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Implications of the Peer Instruction Type Flipped Classroom Learning Model with Traditional Flipped to Improve Learning Outcomes of Science

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Abstract: The results of observations conducted by researchers at SDN Gisikdrono 02 Semarang show that students are less active in participating in classroom learning, especially in science subjects. This contributes to their low learning outcomes. To overcome this problem, The purpose of this study is to compare the effectiveness of the peer instruction type flipped classroom learning model with the traditional flipped model in improving student learning outcomes on science material in grade V SDN Gisikdrono 02 Semarang. This study employed a quasi-experimental approach with data collection methods utilized in this study included observations, interviews, and documentation. According to the results of the hypothesis testing using the independent sample t-test, the significance value. (2-tailed) which is smaller than $\alpha = 0.05$ ($0.000 < 0.05$). This indicates that H_0 is rejected in favor of Ha. Based on the calculation of the N-Gain score, the experimental and control classes scored 0.63 and 0.39, which are both included in the medium category. Based on the N-Gain percent criteria, the experimental class with a score of 63% is said to be quite effective, while the control class with a score of 39% is said to be ineffective. This outcome Suggests that the execution of peer instruction type Instructional model in the experimental class is more effective than the traditional flipped model in the control class.

Keywords: Flipped classroom; Learning model; Learning outcomes; Science

Introduction

Anwar Muhammad al-Syarqawi in Jayana (2021) explained that learning is a process towards semi-permanent changes in individuals that cannot be observed directly. Effective learning occurs efficiently, achieving objectives that enrich students with valuable knowledge for both present and future use (Istamar et al., 2023). In the book Learning Theories, the understanding of the term learning has become increasingly widespread in the social sphere, especially after the enactment of Law No. 20/2003 on the National Education System, which legally defines learning. Technically, learning can be explained as an organized and systematic effort to create a learning environment that supports the learning process that will help develop the potential of individuals as students (Rahim et al., 2024). Therefore, an educator should be capable of aligning with the advancements of the current era (21st century) which is expected to be able to provide an application in learning known as an innovative and meaningful learning model, where the teaching model is able to achieve success in learning (Kotimah, 2024).

Quoting from Istarani in Nisa (2020), the learning model is defined as a series of ways of delivering learning material which includes all elements before, during, and after the learning process carried out by the teacher. Education at the primary school level (SD) includes various types of learning materials, some of which must be delivered in a structured and systematic

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manner (Kiptiyah et al., 2023). In education, Students receive more than just theoretical knowledge but are also encouraged to develop critical thinking and creativity. This is essential for preparing them to adapt to the evolving demands of the future, particularly in the context of Society 5.0 (Hamzah et al., 2023). Additionally, they have the potential to reduce overall learning costs, making education more accessible and sustainable for a broader range of students (Lestari et al., 2021). Learning can proceed effectively and reach its intended goals when students feel comfortable, not stressed, and possess high self-efficacy (Nur DS et al., 2023). Technology that is growing rapidly today can be an effective learning tool for teachers and students (Pratiwi, 2022)

According to Ribeirinha et al. (2024), the flipped classroom model in its application encourages the use of technology in learning. Students make it possible to access learning videos through online platforms anywhere and anytime. This is also reinforced by the opinion of Qahfi et al. (2022) with the application of the Flipped Classroom learning model that utilizes online technology, students are able to access material anytime and anywhere. The flipped classroom model puts the focus on students with the aim of increasing the effectiveness of learning to support learning outcomes. Shifts in student behavior and academic performance during the learning process, will be a benchmark for whether students can understand the material provided (Sholikhah et al., 2022). According to the opinion of Ölmefors et al. (2023), Turan et al. (2020), and Syafruddin et al. (2023), the flipped classroom model is capable of provide an active learning process to students in the classroom through collaboration. According to Steele in Ummi (2021) the flipped classroom learning model can be classified into 4 types: (1) Traditional Flipped, (2) Mastery Flipped, (3) Peer instruction Flipped, (4) Problem based learning flipped. The ones applied by researchers include traditional flipped classroom applied in the control class and peer instruction flipped applied in the experimental class. Traditional flipped type is one of the simplest flipped classroom learning models and is generally applied by teachers who are applying the flipped classroom model for the first time. Meanwhile, according to Steele's view in Syafria et al. (2023) flipped classroom type peer instruction is a learning model that directs students to study at home listening to learning videos first before starting class.

With the application of this model, it is hoped that students before learning in class have understood the material and have a deeper picture of the material to be taught in class, with the hope that during the learning process students can be more active. This research is in accordance with Zhang et al. (2024) in the study the application of the Flipped classroom moves students to learn independently and creatively. The implementation of flipped classroom learning can be carried out with synchronous and asynchronous implementation (Rindaningsih et al., 2021). The synchronous application can be implemented through zoom, Google Meet, WhatsApp Group to share and teach material to students, while the asycrhonous application of the teacher makes a learning video to explain the material/teaching material that will be shared with students (Latifah et al., 2023). However, in this study researchers emphasized the application of asynchronous learning.

The steps of peer instruction flipped learning according to Steele in Kinteki (2020) as depicted in the figure 1.

