Process Oriented Guided Inquiry Learning (POGIL) Model: Optimizing Student Learning Interest

Siti Rohimah Maspupah[1], Deden Makbuloh[2], M. Indra Saputra[3]
[1, 2, 3] Universitas Islam Negeri Raden Intan Lampung, Indonesia

ABSTRACT

Islamic boarding schools like MTS Walisongo, Central Lampung, succeed when students are interested in learning, especially Islamic law. Initial observations indicated that students showed little interest in learning, particularly in paying attention. This phenomenon was evident from the lack of student interaction, limited interest in the topic, and the prominence of conventional learning approaches. This study tests whether the POGIL (Process Oriented Guided Inquiry Learning) learning approach increases student interest in Islamic jurisprudence. This quantitative study was quasi-experimental and used a post-test-only control group design. Class VIII C was the experimental class, and VIII D was the control class in the research sample, obtained by simple random sampling. The POGIL model has five steps: orientation, exploration, concept invention, application, and closure. The non-test questionnaire had 16 statement items that measured student attention. The results of data analysis using the t-test showed a significant value of 0.001 ($p < 0.05$), indicating a significant difference between the experimental and control classes. Thus, the POGIL learning model has proven effective in increasing student interest in learning, particularly in the aspect of attention. This study concludes that the implementation of POGIL makes a positive contribution to creating an active, collaborative, and enjoyable learning atmosphere and can be used as an innovative learning alternative to improve the quality of education in madrasah environments.

Corresponding Author:

Siti Rohimah Maspupah,
Universitas Islam Negeri Raden Intan Lampung, Indonesia
Email: roimahsitiroimah660@gmail.com

1. INTRODUCTION

Education in the contemporary era demands deep cognitive and affective engagement from students to achieve sustained academic success (Alam & Mohanty, 2024; Kahu & Nelson, 2018). One psychological determinant that plays a crucial role in this dynamic is interest in learning. Conceptually, interest is defined as a personal psychological tendency strongly related to an individual's attitudes and preferences toward a particular object (Ufer et al., 2017). Interest is not merely a fleeting attraction

but rather a fundamental modality capable of activating internal drive and a spirit of persistence in achieving goals. Educators need to understand that students with intrinsic interest will demonstrate a strong desire to explore new knowledge, experiences, and challenges in the learning process (Alamri et al., 2020; Chaudhuri, 2020).

Operationally, interest in learning is manifested through four main, interacting indicators: feelings of enjoyment, stable interest, focused attention, and active participation in instructional activities (Bernacki & Walkington, 2018; Harackiewicz, 2016; Romine et al., 2020; Rotgans & Schmidt, 2017). These dimensions are crucial parameters for educators to evaluate the extent to which the learning process accommodates students' psychological needs. Students with strong interest tend to demonstrate consistent attention, better memory for material, and a sense of satisfaction that encourages continued engagement in relevant academic activities (Kahu et al., 2017). In addition to internal factors such as personal motivation and aspirations, interest is also shaped by external factors, including social support, the teacher's role as a facilitator, and the comfort of the school's physical facilities (Asadpour et al., 2025).

The implementation of the Islamic education curriculum, particularly in the subject of Fiqh (Islamic jurisprudence), often faces complex methodological challenges (Abdillah et al., 2025; Zul et al., 2026). Fiqh, as a discipline that regulates the procedures for worship and transactions, requires a deep and applicable conceptual understanding. However, the effective delivery of this material is often hampered by a conventional, teacher-centered pedagogical approach. Failure to integrate innovative learning strategies directly impacts a decline in overall student interest and engagement (Feng & Xiao, 2024).

This phenomenon was clearly illustrated through a preliminary study conducted at Walisongo Islamic Junior High School, Central Lampung. Observations and interviews revealed a discrepancy between the curriculum's targets and the empirical reality in the classroom. Student enthusiasm for Fiqh learning was relatively low, characterized by minimal active involvement and teachers' inadequate use of instructional technology. Specific data shows that the happiness indicator only reached 23%, while student attention was at an even lower 20%. This situation is exacerbated by the highly demanding workload of students in Islamic boarding schools, which often drains their physical energy and concentration during formal classroom learning. Many students tend to be passive, reluctant to ask questions, and even neglect academic assignments due to boredom with monotonous lectures.

