



# The effectiveness of the argument-driven inquiry model based on the toulmin argumentation pattern on the argumentative writing skills of eleventh grade senior high school students

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## ABSTRACT

This study was motivated by the low ability of students to write argumentative texts that are logical, systematic, and evidence-based. The research aimed to examine the effectiveness of the Argument-Driven Inquiry (ADI) model based on the Toulmin Argumentation Pattern (TAP) in improving the argumentative writing skills of eleventh-grade students at SMA Negeri 3 Padang. The study employed a pre-experimental method with a one-group pretest-posttest design. The sample consisted of 37 students selected through simple random sampling. Data were collected using a performance test of argumentative writing and analyzed using normality testing, homogeneity testing, paired sample t-test, and N-Gain calculations. The results showed a significant increase in students' argumentative writing skills after the implementation of the TAP-based ADI model, with the average score increasing from 59.60 (pretest) to 72.32 (posttest). The paired sample t-test produced a t-value of -18.714 with Sig. (2-tailed) = 0.000 < 0.05, while the N-Gain value of 0.31 fell into the medium category. These findings indicate that the TAP-based ADI model is effective in enhancing the argumentative writing skills of eleventh-grade students at SMA Negeri 3 Padang.

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## INTRODUCTION

Education in the era of the Industrial Revolution 4.0 and Society 5.0 positions critical thinking skills and literacy competencies as the primary capital for personal and professional success. Among these competencies, argumentative ability emerges as an essential foundation for active participation in academic discourse and public life. In the context of Senior High School, the demand for this skill increases as students are required to engage with complex materials and produce written works that are not merely descriptive, but analytical, persuasive, and evidence-

based (Driver et al., 2000). This learning is crucial because it allows students to express their ideas and viewpoints. The importance of argumentative writing is stated in the Learning Outcomes under the writing element, which emphasizes that students must be able to write ideas, thoughts, viewpoints, and metacognitive knowledge for various purposes in a logical, critical, and creative manner. Students are also expected to produce various types of literary works, reflective texts, research reports, functional workplace texts, and academic writing, as well as publish their writings in print or digital media. Derived from these outcomes, the Learning Objective Sequence requires students to write argumentative texts related to new and complex phenomena in science, social studies, or the humanities, supported by claims and evidence from observation, experience, and references. Thus, the learning goal emphasizes the ability to write argumentative texts by paying attention to key components, such as factual and opinion sentences.

However, based on observations of argumentative texts written by eleventh-grade students at SMA N 3 Padang, it was found that most students were unable to construct proper argumentative texts. Students struggled to articulate their opinions and were unable to present supporting facts to justify their claims. Interviews with the Indonesian language teacher revealed that students found it difficult to begin writing due to a lack of ideas and limited vocabulary. Moreover, the students' difficulty was exacerbated by their limited understanding of the debated topic, preventing them from finding strong and specific evidence. Similar findings were reported by Firdaus et al. (2024), who stated that students' main difficulty in argumentative writing lies in developing ideas into coherent texts. Passive attitudes, low learning motivation, insufficient practice, and the tendency to copy content from online platforms further hinder students' ability to formulate original ideas in writing.

Another factor contributing to these difficulties is the dominance of teacher-centered learning. In this model, teachers act as the primary source of knowledge through lectures, while students remain passive, merely listening, taking notes, and memorizing. Consequently, students rarely engage in critical discussions, independent claim formulation, or authentic evidence exploration. This passive learning environment directly inhibits the development of higher-order thinking skills required in argumentation, such as analyzing evidence, evaluating proof, and constructing logical warrants. Without practice in defending their claims or responding to counterarguments, students struggle to translate logical reasoning into coherent and convincing argumentative texts. Rosyidah et al. (2023) similarly argue that high school students' argumentative skills remain low because their curiosity is underdeveloped and the instruction remains teacher-centered.

Argumentative writing is inherently challenging because its purpose is to persuade and convince readers about what should or should not be done. Argumentative texts present the writer's opinions supported by reasons and evidence delivered logically and objectively (Mahsun, 2014). Putri (2018) also notes that argumentative writing is often perceived as difficult because it requires critical thinking, scientific ideas, and strong argumentative expression. Effective argumentative writing is characterized by coherent structure, valid evidence, and logical conclusions. However, findings from national and international studies show that eleventh-grade students often encounter fundamental difficulties related to the substance and structure of arguments. Students frequently fail to provide relevant, sufficient, or credible evidence (grounds) to support their claims, often resorting to personal opinions or untested generalizations instead of evidence-based reasoning. Even when evidence is provided, students often struggle to justify the logical relationship between the evidence and the claim, reflecting their inability to construct warrants or strong backings (Erduran, Simon, & Osborne, 2004). As a result, their argumentative texts become fragmented, unconvincing, and often lack rebuttals to opposing viewpoints. These weaknesses indicate the need for pedagogical interventions that address both content development and argument structure.