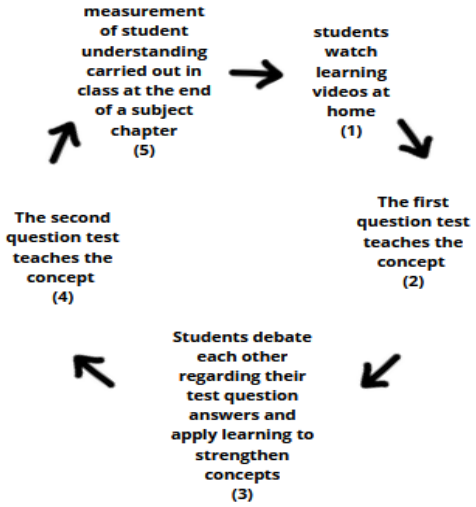

Figure 1. Peer instruction flipped classroom learning steps

The steps of Traditional Flipped learning according to Steele (2013) in Kinteki (2020) as depicted in the figure 2.

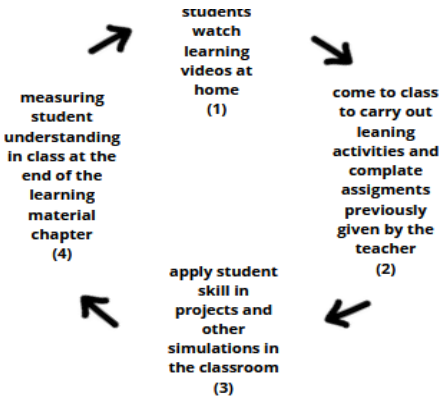

Figure 2. Traditional flipped learning steps

It can be inferred distinction in the implementation of the peer instruction type flipped classroom model and

the traditional flipped is in the application of the concept test question, which in the peer instruction flipped type students are given a concept test question while in class while the traditional flipped type, when in class students are only given reinforcement and assignments by the teacher then directed to discuss the solution of the problem given.

Based on the study sources related to the benefits and advantages of the Flipped Classroom learning model, the advantages of flipped classroom learning can be identified according to (Fauzan et al., 2021) including: (1) Students can study material at home before learning by utilizing learning resources provided by the teacher, can repeat material without limits, and can be accessed at any time. (2) Students can learn comfortably by collaborating, exchanging ideas with peers. (3) Helping students who have many activities outside of school will benefit from the implementation of the Flipped Classroom learning model.

Every learning model is not always able to overcome all aspects of problems in the teaching and learning process, because each model must have its own weaknesses (Fauzan et al., 2021), as well as the flipped classroom model with its disadvantages including: (1) To watch and play videos, you must have at least one gadget, if you don't have this, it will complicate the situation so that students cannot follow the learning properly. (2) Students need supervision from parents when watching videos so that it can be ensured that the student is really watching the video appropriately and not watching something else. (3) Mentors should also ensure that learners are able to grasp the content without any difficulties.

Despite the weaknesses and shortcomings, the researcher has communicated with the homeroom teacher if every parent has a gadget and there is a homeroom teacher whatsapp grub, so research related to the flipped classroom learning model can be carried out at SDN Gisikdrono 02.

Basically, the flipped classroom learning model has a relationship with Bloom's taxonomy and leads to the cognitive domain of students. The cognitive domains in question are: (1) Remembering, (2) Understanding, (3) Applying, (4) Analyzing, (5) Evaluating, (6) Creating (Islamiya et al., 2022). To achieve the cognitive domain described by the researcher above, students, especially in elementary school, need learning materials that cover the stages of the cognitive domain, one of which is science material. Science helps improve students' cognitive development which is very relevant to the teaching and learning process at school, this is described by Syarif in Gustalia et al. (2023). Science plays an important role in helping students solve problems through the application of science. An appropriate curriculum is needed to encourage the development of scientific intelligence, technology, critical thinking, creativity, and the ability to discuss and collaborate to face global challenges (Purba et al., 2023). Science studies human life and its relationship with the environment, emphasizing systematic knowledge and cause-and-effect in natural phenomena, as defined in the Big Indonesian Dictionary (Kemendikbud, 2022).

The flipped classroom model for blood circulation promotes active student engagement and enhances higher-order thinking through an interactive learning approach. Students' behavior and learning outcomes serve as indicators of their ability to comprehend the material presented (Sholikhah et al., 2022). Test is one of the instruments used to assess learning outcomes in the cognitive aspect (Aslan et al., 2020).

Teachers at SD Gisikdrono 2 Semarang use Problem-Based Learning with PPT, but lessons remain teacher-centered. This leads to student disengagement and affects comprehension and learning outcomes, worsened by a lack of innovative teaching methods. Research that supports this learning model is research from Pratiwi (2023) with the title "Implementation of Video-Based Flipped Classroom: A Strategy for Improving Learning Outcomes during the Pandemic Period" The study's findings show that the flipped classroom model has been effective in increasing student engagement in learning during the pandemic, particularly with the support of video media in science education.

