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Application Of Interactive Demonstration Learning Model To Improve Understanding Of Simple Aircraft Material Concepts In Grade VIII Students Of SMPN 34 Pekanbaru

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Abstract- This study aims to analyze the effectiveness of the Interactive Demonstration learning model in improving students' understanding of concepts in simple aircraft materials and to examine the significant differences between classes that applied this model and those using conventional methods. The research was motivated by the fact that students' understanding of science concepts, particularly on simple aircraft, remains relatively low. One of the causes is the dominance of teacher-centered instruction, with limited opportunities for students to engage in hands-on activities or active learning. The Interactive Demonstration model was selected as an alternative because it emphasizes student involvement, encourages inquiry, and connects abstract concepts to real experiences through experimental demonstrations. The method employed was a quasi-experimental design with a posttest-only control group. The sample consisted of two Grade VIII classes at SMPN 34 Pekanbaru during the even semester of the 2024/2025 academic year, chosen randomly. Data collection focused on students' conceptual understanding, assessed through posttest results, and analyzed both descriptively and inferentially using the Mann-Whitney U test. The findings revealed that the experimental class, which was taught using the Interactive Demonstration model, achieved a higher mean score (79.16) compared to the control class (58.78). Furthermore, the analysis per indicator demonstrated that the experimental group consistently outperformed the control group across all aspects of conceptual understanding, including interpreting, exemplifying, classifying, and applying. The Mann-Whitney U test showed Asymp. Sig. = 0.000 (<0.05), indicating a statistically significant difference between the two groups. Therefore, it can be concluded that the Interactive Demonstration model is effective in enhancing students' understanding of simple aircraft concepts. The study recommends that science teachers adopt Interactive Demonstration as a viable learning model to foster active participation, deepen students' conceptual grasp, and promote meaningful learning experiences in science classrooms.

Keywords: *Interactive Demonstration, Concept Understanding, Simple Plane, Quasi Experiment.*

1 Introduction

Natural Science Education (IPA) plays a crucial role in shaping a generation that is able to adapt to technological advances and face the challenges of the times. In the era of globalization and the industrial revolution 4.0, a strong understanding of science concepts is essential to encourage innovation, critical thinking, and problem-solving skills in daily life (Muharam et al., 2023). Science does not only involve mastering scientific facts, concepts, and principles, but is also a systematic discovery process that requires the ability to reason, observe, and have a deep understanding of natural phenomena (Fatmawati, 2024). Thus, effective science learning must be able to develop not only the cognitive aspects, but also the affective and psychomotor aspects of learners, preparing them to become adaptive and contributory individuals (Irawan, 2023).

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However, the reality in the field often shows that there is a gap between ideal expectations and actual conditions in science learning. Initial observations at SMPN 34 Pekanbaru indicate that the understanding of science concepts, especially in simple aircraft materials, is still a significant obstacle for students. This condition is reflected in the learning outcomes that have not been maximized and the inability of students to apply basic science concepts. This problem is often rooted in learning methods that tend to be conventional and teacher-centered, where learning activities are dominated by one-way information transfer (Ayu Sri Wahyuni, 2022). The lack of variety in learning strategies results in a lack of student activity and enthusiasm, triggering the perception that science is a difficult and boring subject (Hernawati, 2021). As a result, students have difficulty in constructing concepts independently, which is the essence of meaningful science learning. They lean more towards memorization than deep understanding, so the concepts learned are easily forgotten or cannot be applied in different contexts (Ninla Elmawati Falabiba et al., 2021).

In overcoming this complex problem, innovation and paradigm shifts are needed in learning models that are able to create a more interesting, interactive, and meaningful learning atmosphere (Fajria et al., 2025). One of the learning models that is considered to have great potential in improving concept understanding is *Interactive Demonstration*. This model offers a different approach, namely by involving learners directly in problem-solving activities through demonstrations (Line, 2022). In its implementation, students are not only passive observers, but are invited to actively participate in the prediction stage (*predict*), observasi (*observe*), discussion (*Discuss*), and generalizations (*generalize*). This approach is in line with constructivist learning theory which emphasizes that knowledge is actively constructed by individuals through interaction with the environment and real experiences (Sejati et al., 2021). Through *Interactive Demonstration*, abstract concepts can be visualized, tested, and discussed concretely, bridging theoretical understanding with real-world phenomena (M & Sarkity, 2023). This encourages students to think critically, analyze, and ultimately, understand concepts as a whole and be able to relate them to applications in daily life, which is very important in science learning(Sarianti et al., 2023).