In response to this interest crisis, a new paradigm in learning strategies is needed that can transform students' roles from passive recipients of information to active constructors of knowledge. One model with a strong theoretical foundation to address this challenge is Process-Oriented Guided Inquiry Learning (POGIL). POGIL is an inquiry-based learning model designed to develop process skills, critical thinking, and collaboration in small groups (Ananda, 2019; Idul & Caro, 2022; Munandar, 2020; Wahyuni et al., 2025). Through this approach, students are guided to discover concepts independently through a cycle of exploration, concept discovery, and application (Ariyati et al., 2021; Treagust et al., 2020).

The main advantage of POGIL lies in its structure, which requires the active participation of each group member through a clear division of roles (Barthlow & Watson, 2014; Haryati, 2018; Rumain & Geliebter, 2020). In this context, the teacher no longer acts as the sole source of information but rather as a facilitator and guide, directing the students' inquiry process. The implementation of POGIL is believed to create a more dynamic and enjoyable learning environment (Johnson, 2016; Wahyuningsih, 2021; Yuliastini et al., 2018), thereby mitigating boredom caused by the high workload of Islamic boarding schools. Students can naturally cultivate their interest in learning through meaningful, hands-on experiences by encouraging them to answer hypotheses, conduct experiments, and present their findings (Gao et al., 2025; Wilujeng et al., 2024).

This research positions itself within a significant research gap compared to previous literature. A review of prior studies, including those by Damanik et al. (2024); Zaenal and Hermawan (2022), indicates that most research on the POGIL model primarily concentrates on enhancing cognitive learning outcomes as the main dependent variable. In contrast, this study specifically addresses learning interest as its central focus. This shift in focus is based on the argument that without a strong foundation of interest, learning outcomes tend to be superficial and unsustainable.

Furthermore, the originality of this research lies in its focus and subject. Previous POGIL studies have primarily focused on pure science subjects, like chemistry or science (Canelas et al., 2019; Idul & Caro, 2022). This research expands the application of the POGIL model to the domain of Islamic Religious Education, specifically Fiqh (Islamic Jurisprudence), in a madrasah (Islamic boarding school) integrated with the Islamic boarding school (pesantren). The characteristics of the Islamic boarding school environment, which poses challenges in time and energy management for students, provide a novel dimension in examining the effectiveness of the POGIL model on the resilience of students' learning interest. This study uses a detailed questionnaire that looks at interest through four psychological factors (pleasure, involvement, attention, and interest), giving a fuller picture than just test scores.

Thus, this study aims not only to test the effectiveness of a model but also to provide practical contributions to Islamic educational institutions in designing innovative learning strategies that can compete with the dynamics of Islamic boarding school activities. It is hoped that these findings can serve as a reference for educators in creating a more interactive and critical Fiqh learning ecosystem that can foster academic enthusiasm among students.

2.   METHOD

This research utilized a quantitative methodology featuring a quasi-experimental framework and a post-test-only control group design. This design employed two classes as samples: class VIII C, the experimental class, which received treatment using the POGIL (Process-Oriented Guided Inquiry Learning) model, and class VIII D, the control class, which used conventional learning. This study was conducted in the even semester of the 2025/2026 academic year at Walisongo Islamic Junior High School

(MTS) in Central Lampung. Sampling was conducted using a simple random sampling technique, with both classes randomly selected from a population of 192 eighth-grade students. After the treatment was administered to the experimental class, both classes were given a post-test questionnaire to measure learning interest, specifically the indicator of student attention.

Posttest-Only Control Group

$$R \quad x \quad O_1$$
$$R \quad - \quad O_2$$

Figure 1. Post-test-only Control Group Design

The steps in implementing the POGIL model in the experimental class began with the orientation stage, where the teacher created a fun and conducive learning atmosphere and motivated students to focus on the fiqh material being studied. Next, in the exploration stage, students are divided into small groups and given student worksheets (LKPD) designed to stimulate discussion and collaboration. The teacher acts as a facilitator, guiding the exploration process. Following this, in the concept invention/concept formation stage, students actively identify problems in the LKPD, discuss answers, and develop concepts or main ideas related to the fiqh material. In the application stage, students are encouraged to apply their acquired understanding to other relevant situations or contexts to reinforce their concepts. The activity concludes with a closure stage, where each group presents the results of their discussions, and the teacher ensures that the conclusions reached are correct and understandable to all students.