This research is also relevant to the research of Fitriani et al. (2021) entitled "Application of the Flipped Classroom Learning Model to Improve Learning Outcomes of Theme 8 Class 5 Sdn Sidomulyo Gunem Rembang District 2020/2021". This study confirms the effectiveness of the Flipped Classroom model in improving learning outcomes for theme 8 in grade V at SDN Sidomulyo, Gunem, Rembang. By combining asynchronous independent study and synchronous in-class discussions, this approach enhances learning quality, student engagement, and teacher effectiveness, leading to continuous improvement in thematic learning outcomes. Another supporting research is Supriyatni's research (2021) entitled "Improving Science Learning Outcomes through the Flipped Classroom Learning Model Integrated with the Learning Home Portal for Elementary Students" in this study there was an increase in science learning outcomes.

Based on previous research, the implementation of the Flipped Classroom model has a constructive influence on student learning outcomes. This approach helps students in improving understanding and learning outcomes in science material. In this study, what distinguishes it from previous research is the

existence of a control class given the same model treatment but a different type, namely the traditional flipped learning model and the experimental class using the peer instruction type flipped classroom learning model and the subject of this study applied in grade 5 elementary school. Based on Based on the issues outlined, it can be concluded that with a total of 55 students there are still some students who have problems with the ability of students' science learning outcomes to be classified as low. Many factors can affect the low learning outcomes of students. Thus, to overcome these problems, efforts are needed to enhance problem-solving skills in science material, especially in circulatory material, teachers need to approach students by implementing a more supportive learning approach.

With the research carried out, it is expected to be capable of have a positive impact on grade V students, and bring changes towards the future of students by getting used to using gadgets as a learning resource instead of other negative things.

Based on the explanation above, the researcher is interested to carry out an analysis with the title "Implication of Flipped Classroom Learning Model Type Peer Instruction Flipped compared to traditional flipped to Improve Learning Outcomes of Science Grade V Science SDN Gisikdrono 02 Semarang".

Method

This research employs a quantitative approach with experimental research type. Researchers applied the Quasi Experimental Design design in this study. Researchers narrowed down the quasi-experimental research design to the Nonequivalent control group design.

Table 1. Nonequivalent Control Group Design

O_1	X	O_2
O_3		

Description:

O_1 and O_3 : Group of students before being treated by the researcher

X : Treatment through learning using the Problem Flipped Classroom Type Peer Instruction model

O_2 : Group of students after being treated with learning using the Flipped Classroom Type Peer Instruction model

O_4 : Group of students treated with Traditional Flipped learning model

This study compares an experimental group (O1) and a control group (O3). Both groups took a pretest to assess initial abilities before treatment. The experimental group used the Peer Instruction Flipped Classroom model, while the control group applied the Traditional Flipped model. A posttest was conducted to evaluate learning outcomes and determine the effectiveness of the Peer Instruction model in science learning.

Blood Circulation material in the fifth grade of SDN Gisikdrono 02 Semarang.To test the truth of the effectiveness of the model according to Abdulah (in Yam & Taufik 2021) requires a research hypothesis, the hypothesis has several important components, namely temporary conjectures, relationships between variables and truth tests. The arrangement of hypotheses in this study is as follows:

Ha : Peer Instruction Flipped Claasroom Learning Model is more effective than traditional flipped learning model.

Ho : Peer Instruction Flipped Claasroom Learning Model is not effective compared to traditional flipped.

Table 2. Question Item Validity

Question item number	Description
1, 2, 5, 7, 8, 9, 11, 12, 14, 15, 18, 20, 22, 23, 24, 25, 26, 27, 28, 31, 32, 33, 34, 36, 37	Valid
3, 6, 10, 13, 16, 17, 19, 21, 29, 30, 35, 38, 39, 40	Not Valid

With the item validity test, researchers get 25 valid questions which will be used as pretest and posttest questions.

Result and Discussion

Result

The data description in this study includes the pretest and posttest scores of students who were given different treatments, namely the peer instruction type flipped classroom model applied in the experimental class and the traditional flipped model applied in the control class. Descriptive analysis is employed to summarize research data, including the total amount of data, maximum value, minimum value, average value, and other relevant metrics. The following is a descriptive analysis obtained using SPSS 26 for Windows, which is presented in Table 3.

Table 3 shows that the experimental class had 27 valid samples, with pretest scores ranging from 48 to 84 and a minimum of 66.07. Posttest scores ranged from 76 to 100, with a minimum of 87.04. The control class had 28 valid samples, with pretest scores between 40 and 76 and a minimum of 55.86. Posttest scores ranged from 52 to 88, with a minimum of 73.29.

To assess the significant difference and effectiveness of the two flipped classroom models based on student learning outcomes, the research hypothesis

was tested. Before this, a preliminary test was conducted, including a normality and homogeneity test. The normality test determines whether the data follows a normal distribution. If it does, parametric statistics are used; otherwise, non-parametric statistics are applied (Permana et al., 2023).

Table 3. Descriptive Analysis of Learning Outcome Data

Descriptive Statistics					
	N	Range	Minimum	Maximum	Mean
Pretest experiment	27	36	48	84	66.07
Posttest experiment	27	24	76	100	87.04
Pretest control	28	36	40	76	55.86
Posttest kontrol	28	36	52	88	73.29
Valid N (listwise)	27				

Table 4 presents the normality test results for learning outcomes, analyzed using SPSS 26 for Windows. Table 4 shows the Shapiro-Wilk normality test results. The experimental class had significance values of 0.740 (pretest) and 0.096 (posttest), while the control class had 0.125 (pretest) and 0.076 (posttest). Since all values exceed 0.05, the data follows a normal distribution, allowing the use of parametric statistics.