National reports also indicate that Indonesian students' literacy skills remain relatively low, particularly in writing. According to the Policy Brief issued by the Agency for Standards,

Curriculum, and Assessment of Education (BSKAP) of the Ministry of Education, the average reading literacy score of Indonesian students in PISA 2022 reached only 359 points, far below the OECD average (around 487 points). This condition reflects students' limited ability to comprehend complex texts and engage in critical thinking, which consequently affects the quality of their argumentative writing. In addition, a study conducted by Nakrowi et al. (2023) found that 97.5% of senior high school students demonstrated low scores in argument structure when assessed using the Toulmin framework, and substantively, 81.25% of them obtained low scores when evaluated based on the Intellectual Standards.

One approach proven effective for fostering scientific reasoning is the Argument-Driven Inquiry (ADI) model. ADI is an instructional framework that explicitly integrates inquiry and scientific argumentation at the core of learning. It guides students through structured steps, including problem identification, data collection, argument production (containing claims, evidence, and justification), and final report writing (Sampson, Grooms, & Walker, 2011). The model effectively addresses issues of argument substance by engaging students in authentic contexts that require them to generate empirical evidence as the basis for their arguments. ADI also encourages students to evaluate the relevance and quality of evidence before using it to support claims. Sampson et al. (2013) highlight that ADI enhances students' abilities to construct and communicate arguments both orally and in writing. Moreover, ADI emphasizes personal interaction between teachers and students, allowing better understanding of the material (Adistia et al., 2021). Hamidah (2025) further emphasizes that ADI has strong potential to foster argumentative writing skills because each stage systematically supports the construction of claims, evidence, warrants, qualifiers, and rebuttals.

Although ADI effectively develops evidence, it still requires a more explicit structure for organizing arguments into coherent texts. Therefore, this study incorporates the Toulmin Argumentation Pattern (TAP). Toulmin (2003) provides a micro-level structure for constructing arguments using six key components: Claim, Data, Warrant, Backing, Qualifier, and Rebuttal. This pattern functions as a cognitive scaffold, helping students logically structure evidence-based arguments. TAP is especially beneficial for high school students because it helps them move beyond personal opinions and justify the logical link between evidence and claim – one of the most common challenges in argumentative writing. The inclusion of rebuttals promotes critical thinking by training students to anticipate and respond to opposing viewpoints, making their texts more comprehensive and persuasive.

Fulkerson (1996) and Wood (2001) argue that Toulmin's model helps students move beyond opinion-based argumentation toward evidence-tested reasoning. It develops critical thinking skills by requiring students to identify and differentiate argument components, analyze evidence, and apply logical justification. TAP also improves coherence in argumentative essays by providing explicit scaffolding for organizing ideas. Additionally, the model strengthens rebuttal skills, enabling students to construct strong, convincing, and academically sound arguments.

Thus, integrating the ADI model with the Toulmin Argumentation Pattern creates an optimal synergy. ADI serves as the generator of empirical evidence and inquiry context, while TAP functions as the structural blueprint for organizing this evidence into a complete, logical, and coherent argument – particularly in written form. Choi (2021) found that this integration significantly improved the quality of oral argumentation, further supporting its pedagogical potential.

Several previous studies have demonstrated that the Argument-Driven Inquiry (ADI) model is effective in improving students' critical thinking skills and scientific argumentation. Likewise, the Toulmin Argumentation Pattern (TAP) has been widely used to support students in constructing complete and well-structured arguments, consisting of claims, data, warrants, and backings. However, studies that integrate ADI and TAP within the context of Indonesian language learning, particularly in the skill of writing argumentative texts, remain very limited. Most existing research

focuses on science subjects or laboratory-based settings, making their application in language learning, which has distinct characteristics, insufficiently explored.

In addition, these studies generally emphasize oral argumentation skills or scientific problem-solving rather than fully developed written argumentation. This indicates the presence of a research gap, namely the lack of empirical studies examining the effectiveness of integrating the ADI model and the Toulmin argumentation pattern in improving students' argumentative writing quality. Yet, an approach that guides students to produce evidence-based arguments in a gradual and systematic manner is highly relevant to addressing the problem of low argumentative writing skills in secondary schools.

Based on the above explanation, there is a need for research that specifically examines the effectiveness of implementing the Argument-Driven Inquiry (ADI) model integrated with the Toulmin Argumentation Pattern (TAP) in teaching argumentative writing. This study is expected to fill the gap in previous research and contribute to Indonesian language teaching practices that are more oriented toward developing students' argumentative skills.