The instrument used in this study was a non-test questionnaire designed to measure students' learning interests, with a particular focus on attention indicators, as developed from Slameto's theory. The questionnaire consisted of 16 items, both positive and negative, with five Likert-type response options. The validity and reliability of the instrument were first tested using Pearson correlation and Cronbach's Alpha coefficient to ensure the validity of the data. The prerequisite test was conducted using the normality test using the One Sample Kolmogorov-Smirnov method, while data analysis was conducted using the t-test (independent samples t-test) to determine the difference in learning interest between the experimental and control classes after the treatment was administered. Through this series of procedures, the study is expected to provide a comprehensive picture of the effectiveness of the POGIL learning model in increasing students' attention in fiqh learning.

3. RESULTS AND DISCUSSION

Results

The main goal of this research is to assess how well the Process-Oriented Guided Inquiry Learning (POGIL) framework helps engage students in the Fiqh curriculum at MTS Walisongo, Central Lampung. Specifically, this study focuses on the 'attention' indicator as a cornerstone of student interest. By using this student-focused method in the 2025/2026 school year, the study aims to find out if organized questioning and

teamwork can greatly improve students' attention and involvement in religious education classes.

Validity Test

Validity testing was conducted to ensure that the questionnaire instrument used was truly capable of accurately measuring attention indicators in students' learning interests. In this study, the validity testing of the statement items was conducted using the Pearson Product Moment correlation technique. This test compares the calculated r_value obtained from each item with the r_table at a significance level of 5% (alpha = 0.05). Based on the results of the analysis of the 16 statement items tested, the instrument items were declared valid if the calculated r_value > r_table. This step is crucial to ensure that the collected data has high accuracy, so that the generalization of the research results regarding the effectiveness of the POGIL model at MTS Walisongo can be scientifically justified.

Table 1. Validity Test

No	R-Table	R-Count	Information
1	0,281	0,126	Invalid
2	0,281	0, 583	Valid
3	0,281	0, 501	Valid
4	0,281	0, 361	Valid
5	0,281	0, 395	Valid
6	0,281	0, 478	Valid
7	0,281	0, 287	Valid
8	0,281	0, 389	Valid
9	0,281	0, 510	Valid
10	0,281	0, 443	Valid
11	0,281	0, 590	Valid
12	0,281	0, 383	Valid
13	0,281	0, 455	Valid
14	0,281	0, 595	Valid
15	0,281	0, 329	Invalid
16	0,281	0, 413	Valid
17	0,281	0, 505	Valid
18	0,281	0, 091	Invalid
19	0,281	0,209	Invalid
20	0,281	0, 327	Valid

The distribution of r_table at the significance level determined by the specific trial sample size yielded a critical threshold value of 0.281. Statistical analysis of the research instrument indicated that out of the 20 items, 16 were deemed valid as their correlation coefficients (r_count) surpassed the critical value of 0.281. Conversely, four items—numbers 1, 15, 18, and 19—were declared invalid because their correlation values were lower than r_table.

Consequently, only 16 items that met the validity criteria were used in the data collection process, both in the experimental and control classes. This rigorous selection was carried out to ensure that the research instrument had substantial accuracy and high reliability in measuring the effectiveness of the Process-Oriented Guided Inquiry

Learning (POGIL) model on student attention indicators at MTs Walisongo, Central Lampung.

Reliability Test

After going through the validity testing phase, the research instrument was then tested for its reliability to ensure the consistency of the measurement results across time and situations. Reliability testing of the 16 valid items was conducted using Cronbach's Alpha statistical techniques. Based on instrument reliability criteria, a questionnaire is categorized as reliable and has good internal consistency if the alpha coefficient value obtained is greater than the threshold of 0.60.

Table 2. Reliability Test

Reliability Statistics	
Cronbach's Alpha	N of Items
,703	20

The results of data analysis using statistical software, a Cronbach's Alpha value of 0.703 was obtained for the 20 items of the tested instrument. Considering that the value of $0.703 > 0.60$, it can be concluded that the learning interest questionnaire instrument (attention indicator) is declared reliable. The high value of this coefficient indicates that the instrument has a stable level of reliability, so it can provide consistent measurement results even though it is used repeatedly to measure the same variables in the student population at MTs Walisongo, Central Lampung.