Based on the description above, this study aims to apply the *Interactive Demonstration* learning model to improve students' understanding of concepts in simple aircraft materials. The main problem to be investigated is the extent to which this model can improve concept understanding and whether there is a significant difference in concept understanding between students who learn using *Interactive Demonstration* compared to conventional learning that is still dominant.

2 Research Methodology

The research design used in this study is quantitative research. This study applies the *Quasi Experiment* method, where the implementation uses two classes, namely the experimental class (the class that gets treatment) and the control class (the class that does not get treatment). The design used in this study is *a posttest-only control group design*, which is a study with dependent variable measurement (*posttest*) only carried out once at the end of treatment for both groups, so that the observed differences can be attributed to the effects of the treatment given (Irfan et al., 2023:29. The research design can be seen in table 1.

Table 1. *Posttest-only control group design*

Class	Treatment	*Posttest*
Experimental Classes	X	O1
Control Class	-	O2

(Source: Harahap et al., 2021)

The population in this study is grade VIII students at SMPN 34 Pekanbaru for the 2024/2025 Academic Year which totals 7 classes of 259 students. The sampling technique in this study was carried out randomly from the population using *random sampling techniques*. The determination of the sample was carried out through a normality test and also a homogeneity test in the population using SPSS 26 based on the student's PTS score. The sample selected in this study was class VIII.1 as the experimental class and class VIII.2 as the control class, with a total of 71 students from both classes.

The data collection technique in this study was carried out by test. The test in this study is *Posttest*. The instrument used in this study is a concept understanding test in the form of multiple-choice questions with four answer options on simple aircraft material. This test is prepared based on the indicators of understanding the concept of science, namely translation, interpretation and extrapolation. This test consists of 15 question items from 3 indicators measured. In detail, the question numbers and the measured indicators are presented in Table 2.

Table 2. Concept Understanding Indicators

No	Indicator	Question Number
1	Translasi	1, 2, 3, 12, 15
2	Interpretasi	4, 5, 8, 11, 13
3	Extrapolation	6, 7, 9, 10, 14

The data analysis technique in this study will be carried out through two types, namely descriptive analysis and inferential analysis. The descriptive analysis aims to provide a detailed and comprehensive picture of the research results, especially the level of conceptual understanding of students from both groups (experiment and control). Descriptive analysis includes basic statistical calculations such as mean, variation, percentage, and standard deviation. In addition, visual representations such as bar charts will also be used to facilitate data interpretation. The value of students' understanding of concepts will be calculated using the following equations:

$$Nilai = \frac{jumlah\ soal\ benar}{jumlah\ seluruh\ soal}\ x\ 100 \quad (1)$$

After getting the score of the concept understanding results, to find out the level of understanding of the concept, students are grouped into five criteria. The criteria for understanding the concept of students can be seen in Table 3.

Table 3. Concept comprehension category

Value Interval	Category
$80< X \leq 100$	Very High
$60< X \leq 80$	Tall
$40< X \leq 60$	Enough
$20< X \leq 40$	Low
$0\leq X \leq 20$	Very Low

(Source : Rahmah, 2023)

Inferential analysis is a more in-depth stage, where the data obtained from the sample will be used to draw conclusions and make generalizations about the larger population (Sugiyono, 2021). Before conducting a hypothesis test, *the concept understanding posttest data* will go through a series of assumption tests. First, a normality test using the Kolmogorov-Smirnov test will be performed to determine whether the distribution of data from both groups follows the normal distribution or not. The criterion used is that if the significance value (Sig. or p-value) of this test is greater than 0.05, then the data is considered to be normally distributed. Second, the variance homogeneity test using the Levene test will be carried out to check whether the variance of the two groups is the same or homogeneous. The criterion used is that if the significance value (Sig. or p-value) is greater than 0.05, then the variance is considered homogeneous. Based on the results of the normality test that showed that the data was not normally distributed, a hypothesis test to compare the understanding of concepts of the two groups would be carried out using the Mann-Whitney U non-parametric statistical test.

3 Results and Discussion

The data from the test results of understanding the concept of simple aircraft in grade VIII students at SMPN 34 Pekanbaru are presented with two types of analysis, namely descriptive analysis and inferential analysis. Descriptively, the value of students' concept understanding was obtained in the experimental class of 79.16, which is included in the category of High concept understanding. Meanwhile, the control class obtained an average score of 58.78, which is classified as Sufficient concept understanding. The difference in the scores of the two shows that the students' understanding of concepts in the experimental class is higher than in the control class. The results of the descriptive analysis of students' concept understanding can be seen more clearly in Table 4 which shows the average of student test scores.