## RESEARCH METHODOLOGY

This study employed a quantitative approach using a pre-experimental method with a one-group pretest-posttest design to examine the effectiveness of the Argument-Driven Inquiry (ADI) model integrated with the Toulmin Argumentation Pattern (TAP) on students' argumentative writing skills. The study population consisted of all eleventh-grade students at SMA Negeri 3 Padang in the 2024/2025 academic year. The population was first tested for normality and homogeneity as the basis for sample determination. After meeting the criteria of normal and homogeneous distribution, the sample was selected using a simple random sampling technique, resulting in class XI F3 with 37 students being designated as the research subjects.

The primary instrument was a performance test in which students produced argumentative texts during both the pretest and posttest stages. Content validity was established through evaluations by three experts using a validation sheet that assessed construct alignment, competency indicators, and linguistic appropriateness. Instrument reliability was determined through inter-rater reliability analysis using Cohen's Kappa coefficient involving two independent raters, which indicated a high level of scoring consistency ( $\kappa > 0.75$ ). The writing performance was assessed using an analytic rubric comprising five indicators: clarity of claim, adequacy and relevance of data, accuracy of warrant/backing, coherence of argument organization, and language accuracy. Each dimension was scored on a 1–5 scale.

The research procedure consisted of preparation, implementation, and data collection stages. The implementation stage was carried out over four meetings (each lasting  $2 \times 45$  minutes). The first meeting was used to administer the pretest, while the subsequent meetings were allocated for the treatment using the ADI syntax, which included: (1) problem identification, (2) investigation planning, (3) data collection, (4) construction of arguments using the Toulmin model, (5) argumentation session, (6) argument revision, and (7) reflection. The posttest was administered at the end of the treatment.

Several strategies were employed to control threats to internal validity: (1) practice effects were minimized by using different but equivalent sets of pretest and posttest tasks; (2) history threats were controlled by maintaining a consistent learning environment throughout the relatively short research period (two weeks); and (3) maturation threats were reduced by ensuring consistent treatment duration and controlling external variables. Data were analyzed using SPSS. Preliminary tests (normality and homogeneity) were conducted prior to inferential analysis. Differences between pretest and posttest scores were examined using the Paired Sample t-Test, and the effectiveness of the treatment was determined through the calculation of N-Gain.

## RESULTS AND DISCUSSIONS

The results of this study consist of three parts, namely the students' ability to write argumentative texts before the implementation of the Argument-Driven Inquiry (ADI) model based on the Toulmin Argumentation Pattern (TAP), the students' ability to write argumentative texts after the implementation of the Argument-Driven Inquiry (ADI) model based on the Toulmin Argumentation Pattern (TAP), and the results of hypothesis testing. The indicators used to assess the students' argumentative texts refer to the structure of argumentation based on the Toulmin framework, which includes claim, data, warrant, backing, qualifier, and rebuttal. The results of students' ability to write argumentative texts before applying the Argument-Driven Inquiry (ADI) model based on the Toulmin Argumentation Pattern (TAP) can be seen in the following table.

**Table 1.** Frequency Distribution of Students' Argumentative Writing Scores Before Using the Argument-Driven Inquiry (ADI) Model Based on the Toulmin Argumentation Pattern (TAP)

No.	Score	Frequency	Percentage
1	54	1	2,7%
2	55	1	2,7%
3	57	5	13,5%
4	58	6	16,2%
5	59	10	27%
6	60	1	2,7%
7	61	3	8,1%
8	62	4	10,8%
9	63	3	8,1%
10	64	1	2,7%
11	65	2	5,4%
Total		37	100%

Based on the table, the frequency distribution of scores from 37 students during the pretest shows that the score range is between 54 and 65. The most frequent score obtained by students was 59, with a frequency of 10 students or 27%, making it the mode of the data. The scores 58 and 57 also had relatively high frequencies, with 6 students (16.2%) and 5 students (13.5%), respectively, indicating that most students fell within the middle score group, ranging from 57–59. The least frequent scores, each obtained by only 1 student (2.7%), were 54, 55, 60, and 64, while higher scores such as 65 were obtained by 2 students (5.4%). Based on the calculation, the mean score was 59.6 with a standard deviation of 2.6, indicating that the score distribution was not widely dispersed and the differences among students were not substantial.

The results of students' argumentative writing ability after applying the Argument-Driven Inquiry (ADI) model based on the Toulmin Argumentation Pattern (TAP) can be seen in the following table.