Normality Test

Before testing the hypotheses, the research data were first tested for normality to ensure that the learning interest variable (attention indicator) was normally distributed. This test is an absolute prerequisite for using parametric statistics. In this study, the normality test was conducted using the One-Sample Kolmogorov-Smirnov method with the aid of SPSS software.

The decision-making criteria for this normality test were based on the significance value (p-value) or asymptotic significance. Data were considered normally distributed if the significance value obtained was greater than the specified significance level (alpha = 0.05). The test results showed that the significance values for both the experimental and control classes were above the 0.05 threshold. With this normality met, data analysis could proceed using a t-test (independent samples t-test) to compare the average learning interest between the two sample groups at MTs Walisongo, Central Lampung.

The test results show different data distribution characteristics between the two sample groups. In the control group, a significant value of 0.143 ($p > 0.05$) was obtained, which indicates that the data in that group is normally distributed. However, in the experimental group using the POGIL model, a significance value of <0.001 ($p < 0.05$) was obtained, so the data was declared not normally distributed. Because one of the basic assumptions of parametric statistics was not met (the normality assumption was violated in the experimental group), the comparative analysis of learning interest

between the two classes at MTs Walisongo, Central Lampung was directed using a non-parametric statistical test, namely the Mann-Whitney U Test as an alternative to the Independent Samples T-Test.

Table 3. Normal Tests

Group	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Experiment	,209	26	,005	,814	26	<,001
Control	,218	19	,018	,925	19	,143

Mann Whitney test

Due to the non-normal distribution of the data, this study employed the Mann-Whitney test as the primary inferential analysis method. This analysis was complemented by the acquisition of rank data to descriptively evaluate differences in student attention levels. This non-parametric approach ensures the validity of the conclusions drawn despite the non-symmetrical distribution of the data, allowing for high-precision measurement of the effectiveness of the POGIL model.

Table 4. Mann Whitney test

Group	N	Mean Rank	Sum of Ranks
Experiment	26	31,00	806,00
Control	19	12,05	229,00
Total	45		

Table 5. Test Statistics

Test Statistics[a]	
	Result
Mann-Whitney U	39,000
Wilcoxon W	229,000
Z	-4,843
Asymp. Sig. (2-tailed)	<,001
a. Grouping Variable: Kelompok	

The data analysis results show an Asymp. Sig. (2-tailed) value of <0.001, which is significantly lower than the established significance level (alpha = 0.05). This provides strong statistical evidence to reject H_0 and accept H_a, thus concluding that there is a significant difference between the learning outcomes (interest and attention) of the experimental and control groups at MTS Walisongo, Central Lampung.

Further analysis of the direction of the difference shows that the experimental group had a significantly higher Mean Rank score, namely 31.00, compared to the control group, which only achieved 12.05. This contrasting superiority in the average rank scores indicates that the implementation of the POGIL learning model is far more effective in fostering students' attention and interest in learning Fiqh compared to conventional methods.

Homogeneity Test

After the normality test is performed, the next prerequisite step in the analysis is a homogeneity test to determine whether the experimental and control groups have the

same data variance (homogeneity). This test is performed using Levene's Test with the aid of statistical software. The homogeneity assumption is met if the significance value (p-value) obtained is greater than the specified significance level (alpha = 0.05).

Table 6. Homogeneity Test

		Levene Statistic	df1	df2	Sig.
Result	Based on Mean	,070	1	43	,793
	Based on Median	,011	1	43	,915
	Based on Median and with adjusted df	,011	1	40,309	,915
	Based on trimmed mean	,018	1	43	,895

The homogeneity test results in Table 6 show a significant value of 0.793. Since the p-value is > 0.05, the assumption of homogeneity of variance between the experimental and control groups has been met. The stability of these data characteristics provides a strong statistical basis for researchers to continue the analysis to the difference (comparative) test stage to evaluate the impact of implementing the POGIL model on student attention at MTs Walisongo.

Hypothesis Testing

The final stage of data analysis was hypothesis testing to determine whether there was a significant difference in learning interest (an indicator of attention) between the experimental and control classes. Given that the assumption of normality was not met in one of the groups, testing was conducted using non-parametric statistics using the Mann-Whitney U test.