Table 4. Normality Test Results

Tests of Normality							
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Learning outcomes	Class	Statistic	df	Sig.	Statistic	Df	Sig.
	Pre-Test Experiment	.110	27	.200*	.936	27	.740
	Pre-Test Control	.159	28	.068	.934	28	.125
	Post-Test Experiment	.150	27	.121	.936	27	.096
	Post-Test control	.160	28	.066	.934	28	.076

* This is a lower bound of the true significance
a. Lilliefors Significance Correction

The homogeneity test was performed to assess whether the two groups being evaluated had similar variances, determining if they were homogeneous or not. Decision making in the homogeneity test is based on the significance value: if the sig value <0.05, then H_0 is rejected and Ha is accepted, which means that the variance in the two groups is not the same or not homogeneous. On the other hand, if the significance value is greater than 0.05, H0 is accepted, and Ha is rejected, indicating that the variances of the two groups are equal, meaning they are homogeneous. The results of the homogeneity test for pretest scores can be seen in Table 5 which was analyzed using SPSS.

Table 5. Homogeneity Test Results Pretest Score

		Levene Statistic	df1	df2	Sig.
Learning Outcomes of science	Based on Mean	.152	1	53	.699
	Based on Median	.122	1	53	.728
	Based on Median and with adjusted df	.122	1	51.204	.728
	Based on trimmed mean	.134	1	53	.715

Based on the results of the homogeneity test calculation, it is known that the significant value of based on mean is 0.699. The calculated significant value indicates that it is more than α = 0.05 (0.699 > 0.05) which means H0 is accepted. Therefore, it can be concluded that the pretest data variance for the experimental and control classes is homogeneous.

Table 6. Homogeneity Test Results of Posttest Values

Test of Homogeneity of Variance					
		Levene Statistic	df1	df2	Sig.
Learning Outcomes of science	Based on Mean	1.793	1	53	.186
	Based on Median	1.359	1	53	.249
	Based on Median and with adjusted df	1.359	1	47.805	.249
	Based on trimmed mean	1.709	1	53	.197

The homogeneity test results show a significance value of 0.186, which is greater than α = 0.05 (0.186 > 0.05), indicating that H0 is accepted. This confirms that the posttest data variance in both the experimental and

control classes is homogeneous. After meeting the prerequisite tests, the next step is hypothesis testing using an independent sample t-test to determine whether there is a significant difference in student learning outcomes between the two groups (Nursiah et al., 2022). Researchers conducted an independent sample t-test using the help of SPSS 26 for Windows can be seen in Table 7.

The results of the hypothesis testing using the independent sample t-test show a significance value (2-tailed) of 0.000, which is smaller than α = 0.05 (0.000 < 0.05). This means that H0 is rejected and Ha is accepted. Thus, it can be concluded that the application of the peer instruction type flipped classroom learning model is more efficient than the traditional flipped learning model in improving learning outcomes of science material in grade V SDN Gisikdrono 02 Semarang.

Table 7. Independent Sample T-Test Results

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% confidence interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Value	Equal variances assumed	1.793	.186	6.108	53	.000	13.751	2.251	9.236	18.267
	Equal variances not assumed			6.138	50.429	.000	13.751	2.241	9.252	18.251

The next data analysis is the N-Gain test, which is used to measure the effectiveness of changes in student learning outcomes between before and after treatment. The method is to calculate the difference between the pretest and posttest scores, then divide it by the difference between the ideal maximum score and the pretest score. The researchers performed the N-Gain test with the assistance of SPSS 26 for Windows, as shown in Table 8.

Table 8. N-Gain Test Result

Class	Mean	N-Gain Score	Interpretation	N-Gain Percent	Category
Pretest Experiment	66.07	0.63	Medium	63%	Quite Effective
Posttest Experiment	87.04				
Pretest control	55.86	0.39	Medium	39%	neffective
Posttest control	73.29				

The data above reveals that the experimental class has an average pretest score of 66.07 and an average posttest score of 87.04. Then in the control class the average pretest score was 55.86 and the average posttest score was 73.29. From these data the N-Gain score results obtained in the experimental class were 0.63 and the N-Gain score in the control class was 0.39. It can be concluded that both have a value ≥ 0.3 and ≤ 0.7, so they are included in the medium category. While the results of the N-Gain percent in the experimental class obtained a value of 63% with a fairly effective interpretation and a control class of 39% with an ineffective interpretation.

This shows that the implication of the peer instruction type flipped classroom learning model in the experimental class is more effective than the traditional flipped learning model applied in the control class based on student learning outcomes.

Discussion

This study aims to compare the effects of implementing the flipped classroom model of the peer instruction type with the traditional flipped model on the learning outcomes of fifth-grade students at SDN Gisikdrono 02 Semarang in the subject of Science specifically on the topic of blood circulation. The research subjects involved two classes: Class VA as the control group, consisting of 28 students, and Class VB as the experimental group, consisting of 27 students.