Table 4. The results of the analysis of the value of students' concept understanding

Value Interval	Category	Class (%)	
		Eksperimen	Control
80< X ≤100	Very High	62.5	3.125
60< X ≤80	Tall	37.5	43.75
40< X ≤60	Enough	0	53.12
20< X ≤40	Low	0	0
0≤ X ≤20	Very Low	0	0
Average		79,16	58,78

Based on Table 4 it is shown that the experimental class obtained a higher average concept comprehension score compared to the control group. The experimental group obtained an average score by 78.31, while the control group only reached war-war 57.12. This shows that the application of the learning model *Interactive Demonstration* effective in improving students' understanding of concepts in simple aircraft materials. These findings are in line with the results of several previous studies on those relevant to this study. In the study (Saputri & Suyudi 2020) stated that students' understanding of the concepts of rotational dynamics and rigid object equilibrium has improved after learning *interactive demonstration* with a style chart through real. Then the research (Yusal et al. 2021) revealed that the application of the interactive demonstration model in physics learning can instill a good understanding of the material in the minds of students and the application of the interactive demonstration model can stimulate students in their further intellectual development. And in the study (Susiana et al. 2021) concludes that the model *Interactive Demonstration* can help students in improving problem-solving skills, especially in Newton's legal material in class X students of SMAN 1 Singosari.

Based on the concept understanding indicator, this ability includes 3 aspects of achievement, namely translation, interpretation, and extrapolation. The comparison of concept comprehension skills between students in the experimental class and the control class based on indicators can be seen more clearly in Figure 1 of the graph of student concept understanding based on indicators.

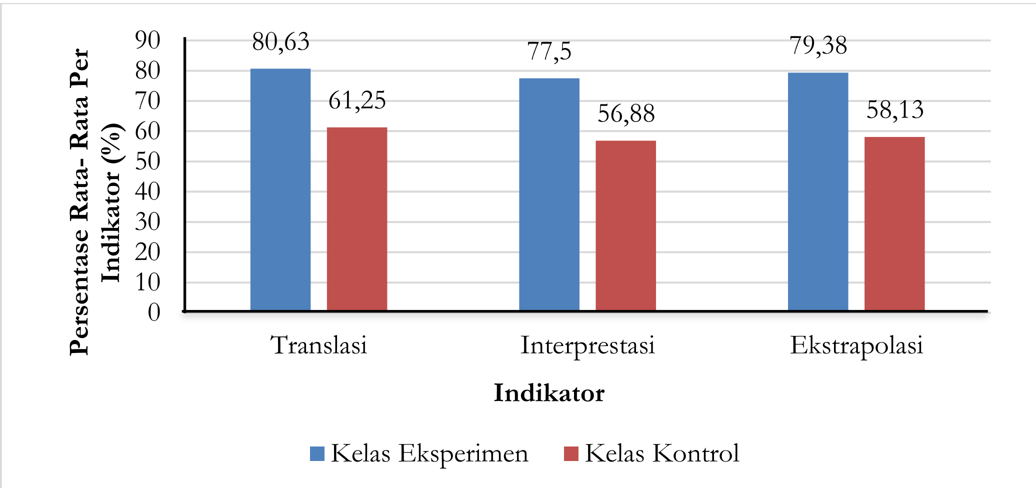

Figure 1. Graph of students' concept understanding

Based on Figure 1, the measurement of students' concept understanding is divided into three indicators. Translation is defined as the ability to transform a particular symbol into another without changing its meaning. This ability also reflects students' efforts in translating the information obtained through learning to then be communicated again. In the concept understanding instrument in this study, there are 15 question items, where students' translation ability is measured through questions number 1, 2, 3, 12, and 15 related to simple aircraft material. Based on the results obtained, the experimental class obtained an average score of 80.63% which was included in the Very High category, while the control class obtained an average score of 61.25% which was included in the High category.

This shows that the experimental class obtained a higher average score than the control class. Interactive demonstration learning can improve translational indicators Learners in the understanding of physics concepts, and the results of the study show that after learning with interactive demonstrations, the translation aspect has improved(Wartono et al., 2022). Research (Kurniawati & Nita 2018) Translational indicators can be done to improve students' understanding of concepts through activities with direct interaction in learning *interactive demonstration*. This shows that the experimental class obtained a higher average score than the control class. Thus, it can be concluded that learning applies the *interactive demonstration* make a positive contribution to improving translation skills Learners.