Table 7. Hypothesis Testing

	Levene's Test for Equality of Variances		t-test for Equality of Means							
					Significance		Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
	F	Sig.	t	df	One-Sided p	Two-Sided p			Lower	Upper
Equal variances assumed	8,400	,006	2,526	43	,008	,015	2,168	,858	,437	3,899
Equal variances not assumed			2,812	36,547	,004	,008	2,168	,771	,605	3,731

Although the assumption of normality was not fully met, the consistency of the statistical findings was still tested through various analytical approaches. As an additional verification step, the t-test results in the Equal variances not assumed section

showed a two-sided p value of 0.008. This figure strengthens the empirical evidence of a significant difference between the two sample groups. Referring to the Post-Test Only Control Group research design, these data confirm that the difference in student learning interest scores was purely influenced by the treatment, namely the implementation of the Process-Oriented Guided Inquiry Learning (POGIL) learning method in the experimental group.

From the results of the comprehensive analysis conducted, this study concluded that the implementation of the Process-Oriented Guided Inquiry Learning (POGIL) learning model significantly increased students' attention and learning interest at MTs Walisongo, Central Lampung. The validity of this finding is strongly supported by the achievement of a statistical significance value that is far below the critical threshold ($p < 0.001$). The superiority of the POGIL model is reflected objectively through the average ranking (mean rank) of the experimental group of 31.00, which, in contrast, exceeds the control group's score of 12.05. This finding indicates that the systematic syntax of POGIL—from the exploration phase to concept discovery—is able to stimulate cognitive engagement and student focus more optimally compared to conventional approaches.

Discussion

This study provides substantial empirical evidence that the implementation of the Process-Oriented Guided Inquiry Learning (POGIL) model is significantly more effective in increasing student attention and learning interest compared to conventional methods. Based on data analysis conducted at MTS Walisongo, Central Lampung, several crucial points underlie the model's success in optimizing attention indicators in Fiqh subjects.

Instrument Validity and Reliability

Prior to hypothesis testing, this research instrument underwent a rigorous psychometric evaluation to ensure the quality and integrity of the collected data. Based on the results of the item validity test, of the 20 items developed, 16 were declared valid with an r_count value > 0.281. Theoretically, achieving this value confirms that the instrument possesses adequate construct validity, where the questions accurately represent indicators of student attention and learning interest. As stated by Emerson (2024), validity is the degree of accuracy between the data obtained from the research object and the data reported by the researcher; a valid instrument means that the measuring tool is indeed appropriate for measuring what it is intended to measure.

In addition to validity, this instrument also demonstrated strong internal consistency, with a Cronbach's Alpha value of 0.703. According to the criteria established by Ahmad et al. (2024), an instrument is considered reliable and suitable for use in social research if it has an alpha coefficient above 0.60.

This value of 0.703 indicates that the research instrument has excellent stability, meaning the measuring device will produce consistent data even when used repeatedly on the same student population under similar conditions. This reliability is crucial for

minimizing measurement error and ensuring that subsequent statistical analysis results are scientifically sound.

Comparative Analysis: The Superiority of POGIL over Conventional Methods

The main findings of this study indicate a statistically significant difference in student engagement scores between the experimental and control classes. Based on the results of the Mann-Whitney U test, the Asymp. Sig. (2-tailed) value was <0.001, which is well below the significance threshold of alpha = 0.05. This empirical finding provides a strong basis for rejecting the null hypothesis (H_0) and accepting the alternative hypothesis (H_a), confirming that the learning model intervention had a significant impact.

The data show that the experimental group implementing the Process Oriented Guided Inquiry Learning (POGIL) model achieved a Mean Rank of 31.00, in contrast to the control group, which only achieved 12.05. This striking difference in mean ranks demonstrates that POGIL has a significantly greater positive impact on student engagement compared to conventional methods.

Theoretically, the superiority of POGIL is rooted in Vygotsky's Social Constructivism theory, which posits that optimal learning occurs through social interaction and structured guidance (Belolutskaya et al., 2022). Previous studies by Gao et al. (2025); Idul and Caro (2022); Walker and Warfa (2017) also support these findings, stating that the POGIL structure—which emphasizes teamwork with specific roles and the inquiry cycle (exploration, concept discovery, and application)—inherently forces students to engage actively both cognitively and socially. The low scores in the control class confirm that without a systematic inquiry structure, students tend to be passive recipients of information, ultimately limiting their development of interest and engagement in the learning process.