Data collection techniques in this study included tests in the form of pre-tests and post-tests, as well as non-test methods in the form of observations.

Effectiveness of the Flipped Classroom Model of the Peer Instruction Type

The application of the flipped classroom model with the Peer Instruction type not only facilitates students in acquiring learning material but also allows teachers to take on various roles such as facilitators, motivators, and mentors. Teachers can stimulate discussion by posing thought-provoking questions and assist students who face difficulties with the material, while also overseeing student (Syafria et al., 2023).

The effectiveness of this learning model can be observed through the pretest and posttest scores

conducted by the researcher in the experimental class. The average pretest score was 66.07, while the posttest score increased to 87.04. This shows a significant improvement between the pretest and posttest outcomes in the experimental class where the flipped classroom model with the Peer Instruction type was applied.

Figure 3. Flipped classroom learning of the peer instruction type in the experimental class

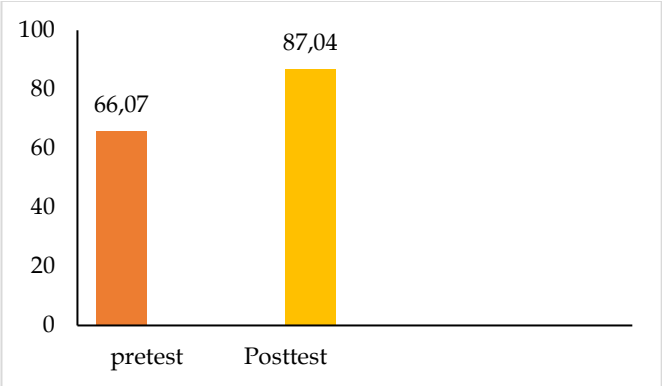

Figure 4. Pre-test and post-test graph of the experimental class

Effectiveness of the Traditional Flipped Classroom Learning Model

According to Steele (2013) in the book Learning Strategies (2024), the traditional flipped classroom model is simpler because the teacher primarily monitors students' engagement by providing worksheets during class after they have watched instructional videos at home.

The effectiveness of this learning model can be observed through the pre-test and post-test scores collected by the researcher in the control class. The mean pre-test score was 55.86, while the post-test score increased to 73.29. This suggests an improvement in learning outcomes in the control class after applying the traditional flipped classroom model.

Figure 5. Traditional flipped classroom learning in the control class

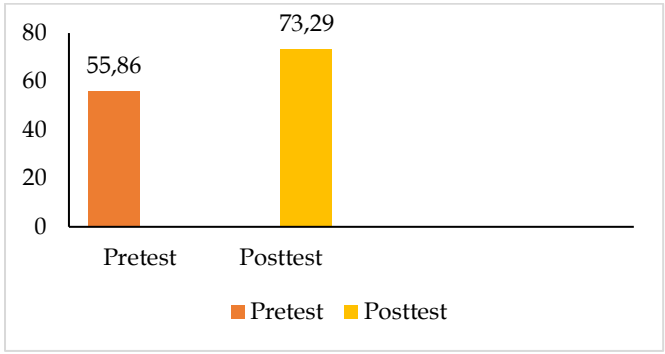

Figure 6. Pre-test and Post-test Graph of the Control Class

When observing the pre-test and post-test learning outcome scores in the control class, it is evident that, similar to the experimental class, both experienced an increase in learning outcomes. However, to compare the effectiveness of the flipped classroom model of the peer instruction type with the traditional flipped model, a more detailed discussion will be provided in the following section.

Comparison of the Flipped Classroom Model Peer Instruction Type with Traditional Flipped Type

To determine the effectiveness of the two models discussed in this article, the researcher conducted prerequisite tests, including normality and homogeneity tests. To identify any significant differences in the implementation of these models, the researcher performed a hypothesis test using an independent sample t-test. Additionally, to assess the effectiveness of each learning model, the researcher analyzed the data using the N-Gain test.

The pre-test normality test results using the Shapiro-Wilk test for the experimental class yielded a value of 0.740, and for the control class, the significance value was 0.125. Both significance values for the pre-test learning outcomes in the experimental and control classes were greater than $\alpha = 0.05$ ($0.740 > 0.05$ and $0.125 > 0.05$), indicating that the pre-test results for both classes are normally distributed.

The homogeneity test for the pre-test data in both classes showed a significance value of 0.699, which is

greater than α = 0.05 (0.699 > 0.05), meaning the null hypothesis (H_0) is accepted. This indicates that the data variance in both the experimental and control classes is homogeneous.

The post-test normality test using the Shapiro-Wilk test revealed a significance value of 0.096 for the experimental class and 0.076 for the control class. Both significance values for the post-test learning outcomes were greater than α = 0.05 (0.096 > 0.05 and 0.076 > 0.05), indicating that the post-test results for both classes also follow a normal distribution.

In the homogeneity test for the post-test data, the significance value between the experimental and control classes was 0.186, which is greater than 0.05. This indicates that the post-test results for both classes are homogeneous, with similar variances.

