences the experience gained by students (Andalangi et al., 2022).

Based on the results of student observations, it is known that the majority of students with high to medium N-Gain categories dominate group discussions, often ask questions to the teacher, and actively explore learning materials independently. On the other hand, students with low N-Gain are passive in group discussions, rarely ask questions to the teacher, show a lazy attitude and are busy with themselves.

In addition, some students only attended one meeting out of two meetings scheduledby the researcher, so that the skills taught were not fully understood by the students. The frequency of learning affects students' mastery of the material taught (Andalangi et al., 2022). Semakin sering belajar, maka penguasaan siswa terhadap materi semakin baik. The more often students study, the better their mastery of the material.

Table 11. N-Gain Average Score of Each Science Process Skills Indicator

Qestions Code	**Science Process Skills Indicator**	**Score Average**		**N-gain**	**Category**
		Pretest	***Posttest***		
1 & 2	Formulating questions	2,08	8,47	0,81	Tinggi
3 & 4	Formulating Hypotheses	0,88	6,00	0,56	Sedang
5 & 6	Identifying and Controlling Variables	0,62	7,04	0,68	Sedang
7 & 8	Interpreting Data	0,77	4,91	0,46	Sedang
9 & 10	Conclude	1,21	6,54	0,60	Sedang

Problem-formulating skills are skills to develop a question to test a problem in an experimental activity. Problem formulation has a dense sentence structure and does not have biased or multiple meanings. Based on the pretest results, the problem-formulating indicator obtained an average score of 2.08 out of a maximum score of 10. This shows that students do not understand how to formulate the correct problem. After the guided inquiry learning model was applied, the overall problem-formulating indicator obtained an N-Gain of 0.81 with high criteria. This skill is trained to students through student activeness in asking questions, so that students are expected to be able to practice the skill of making scientific questions when asking questions (Sudibyo et al., 2018).

A hypothesis is a temporary answer or guess from a problem formulation that has been prepared to test an explanation. The average result of the student pretest on the indicator of formulating a hypothesis showed a score of 0.88 from a maximum score of 10. The low score was caused by students who were not used to formulating hypotheses, so they were not yet able to formulate good and correct hypotheses. After students carried out learning with the guided inquiry learning model, their scores increased. This is evidenced by the results of the N-Gain test of 0.56 with moderate criteria.

Variables are factors that may influence research. Variables that are deliberately changed in research are called manipulation variables. While the variables whose conditions are kept the same are control variables. Variables that contain factors that are observed as a

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result of the manipulation variables are response variables. Initially, students were not able to identify research variables properly and correctly. This is because students have never identified variables before. It is known that after implementing the guided inquiry learning model, there was an increase in students' variable identification skills. This is evidenced by the N-Gain test which obtained a score of 0.68. Based on the N-gain analysis, the score is included in the moderate category.

Data interpretation skills are skills to record experimental results and connect observation results. It is known that the average pretest score of students is 0.77 out of 10. This shows that students have not been able to interpret data in an experiment. The application of the guided inquiry learning model has been proven to be able to improve data interpretation skills in students. Proven by the results of the N-Gain test of 0.46 which is categorized as moderate. Conclusion skills are the ability to draw conclusions or make decisions based on data, information, or findings that have been analyzed. Before the guided inquiry learning model was applied, the average student score was 1.21 out of 10. After the guided inquiry learning model was applied, the score increased by 0.60 which can be categorized as moderate.

Compared to other indicators, the indicator for interpreting data has the lowest increase. The indicator interpreting data obtained the lowest N-Gain score among other indicators. This is because the indicators formulating problems, formulating hypotheses, identifying variables, and concluding are related, so that students find it easier to understand and connect these indicators. For example, the formulation of problems that can be researched is always related to the relationship between two or more variables that can be defined and measured. A hypothesis is formulated to explain the relationship between these variables (Saissi, 2024). Conclusions are prepared based on experimental results to answer whether the hypothesis that has been formulated is proven or not. Data interpretation skills require initial understanding so that students can process data and relate concepts to existing data (Sudibyo et al., 2018). Meanwhile, in guided inquiry learning, students are required to actively explore and construct their own understanding.

Not only that, it is known that the increase in students' hypothesis-making skills is lower than their problem-formulating skills, even though the increase should not be much different. Formulating a hypothesis requires the ability to integrate the theory that students know with the formulation of the problem that has been formulated. The problem is, not all students take part in formulating hypotheses in groups. There are groups that divide tasks, there are also children who are passive so that active students dominate. So, even though in the LKPD students have been able to formulate hypotheses, when tested individually, students are confused in determining the correct hypothesis.

In the learning process, the teacher has provided guidance and direction. However, there are still students who do not understand. It should be noted that each student has different abilities in absorbing learning. This difference includes how students receive, capture, and process information given by the teacher (Chantika et al., 2024). There are students who are able to learn quickly, while others need time to understand, which affects their science process skills.

4. CONCLUSION

Based on the results of the analysis of the application of the guided inquiry learning model to improve the science process skills of junior high school students on simple mechine, it can be concluded that the use of the guided inquiry model in learning additive material shows a 100% success rate with a very good assessment at both meetings. After the implementation of this learning model, students' science process skills increased by 0.55, which is included in the medium category.

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