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THE EFFECT OF USING GROUP INVESTIGATION MODEL ON STUDENT LEARNING OUTCOMES IN STATIC FLUID MATERIAL AT SMA NEGERI 6 NORTH GORONTALO

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Abstract: This study aims to test the effect of using *the Group Investigation learning model* on student learning outcomes in static fluid material at SMA Negeri 6 Gorontalo Utara. This study uses a quasi-experimental method with a *nonequivalent control group design* . The sampling technique used is *total sampling* , with a population of all students of class XI IPA SMA Negeri 6 Gorontalo Utara in the 2023/2024 academic year consisting of three classes. The research sample includes class XI IPA 1 as the experimental class, class XI IPA 2 as the replication class, and class XI IPA 3 as the control class. Data collection was carried out through tests, which were then analyzed using the N-gain test, effect size, and hypothesis testing. Based on the analysis, the N-gain of the experimental and replication classes is in the high category, while the control class is in the medium category. In the experimental class, the t-count value of 7.379 is higher than the t table of 1.706; in the replication class, the t value was 6.183 and in the control class, the t value was 2.952, all of which exceeded the t table value. These results indicate that *the Group Investigation model* has a positive effect on student learning outcomes. Thus, H1 is rejected and H0 is accepted, indicating that the model is significant in improving student learning outcomes.

Keywords: Group Investigation, Learning Outcomes, Static Fluids

Abstrak: *Penelitian ini bertujuan untuk menguji pengaruh penggunaan model pembelajaran Group Investigation terhadap hasil belajar siswa pada materi fluida statis di SMA Negeri 6 Gorontalo Utara. Penelitian ini menggunakan metode quasi eksperimen dengan desain nonequivalent control group design. Teknik pengambilan sampel yang digunakan adalah total sampling, dengan populasi seluruh siswa kelas XI IPA SMA Negeri 6 Gorontalo Utara tahun ajaran 2023/2024 yang terdiri dari tiga kelas. Sampel penelitian meliputi kelas XI IPA 1 sebagai kelas eksperimen, kelas XI IPA 2 sebagai kelas replikasi, dan kelas XI IPA 3 sebagai kelas kontrol. Pengumpulan data dilakukan melalui tes, yang selanjutnya dianalisis menggunakan uji N-gain, effect size, dan uji hipotesis. Berdasarkan analisis, N-gain kelas eksperimen dan replikasi berada pada kategori tinggi, sedangkan kelas kontrol berada pada kategori sedang. Pada kelas eksperimen, nilai t hitung sebesar 7,379 lebih tinggi dari t tabel sebesar 1,706; Pada kelas replikasi, nilai t sebesar 6,183 dan pada kelas kontrol, nilai t sebesar 2,952, semuanya melebihi nilai t tabel. Hasil ini menunjukkan bahwa model Group Investigation berpengaruh positif terhadap hasil belajar siswa. Dengan demikian, H_1 ditolak dan H_0 diterima, yang menunjukkan bahwa model tersebut signifikan dalam meningkatkan hasil belajar siswa.*

Kata Kunci: *Group Investigation, Haisl Belajar, Fluida Statis*

INTRODUCTION

Physics learning is one of the subjects that is less popular with students. Over time, physics education has experienced various challenges, especially in terms of students' understanding of physics concepts (Jelita et al., 2022) . As a result, physics is considered a very difficult subject, causing a lack of student motivation and fostering laziness, which has a negative impact on their

learning outcomes (Agustin et al., 2017) . One of the complicated topics in physics is static fluid. Static fluid refers to the behavior of fluids that are still, without experiencing changes in motion or deformation (Tukimun et al., 2023) . This material is often considered difficult for students to understand because it requires an understanding of concepts, applications in everyday life, and is often not delivered directly and contextually (Novianto et al., 2018) . Static fluid is also known as hydrostatics, which is a part of fluid mechanics that studies fluids at rest (Irfan & Supriyatna, 2024) . The main focus in static fluid material is on pressure. Fluids themselves are substances that can flow, such as water, oil, and gas. To understand static fluids, students need to have a deep understanding of the basic concepts of physics and the ability to apply them in real situations. Many students have difficulty understanding and mastering these concepts. To overcome this, it is important to apply an efficient and effective learning model. Teachers should not only function as lecturers who provide knowledge, but also as facilitators and mediators who help students acquire knowledge (Semaranatha et al., 2016) .

Based on the results of observations conducted, it shows that physics is still a difficult subject for many students. The results of observations by researchers at SMA Negeri 6 North Gorontalo show that students have difficulty in learning and understanding physics concepts because of the many formulas, thus reducing their interest in the subject. When working on physics problems given by teachers, students often use mathematical equations without proper analysis, guess the formulas needed, and memorize examples of problems to solve new problems. This approach can result in low learning achievement.