Following this, a hypothesis test was conducted using the independent sample t-test and N-Gain analysis. The interpretation of the N-Gain score determines the effectiveness: if $g > 0.7$, it falls into the high category; if $0.3 \leq g \leq 0.7$, it is considered medium; and if $g < 0.3$, it falls into the low category. To evaluate effectiveness, the N-Gain percentage was calculated by multiplying the N-Gain score by 100. The interpretation of the N-Gain percentage is as follows: if the percentage is <40%, it is deemed ineffective; between 40%-55%, it is considered less effective; between 56%-75%, it is considered moderately effective; and if >76%, it is considered effective.

The results of the independent sample t-test showed a significance value of 0.000, which is less than 0.05, indicating a significant difference in the results post-test average scores between the experimental and control classes. The N-Gain score analysis showed that the experimental class had an increase of 0.63, while the control class showed an increase of 0.39. Both classes scored within the medium range (≥ 0.3 and ≤ 0.7). The N-Gain percentage for the experimental class was 63%, categorized as moderately effective, while the control class had a score of 39%, categorized as ineffective.

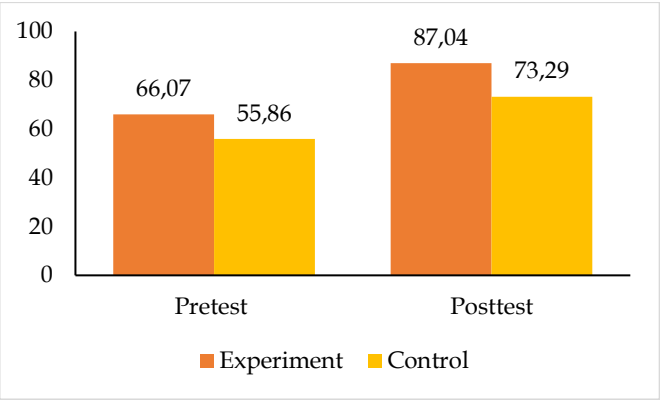

Figure 7. Pre-test and post-test graph of the experiment and control class

Based on the hypothesis test results, H_0 is rejected and Ha is accepted, indicating that the implementation of the flipped classroom model of the peer instruction type in the experimental class is more effective compared to the traditional flipped model in the control class regarding learning outcomes in the science subject on the topic of blood circulation for fifth-grade students at SDN Gisikdrono 02 Semarang. The effectiveness of this model is further supported by the statement of Lin et al. (2024) in Santhi (2024), who stated that the flipped classroom model not only enhances the effectiveness of learning and specific knowledge and skills but also promotes the development of students' practical readiness, self-efficacy, and professional attitudes in solving learning problems.

Figure 7 shows the learning outcomes of the experimental and control classes. In the experimental class, the average pre-test score increased from 66.07 to 87.04 in the post-test. In the control class, the average pre-test score increased from 55.86 to 73.29 in the post-test.

Conclusion

Based on the theoretical review, research results, and analysis conducted by the researcher, It can be concluded that the peer instruction-based flipped classroom model is more effective than the traditional flipped model in enhancing learning outcomes. The results of this study are supported by the independent sample t-test, which showed a significance value (2-tailed) smaller than α = 0.05 (0.000 < 0.05). Based on these results, it can be concluded that H_0 is rejected and Ha is accepted. Therefore, the application of the peer instruction-based flipped classroom model has been proven to be more effective compared to the traditional flipped model in the science subject for fifth-grade students at SDN Gisikdrono 02 Semarang. The results of this study are expected to have a wide positive impact in the field of education and serve as additional references for teaching practices. This study shows that the application of the peer instruction-based flipped classroom model has an impact on enhancing student learning outcomes in the science subject. The flipped classroom model of the peer instruction type can be used as one of the strategies for teachers to achieve success in learning. For teachers and school principals, this study is expected to serve as inspiration to encourage teachers to apply more varied teaching models, as well as to be a consideration in formulating policies to improve the quality of education in elementary schools. Therefore, the use of the flipped classroom model of the peer instruction type needs to be disseminated to various schools. This aims to enhance teachers' pedagogical

skills in applying innovative teaching models so that the quality of education in schools can continue to improve.

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Author Contributions
The contributions of the authors involved in the preparation of this scientific article were made by Aslamiyah (Author 1) who acted and played a role in carrying out observations and research in one of the elementary schools that became the subject of research and writing this scientific article. Ms. Dewi Nilam Tyas (Author 2) as a supervisor who has guided, evaluated, directed the author in the preparation of this scientific article.

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Conflicts of Interest
The authors declare no conflict of interest.

References

Aslan, & Wahyudin. (2020). *Kurikulum dalam Tantangan Perubahan*. Medan: Bookies Indonesia.