Interpretation in concept understanding is the ability to understand and interpret ideas, information, or materials that have been received, then arrange them in different forms so that the meaning is clearer and deeper. In the concept understanding instrument in this study, students' interpretation ability was measured through questions number 6, 7, 9, 10, and 14. Based on the results obtained, the experimental class obtained an average score of 77.50% which was included in the High category, while the control class obtained an average score of 56.88% which was included in the Sufficient category.

This shows that the experimental class that applies learning *interactive demonstration* have better interpretability compared to control classes that do not implement it. Learning *interactive demonstration* can help students master interpretation and problem-solving skills, while improving the ability to explain concepts in more depth (Harizah et al., 2019). In the study (Yulisa et al. 2020) also states that the *interactive demonstration* Assisted learning videos improve students' understanding of concepts on indicators interpretasi. Thus, it can be concluded that learning applies the *interactive demonstration* make a great contribution to improving students' interpretive skills.

Extrapolation is the ability of students to predict or provide an overview based on data and produce estimates among known observations. In the concept understanding instrument in this study, students' extrapolation ability was measured through questions number 4, 5, 8, 11, and 13. Based on the results obtained, the experimental class obtained an average score of 79.38% which was included in the High category, while the control class obtained an average score of 58.13% which was included in the Sufficient category. It can be seen that the experimental class obtained a higher average score compared to the control class. Learning *Interactive Demonstration* able to internalize abstract concepts better, so that students' extrapolation of the material becomes more in-depth and accurate (Suryaningsih et al., 2021). This is in line with research (Zulfa et al. 2016) that the indicator of extrapolation of students' concept understanding increases when applying the learning model *interactive demonstration*. Thus, it can be concluded that learning applies the *interactive demonstration* contribute to improving students' extrapolation skills.

Learning application *interactive demonstration* proven to improve students' understanding of concepts because this model combines hands-on demonstration activities with active interaction between teachers and Learners, as well as the use of simple experimental tools that facilitate Learners in understanding the material concretely. In the study (Saputri & Suyudi 2020) also states that in this learning process, Learners not only observing, but also making predictions and discussing, so as to create an interactive and challenging learning atmosphere that can foster interest and deep understanding of the concepts taught.

Inferential data analysis in this study was conducted with the Mann-Whitney U Test is a non-parametric statistical test used to compare whether there is a significant difference between the two groups. The results of the Mann Whitney U test can be seen in Table 5.

Table 5. Mann Whitney U Test Results

Test Statistics[a]	
	Concept Understanding
Mann-Whitney U	70.000
Wilcoxon W	598.000
Z	-6.005
Asymp. Sig. (2-tailed)	.000
a. Grouping Variables: Control and Experiment	

Based on the results of the Mann-Whitney U test, an Asymp value was obtained. Sig is 0.000 with the provision that if the value of $p < 0.05$ then Ho is rejected and Ha is accepted, and if the value of $p > 0.05$ then Ho is accepted and Ha is rejected. Based on the results of the Mann Whitney U test results from Asymp. Sig is 0.000 < 0.05. So Ho was rejected and Ha was accepted. Through this provision, based on the results of Mann-Whitney U Ho was rejected and Ha was accepted, which means that it can be concluded that "There is a significant difference in students' understanding of concepts between classes that apply *the Interactive Demonstration* learning model and classes that do not apply *the Interactive Demonstration* learning model to simple aircraft materials".

This finding states that the interactive demonstration learning model can improve students' understanding of concepts on simple aircraft materials, as seen from the classes that apply the interactive demonstration learning model get a higher average than classes that do not apply. In line with research (Suryaningsih et al., 2018) with the interactive demonstration model, Learners are better able to do these three indicators because this learning involves direct experience and active reflection, so that concepts are not only memorized but also understood deeply and applicatively in various contexts. This explains why the application of learning *interactive demonstration* effective in improving understanding of concepts Learners in simple aircraft material.

4 Conclusion

Based on the descriptive analysis and inferential analysis of the data that has been carried out, it can be concluded that:

1. Descriptively, *the interactive demonstration* learning model can improve students' understanding of concepts in simple airplane materials at SMP N 34 Pekanbaru.
2. Based on the results of the inferential test in the form of a hypothesis test, it was stated that "There is a significant difference in students' understanding of concepts between classes that apply *the Interactive Demonstration* learning model and classes that do not apply *the Interactive Demonstration* learning model to simple aircraft materials."

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