Conventional teacher-centered learning models often fail to meet students' learning needs in understanding complex physics concepts. This can result in low learning outcomes and lack of student interest in physics subjects (Purwanto et al., 2016) . Therefore, a more innovative and student-centered learning approach is needed to improve their understanding and learning outcomes. One of the learning models that has the potential to overcome these problems is the group investigation model. This model is part of cooperative learning that emphasizes student participation and activities to find information about the material to be studied through available learning resources (Slavin, 2015) . Group investigations allow students to be actively involved in the learning process, develop critical thinking skills, and improve problem-solving abilities (Arinda et al., 2019).

The Group Investigation learning model is an approach that emphasizes student collaboration in small groups to investigate a topic or problem in depth. In the context of education, especially in Static Fluid material in high school, the application of this model aims to improve student learning outcomes. The results of the study show that this method can improve student engagement, critical thinking skills, and overall learning outcomes. For example, research by Eryuliana et al., (2019) shows that the use of the Group Investigation model has a positive effect on student learning outcomes in history subjects, this shows that this model can also be applied to other fields of study such as physics.

One of the advantages of the Group Investigation model is its ability to encourage students to be active in the learning process. Students not only receive information from the teacher, but are also involved in finding and analyzing information independently. This is in line with the theory of constructivism which states that knowledge is built through experience and social interaction. In the context of Static Fluids, students can conduct experiments or simulations related to physics concepts, so they can better understand the material and apply it. (Widiawati et al., 2018).

Based on the description above, the researcher intends to test the effect of using the Group Investigation learning model on student learning outcomes on the subject of static fluids at SMA Negeri 6 North Gorontalo. The purpose of this study was to evaluate the effect of using the Group Investigation learning model on student learning outcomes of class XI IPA SMA Negeri 6 North Gorontalo on the subject of static fluids.

METHOD

This research design is a quantitative research with an experimental approach. Quantitative methods are scientific methods because they contain and fulfill scientific, concrete or empirical, objective, measurable, rational, and systematic principles (Szyjka, 2012 in Rahmatin et al., 2024). This study uses a quasi-experimental research type, which is a development of true experimental design. This type of research involves a control group, but has not been fully able to control external variables that can affect the implementation of the experiment (McMillan, 2012).

The type of quasi-experimental or pseudo-experimental research has its own characteristics, namely in the selection of research subjects (Setyosari, 2020) . This study uses a nonequivalent control group design quasi-experimental design. This design is almost the same as the pretest-posttest control group design, but the experimental and control groups are not selected randomly (Liamputtong, 2019).

This study used 3 classes as samples, 1 experimental class and 1 replication class will receive treatment using the group investigation model, while the control class will use a direct learning model with the lecture method. The sample in this study was determined by the total sampling technique , where class XI IPA 1 as the experimental class with 27 students, class XI IPA 2 as the replication class with 26 students and class XI IPA 3 as the control class with 26 students. Total sampling is used if the number of samples is less than 100. In this study, this technique is used because it is in accordance with the type of research conducted, and considers the material, research schedule, and variables to be measured.

This study uses a test as the main instrument. Specifically, the learning outcome test used is an objective type, which is adjusted to the indicators of achievement of static fluid material. Both the initial test and the final test each consist of 10 questions. Data collection was carried out by administering the test before and after treatment. The analysis of the research data begins with a descriptive statistical analysis which aims to provide an overview of the data being analyzed. Furthermore, the N-Gain test is used to determine the effectiveness of a measured variable, the effect size is used to determine the magnitude of the influence or difference between the treated group (experimental group) and the untreated group (control group). Finally, the t-independent test is used to determine whether the difference in effectiveness is significant or not (Setyosari, 2020).

RESULT AND DISCUSSION

Results

The research data were collected after the treatment was given. Furthermore, the researcher used various theoretical statistical methods for data analysis to draw conclusions that support the research hypothesis. The next section will describe the learning outcomes, present the data results including the N-Gain test, effect sizes, and hypothesis testing.

Based on the statistical analysis used in data processing, it is important to determine the magnitude of the central tendency and the level of dispersion, especially the average value for each sample group. The results of the calculations for the average, standard deviation, and variance are presented in Table 1.

Table 1. *Calculation Results*

Class	Average	Standard Deviation	Variant t
Experimen	81.15	Date 7.11	50.62
Replication	81.11	9.34	87.18
Control	79.62	16.61	275.85

Table 1 shows the results of the calculation of the mean, standard deviation, and variance of t for the three groups in the study, namely the experimental class, the replication class, and the control class. From the data, it can be seen that the average posttest result for the experimental class was 81.15 with a standard deviation of 7.11, while the replication class had a very similar

average, namely 81.11 with a slightly larger standard deviation, namely 9.34. Both showed almost the same increase in learning outcomes, with differences in standard deviations indicating variation between individuals in learning outcomes in the group.