Fauzan, M., Haryadi, H., & Haryati, N. (2021). Penerapan Elaborasi Model Flipped Classroom dan Media Google classroom Sebagai Solusi Pembelajaran Bahasa Indonesia Abad 21. *DWIJA CENDEKIA: Jurnal Riset Pedagogik*, *5*(2), 361. https://doi.org/10.20961/jdc.v5i2.55779

Fitriani, A., Reffiane, F., & Karsono. (2021). Penerapan Model Pembelajaran Flipped Classroom Untuk Meningkatkan Hasil Belajar Tema 8 Kelas 5 Sdn Sidomulyo Kecamatan Gunem Rembang Tahun Pelajaran 2020/2021. *Jurnal Cerdas Mendidik*, *1*(1), 1–11. https://doi.org/10.26877/cm.v1i1.8781

Gustalia, B. B., & Setiyawati, E. (2023). Analisis Kemampuan Kognitif Peserta Didik Dalam Pembelajaran IPAS Berbasis Kearifan Lokal Pada Materi Perubahan Wujud Zat di Sekolah Dasar. *Edukatif: Jurnal Ilmu Pendidikan*, *5*(2), 1575–1583. https://doi.org/10.31004/edukatif.v5i2.5398

Hamzah, A. R., Mesra, R., Br Karo, K., Alifah, N., Hartini, A., Agusta, H. G. P., Yusuf, F. M., Subroto, D. E., Lisarani, V., Ramadhani, M. I., Larekeng, S. H., Tunnoor, S., Bayu, R. A., & Pinasti, T. (2023). *Strategi Pembelajaran Abad 21*. PT. Mifandi Mandiri Digital.

Islamiya, H. A., & Romadhon, D. R. (2022). Analisis Peningkatan Keterampilan Berpikir Kritis Siswa Melalui Model Pembelajaran Problem Based Flipped Classroom Berbantuan Pear Deck. *Prosiding Seminar Nasional 2022 Fakultas Ilmu Tarbiyah Dan KeguruanUniversitas Islam Negeri Syarif Hidayatullah Jakarta*. Retrieved from https://shorturl.at/eR3sO

Istamar, W., & Khumairoh, I. (2023). Penerapan Model Pembelajaran Flipped Classroom Dalam Pelajaran Matematika Kelas V. *Maslahah*, *2*(1), 11–18. Retrieved from https://jurnalsains.id/index.php/maslahah/article/view/55

Jayana, T. A. (2021). Konsep Belajar dalam Perspektif Anwar Muhammad al-Syarqawi dan Albert Bandura serta Implikasinya dalam Pembelajaran di Sekolah. *Jurnal Al-Murabbi*, *7*(1), 31–44. https://doi.org/10.35891/amb.v7i1.2716

Kemendikbud. (2022). *Ilmu Pengetahuan Alam dan Sosial (IPAS) SD-SMA*. Retrieved from https://kurikulum.kemdikbud.go.id/file/cp/dasmen/13. CP IPAS.pdf

Kinteki, R. (2020). *Model Pembelajaran Flipped Classroom Untuk Generasi Milenial*. Kemenbdikbudristek.

Kiptiyah, S. M., Purwanto, E., Ahmadi, F., Tyas, D. N., & Andriani, A. E. (2023). Strategi Penyusunan Perangkat Pembelajaran Inovatif Berbasis Learning Community. *Jurnal Pengabdian Masyarakat Progresif Humanis Brainstorming*, *6*(2), 512–521. https://doi.org/10.30591/japhb.v6i2.4289

Kotimah, E. K. (2024). Efektivitas Media Pembelajaran Audio Visual Berupa Video Animasi Berbasis Powtoon Dalam Pembelajaran IPA. *Jurnal Pelita Ilmu Pendidikan*, *2*(1), 1–18. https://doi.org/10.69688/jpip.v2i1.55

Latifah, U., & Rindaningsih, I. (2023). Implementasi Flipped Classroom dalam Mendukung Merdeka Belajar untuk Meningkatkan Kemandirian Belajar. *Jurnal Papeda: Jurnal Publikasi Pendidikan Dasar*, *5*(2), 156–166. https://doi.org/10.36232/jurnalpendidikandasar.v5i2.4447

Lestari, H., Rahmawati, I., Siskandar, R., & Dafenta, H. (2021). Implementation of Blended Learning with A STEM Approach to Improve Student Scientific Literacy Skills During The Covid-19 Pandemic. *Jurnal Penelitian Pendidikan IPA*, *7*(2), 224–231. https://doi.org/10.29303/jppipa.v7i2.654

Nisa, A. F. (2020). Pengembangan Model Pembelajaran Inovatif SD Inovasi Pendidikan di Era Milenial. *Prosiding Seminar Nasional PGSD UST*, *1*, 5–11. Retrieved from https://jurnal.ustjogja.ac.id/index.php/sn-pgsd/article/view/8870/3664

Nur DS, Y., Fitri, A., Latifatusadiah, T., Dewi, S. M., & Febriansyah, F. (2023). Effect of the Flipped Classroom Model on Self Efficacy Student in Limited Face Learning. *Jurnal Penelitian Pendidikan IPA*, *9*(8), 6278–6283. https://doi.org/10.29303/jppipa.v9i8.4340

Nursiah, S. B., Hermuttaqien, B. P. F., & Ridwan, H. (2022). Pengaruh Penerapan Model Quantum Teaching Tipe Tandur Terhadap Hasil Belajar Siswa Pada Mata Pelajaran IPA Kelas V SDN 52 Panasakkang Kecamatan Tanralili Kabupaten Maros. *Global Journal Teaching Professional*, *1*(3), 293–305. Retrieved from https://jurnal.sainsglobal.com/index.php/gpp/article/view/657