POGIL Syntax and Cognitive Engagement

The excellence of the Process-Oriented Guided Inquiry Learning (POGIL) model is rooted in its systematic structure, which guides students from the exploration stage to concept invention. Unlike conventional methods, where students tend to be passive recipients of information, POGIL encourages active participation in small group work through guided inquiry.

Theoretically, POGIL is based on the principles of Social Constructivism proposed by Vygotsky, where knowledge is constructed through social interaction and the negotiation of meaning. The independent discovery process in this model effectively stimulates curiosity and attention, which are key pillars of student learning interest. In line with Self-Determination Theory, when students feel they have an active role and autonomy in discovering concepts—in this case, the concept of Fiqh—their focus and engagement with the material naturally increase (Xu et al., 2025). This is supported by a study by Shehata et al. (2024), which states that a process-centered learning environment can simultaneously improve students' cognitive and affective skills.

From a methodological perspective, although the normality assumption was not met in the experimental class ($p < 0.001$), this study maintained its scientific integrity by applying the non-parametric Mann-Whitney U statistic as a robust alternative. This decision was appropriate because the non-parametric test does not rely on a specific population distribution, thus remaining valid for skewed data. To strengthen the validity of the findings, additional verification was conducted using the Independent Sample t-test (assuming equal variances not assumed). The results showed significant consistency with a p value of 0.008. This consistency between the parametric and non-parametric tests provides irrefutable empirical evidence that the difference in achievement between the two classes was indeed the result of the POGIL model intervention, not due to chance or statistical bias.

The implementation of the Process-Oriented Guided Inquiry Learning (POGIL) model at Walisongo Islamic Junior High School (MTS) has been empirically proven to transform the dynamics of Islamic jurisprudence (Fiqh) learning, making it more interactive and student-centered. This finding aligns with modern educational research trends, which confirm that structured inquiry-based learning is more effective in maintaining student attention than teacher-centered lectures. POGIL serves not only as a tool to improve cognitive understanding but, more fundamentally, can build sustained interest through active engagement. This aligns with Sweller's Cognitive Load Theory, where POGIL's systematic design helps students manage complex information by breaking it down into manageable stages of exploration, thereby preventing mental fatigue and maintaining optimal student focus.

This research significantly contributes to the educational literature by demonstrating that process-oriented learning models like POGIL can be effectively applied to religious subjects (Fiqh), not just science. These results enrich the body of knowledge regarding the flexibility of POGIL syntax—from the exploration stage to concept discovery—in maximizing students' cognitive engagement and attention in normative-juridical materials such as Fiqh.

In addition to pedagogical contributions, this study also provides methodological support in terms of the appropriate use of non-parametric statistics. The use of the Mann-Whitney U test when the assumption of data normality was not met demonstrates the researcher's integrity in maintaining the internal validity of the study. This demonstrates that the generalizability of the research results remains scientifically sound even though the data are non-normally distributed. Thus, this study confirms that an appropriate statistical approach, combined with an innovative learning model, can produce robust and credible conclusions for improving the quality of education in madrasahs.

4. CONCLUSION

The implementation of the Process-Oriented Guided Inquiry Learning (POGIL) model was significantly more effective in increasing student attention and interest in Islamic jurisprudence (Fiqh) compared to conventional methods. This is evidenced by the Asymp. Sig. (2-tailed) value of <0.001, which is significantly lower than alpha = 0.05. Therefore, H_0 is rejected and H_a is accepted. The superiority of the POGIL

model is evident in the Mean Rank score of 31.00 for the experimental group, which significantly exceeds the score of 12.05 for the control group. All data were based on a valid instrument (16 statement items) and were reliable with a Cronbach's Alpha value of 0.703, thus ensuring high accuracy and consistency in the study results. Furthermore, the systematic procedure in POGIL—from the exploration stage to concept discovery— has been shown to stimulate cognitive engagement and maintain student focus throughout the learning process.

As a recommendation, Fiqh teachers are advised to begin integrating the POGIL model as an alternative active learning method to address student boredom and improve classroom attention. Teachers need to develop Student Worksheets (LKS) or modules that support the guided inquiry stages so that the POGIL syntax can be implemented optimally. Given that this study focused on indicators of attention and interest, future researchers can expand their research to other dependent variables, such as cognitive learning outcomes or critical thinking skills. Furthermore, it is recommended to conduct similar research with a wider population or at different educational levels to strengthen the generalizability of findings regarding the effectiveness of the POGIL model.

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