In contrast, the control class, which was not given any special intervention, had a posttest mean of 79.62, slightly lower than the experimental and replication classes. Interestingly, however, the standard deviation and t-variance in the control class were much larger, with a standard deviation of 16.61 and a t-variance of 275.85. This suggests that learning outcomes in the control group varied significantly across participants. This greater variation may mean that without any special intervention or learning method, student learning outcomes are more diverse, perhaps due to uncontrollable external factors, such as differences in initial ability, individual motivation, or the learning approach used by each student independently.

Overall, the experimental and replication classes showed more consistent results, with significantly smaller t-variances (50.62 and 87.18) compared to the control class. This confirms that the intervention implemented in both classes was not only effective in improving learning outcomes, but also able to minimize variations between students. On the other hand, the large variance in the control class indicates that, without structured intervention, learning outcomes are more difficult to predict and highly dependent on individual student factors.

The student learning outcome data examined in this study included three groups: experimental class, replication 1, and replication 2, all of which were taught using the Group Investigation learning model. After a posttest was conducted to evaluate the effectiveness of the Group Investigation model in the experimental class, the results for the replication and control are presented in Table 2.

Table 2. *Learning Achievements (Pre-test and Post-test)*

No	Class	Average value	
		Pre-exam	After the exam
1.	Experimen	27.69	81.15
2.	Replication	34.44	81.11
3.	Control	31.92	79.62

In this study, there were three groups analyzed: experimental class, replication class, and control class. The experimental class showed a significant increase from pretest to posttest. In the pretest, the average score of the experimental class was 27.69, then increased to 81.15 after the posttest. This shows that the intervention implemented in the experimental class with the group investigation model has succeeded in providing a large positive impact on student learning achievement.

Class replication was used to ensure the consistency of the results of the treatment applied in the experimental class. The results obtained showed that the class replication had the same improvement pattern as the experimental class. In the pretest, the class replication obtained an average score of 34.44, and after the posttest, the average score jumped to 81.11. This shows that the results of the experimental class treatment can be replicated or repeated with consistent results across other groups, confirming the reliability of the applied model.

Meanwhile, the control class that was not given any special intervention only showed moderate improvement. The average pretest score in the control class was 31.92, and the average posttest score increased to 79.62. This improvement was lower compared to the experimental and replication classes. In conclusion, the methods or treatments applied to the experimental and replication classes proved to be more effective in improving student learning outcomes compared to the approaches applied to the control class. This confirms that the intervention tested in this study had a positive and significant effect on learning achievement.

The n-gain test aims to see the improvement of student learning outcomes through pretest and posttest. The n-gain value of student learning outcomes can be seen in Table 3 .

Table 3. *N-Gain Analysis of Student Learning Outcomes*

No	Class	*N-Gain*	Criteria
1	Test	0.73	High
2	Replication	0.71	High
3	Control	0.70	Medium

The table above shows the results of the N-Gain analysis that measures the increase in student learning outcomes in three groups, namely the experimental class, the replication class, and the control class. N-Gain or "N Gain" is an indicator used to see how much the increase in student learning outcomes is after treatment compared to the maximum score that can be achieved.

The class experiment showed that the N-Gain was 0.73, which is included in the High category , indicating that the method or intervention given to this class successfully provided a significant impact on improving student learning outcomes. Class replication, which aims to repeat the intervention in different groups, with an N-Gain of 0.71 , is also included in the High category , indicating that the results of the treatment in the experimental class can be replicated consistently in other groups.

Meanwhile, the control class has an N-Gain of 0.70 which is in the Medium category . This shows that although there was an increase in learning outcomes in the control class, the increase was not as high as in the experimental and replication classes. This difference in categories shows that the intervention implemented in the experimental and replication classes has a higher effectiveness in improving students' understanding and learning achievement compared to the methods or approaches used in the control class.

Hypothesis testing aims to determine whether or not there is an influence of the Group Investigation learning model on student learning outcomes in the experimental, replication and control classes on student learning outcomes. For hypothesis testing in the experimental, replication and control classes can be seen in Table 4.

Table 4. *Hypothesis testing results*

Class	Number of T	T -table	Status
Test	7,379	1,706	H 1 Accepted
Replication	6.183	1,706	H 1 Accepted
Control	2,952	1,706	H 1 Accepted

From the calculation results, all groups have t-counts greater than t-tables (7.379 > 1.706, 6.183 > 1.706, and 2.952 > 1.706). Therefore, the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_1) is accepted for all groups. This indicates that there are significant differences in the tested variables across the three groups.

Acceptance of the alternative hypothesis (H_1) in all groups indicates that the treatment given in this study has a real impact. If the research is related to the effectiveness of a particular learning method or intervention, it can be concluded that the tested method has a significant effect compared to the control condition.