Ölmefors, O., & Scheffel, J. (2023). High school student perspectives on flipped classroom learning. *Pedagogy, Culture & Society*, *31*(4), 707–724. https://doi.org/10.1080/14681366.2021.1948444

Permana, R. A., & Ikasari, D. (2023). Uji Normalitas Data Menggunakan Metode Empirical Distribution Function Dengan Memanfaatkan Matlab Dan Minitab 19. *Seminar Nasional Riset Dan Inovasi Teknologi*, *7*(1), 7–12. https://doi.org/10.30998/semnasristek.v7i1.6238

Pratiwi, D. (2022). Implementasi Model Flipped Classroom Pada Pembelajaran IPS Materi Kegiatan Ekonomi Kelas V SDN 601 Menanggal Surabaya. *Snhrp*, 919–924. Retrieved from https://snhrp.unipasby.ac.id/prosiding/index.php/snhrp/article/view/409/

Pratiwi, D., Kusuma, M., & Hayati, M. N. (2023). Implementasi Flipped Classroom Berbasis Video: Strategi Peningkatan Hasil Belajar Di Masa Pandemi. *LENSA (Lentera Sains): Jurnal Pendidikan IPA*, *13*(2), 120–126. https://doi.org/10.24929/lensa.v13i2.179

Purba, P., Rahayu, A., & Murniningsih, M. (2023). Penerapan Kurikulum Merdeka pada pembelajaran IPAS kelas IV di SD Negeri Tahunan Yogyakarta. *Bulletin of Educational Management and Innovation*, *1*(2), 136–152. https://doi.org/10.56587/bemi.v1i2.80

Qahfi, B. A., & Rahmatillah. (2022). Penerapan Model Pembelajaran Inkuiri Terbimbing Berbantuan Simulasi PhET Terhadap Kemampuan Berpikir Kritis Siswa di SMAN 1 Donggo. *Jurnal Pengabdian Magister Pendidikan IPA*, *5*(2), 133–139. https://doi.org/10.29303/jpmpi.v5i2.1591

Rahim, A., Almadani, H. A., Ramadhan, D., Jannah, I. I., & Sakinah, N. (2024). Penyuluhan Tentang Kewenangan Pemerinth dalam Pengembangan Pendidikan Berdasarkan Undang-Undang No. 20 Tahun 2003 di Yayasan Perkasa Karunia Luhur Tangerang. *Jurnal Abdimas Bina Bangsa*, *5*(2), 885–896. https://doi.org/10.46306/jabb.v5i2.1004

Ribeirinha, T., & Silva, B. (2024). O envolvimento do aluno no modelo Flipped Classroom implementado na aprendizagem online. *Revista Latinoamericana de Tecnología Educativa - RELATEC*, *23*(1), 43–59. https://doi.org/10.17398/1695-288X.23.1.43

Rindaningsih, I., Findawati, Y., Hastuti, W. D., & Fahyuni, E. F. (2021). Synchronous And Asynchronous With Flipped Learning Environment In Primary School. *PrimaryEdu: Journal of Primary Education*, *5*(1), 33–44. https://doi.org/10.22460/pej.v5i1.1883

Santhi, F. (2024). Efektivitas Model Flipped Classroom dalam Pelatihan Online Berbasis Scenario-Based E-Learning: Systematic Literature Review. *Didaktika: Jurnal Kependidikan, 13*(4), 4839-4852. https://doi.org/10.58230/27454312.1168

Sholikhah, O. M., & Alyani, F. (2022). Impact of Flipped Classroom Learning Model Assisted by Google Slide towards the Study Result of Science Studies of Elementary School. *Jurnal Penelitian Pendidikan IPA*, *8*(4), 2036–2042. https://doi.org/10.29303/jppipa.v8i4.1717

Syafria, M. N., Pratiwi, I. A., & Kuryanto, M. S. (2023). Pengaruh Media Ular Tangga Keberagaman dalam Meningkatkan Hasil Belajar Muatan PPKn Siswa Sekolah Dasar. *Jurnal Basicedu*, *7*(5), 3111–3117. https://doi.org/10.31004/basicedu.v7i5.5863

Syafruddin, S., Agustina, I., Jemmy, J., Komari, K., & Santosa, T. A. (2023). Effectiveness of IoT-Based Flipped Classroom Model on Students' Critical Thinking Skills: A Meta-Analysis. *Jurnal Penelitian Pendidikan IPA*, *9*(10), 883–891. https://doi.org/10.29303/jppipa.v9i10.5265

Turan, Z., & Akdag-Cimen, B. (2020). Flipped classroom in English language teaching: a systematic review. *Computer Assisted Language Learning*, *33*(5–6), 590–606. https://doi.org/10.1080/09588221.2019.1584117

Ummi, P. (2021). Test Jurnal Perseda. *Jurnal Perseda : Jurnal Pendidikan Guru Sekolah Dasar*, *4*(3), 1–10. https://doi.org/10.37150/perseda.v4i3.1462

Zhang, H., & Austria, R. S. (2024). Best Practices in the Implementation of Flipped Classroom in Rural Elementary School in Shandong China. *Journal of Education, Humanities and Social Sciences*, *25*, 223–229. https://doi.org/10.54097/np1d1m45