Discussion

The purpose of this study was to evaluate the effect of the Group Investigation learning model on student learning achievement in the concept of static fluid. This study is supported by the perspective of Sunga et al., (2020) which states that learning outcomes reflect the mastery of knowledge that is manifested as behavioral changes that students are expected to achieve during their educational experience. Dewi et al., (2018) further argue that learning outcomes function as a benchmark for the effectiveness of the educational process. Higher learning outcomes indicate the success of the learning process, while lower learning outcomes indicate an educational process that is potentially less effective or unsuccessful .

The researcher acts as a facilitator in guiding students to understand the concept of static fluids using a group investigation learning model, which has a positive impact on student learning outcomes. Analysis of the average test scores shows an increase in student achievement in all experimental classes, replication 1, and replication 2 that meet high standards. Thus, it can be concluded that the average posttest score exceeds the average pretest score in each class, indicating that connecting material mastery with real-life contexts improves students' understanding of the lesson content.

According to Iswati (2021) , the findings of the updated Bloom's Taxonomy show that student learning outcomes are demonstrated through mastery of three competencies, namely cognitive, affective, and psychomotor domains. The cognitive domain includes students' abilities to remember, understand, apply, analyze, evaluate, and create. This makes it easier for students to understand concepts related to everyday experiences, thus facilitating understanding of the material. This is in line with the opinion of (Sukardi et al., 2024) which states that the group investigation model is an effective learning approach that can improve learning outcomes by increasing student involvement and encouraging collaboration between students in small groups, so that it can help solve problems through cooperative investigations.

To find out whether the group investigation model has a positive effect on student learning outcomes in the experimental class, including replication 1 and replication 2, a hypothesis test was conducted. The results obtained , namely t count is greater than t table at the α level of 0.05, causing H1 to be accepted and H0 to be rejected. This conclusion was obtained by comparing the average sample of each class with the KKM and looking at the percentage of students' posttest scores. Table 5 shows that the percentage value of each experimental and replication class is relatively high with minimal differences between sample groups. This is in line with Nupura et al., (2021) which shows that replication functions to refine estimates and assess the consistency of the results obtained.

The analysis of this hypothesis concludes that the alternative hypothesis (H0) is accepted. After the implementation of the group investigation learning model, an increase in student learning outcomes on the static fluid material was observed. This conclusion is supported by the fact that most students in the experimental and replication classes achieved average scores exceeding the KKM (minimum completion criteria). In addition, consistent results were observed across classes when the same treatment was applied, indicating no significant difference in scores. This indicates a uniform treatment effect across the three classes. However, students who did not achieve scores close to the KKM most likely did so due to limited attention and inactivity during group work .

In line with the research of Astutik et al., (2017) on the impact of the group investigation learning model on student learning outcomes, it is proven that there is a significant variation in student achievement after the implementation of this model. This difference arises because the intervention in the experimental group changes learning from a traditional teacher-centered approach to a more dynamic and active format for students through the group investigation model.

Research on the application of the Group Investigation model in Static Fluid learning has several limitations that need to be considered. According to Sari et al., (2017) one of the main limitations is that the time needed to implement this model tends to be longer than conventional methods so that it can interfere with the allocation of time for other materials. In addition, Wahyuningsih, (2012) revealed that the effectiveness of this model is highly dependent on the teacher's ability to manage the class and facilitate group discussions, which not all teachers have adequate skills in this regard.

CONCLUSION

Based on the research conducted using the experimental method and involving the experimental class, the results of the study were evaluated through two repetitions to ensure consistency. This study examines the impact of the Group Investigation model on student learning outcomes at SMA Negeri 6 North Gorontalo in class XI IPA. Hypothesis testing shows that in the experimental class, the t-count value of 7.379 exceeds the t-table value of 1.706; in the replication

class, the t-count value of 6.183 is higher than the t-table value of 1.706; and in repetition 2, the t-count value of 2.952 exceeds the t-table value of 1.706. These results indicate that the t-count value is consistently greater than the t-table value, which means that the Group Investigation model has a positive effect on student learning outcomes. However, it should be noted that although there is a positive effect, the effect size of 0.073 indicates that the effect is relatively weak. This means that although there is a significant difference in learning outcomes in terms of statistics, the impact in practice may not be too great.

Class replication in this study has an important role to ensure the consistency and reliability of the results. The main purpose of class replication is to test whether the results obtained from the experimental class can be reproduced or repeated under the same conditions. With consistent results between the experimental class and the replication class, this study strengthens the conclusion that the Group Investigation model does have its own influence on student learning outcomes, although the influence is weak. This finding shows that both the experimental, replication, and control groups experienced an increase in learning outcomes, but the differences between groups were not too large.

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