**Table 2.** Frequency Distribution of Students' Argumentative Writing Scores After Using the Argument-Driven Inquiry (ADI) Model Based on the Toulmin Argumentation Pattern (TAP)

No.	Score	Frequency	Percentage
1	67	2	5,4%
2	68	2	5,4%
3	69	1	2,7%
4	70	4	10,8%
5	71	6	16,2%
6	72	4	10,8%
7	73	6	16,2%
8	74	4	10,8%
9	75	5	13,5%

10	76	1	2,7%
11	78	1	2,7%
12	80	1	2,7%
Total		37	100%

Based on the table, the posttest scores of the 37 students ranged from 67 to 80. The most frequently appearing scores were 71 and 73, each achieved by 6 students (16.2%), making them the mode of the distribution. The score of 75 also appeared relatively often, with 5 students (13.5%) obtaining it. Meanwhile, the scores 70, 72, and 74 were recorded by 4 students each (10.8%), showing that the majority of learners were clustered within the 70–75 range. Several scores appeared infrequently – 69, 76, 78, and 80 – each recorded by only 1 student (2.7%). The lowest scores, 67 and 68, were achieved by 2 students each (5.4%). The average posttest score reached 72.32 with a standard deviation of 2.97, indicating that the spread of students' scores was relatively small. The following presents a comparison diagram of the pretest and posttest scores.

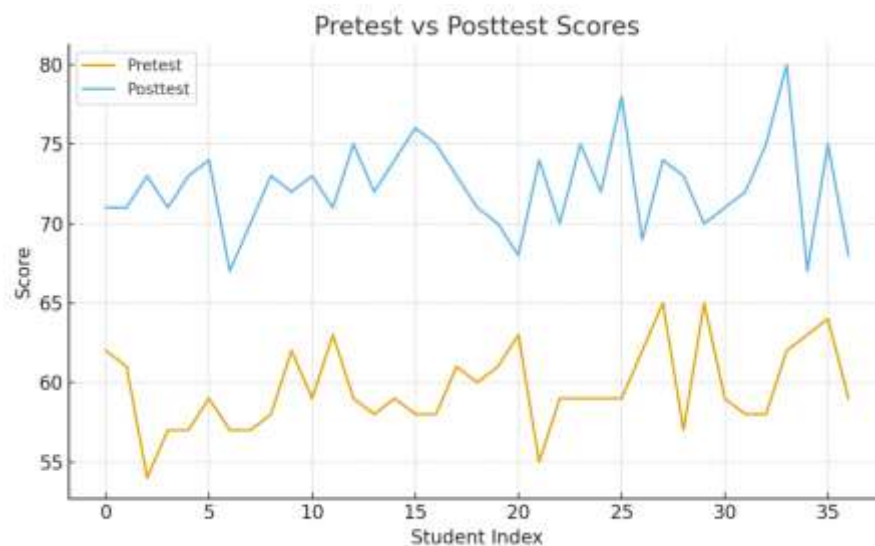


Figure 1. Comparison of pretest and posttest scores

This graph shows the change in each student's score before and after the treatment. It is clearly visible that almost all students experienced an increase in their scores. Before performing the hypothesis test, prerequisite analyses were conducted, including tests of normality and homogeneity. The normality test was used to determine whether the distribution of learning outcomes from the sample followed a normal pattern. In this study, SPSS served as the tool for data analysis. The decision rule referred to the p-value: if  $p > 0.05$ , the dataset was considered normally distributed; if  $p \leq 0.05$ , it was considered not normally distributed. The Shapiro–Wilk test was applied to assess the normality assumption. The results are presented in the following table.

**Table 3. Results of the Normality Test**

	Kolmogorov-Smirnov		
	Statistic	df	Sig.
pretest	.215	37	.000
posttest	.093	37	.200*

The analysis showed that the pretest score had a significance value of 0.111, while the posttest score had a significance value of 0.466. Since both values exceed the threshold of 0.05, the pretest and posttest data can be classified as normally distributed.

Following the normality assessment, a homogeneity test was carried out. This test aimed to determine whether the data in both groups had equal variances. Levene's Test, accessed through the One-Way ANOVA feature in SPSS, was employed for this purpose. The decision rule stated that if the significance value (Sig.) was greater than 0.05, the data met the homogeneity assumption. The outcomes of this analysis are presented in the table below.

**Table 4.** Results of the Homogeneity Test

Levene Statistic	df1	df2	Sig.
.072	1	72	.790

Based on the homogeneity test, the Levene Statistic value was 0.072 with a significance value of 0.790. Since the significance value is greater than 0.05, the data are considered homogeneous. Therefore, the data meet the assumption of homogeneity and can be analyzed using parametric statistical tests. In this study, the paired-samples t-test was used to determine the difference between pretest and posttest scores within the same group. The results are presented in the following table.

**Table 5.** Hypothesis Testing Results

		Paired Differences			95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	pretest-posttest	-12.703	4.129	.679	-14.079	-11.326	-18.714	36	.000

Based on the table, the t-value obtained was -18.714 with degrees of freedom (df) = 36 and a significance value (Sig. 2-tailed) = 0.000. Since the significance value is smaller than 0.05, it can be concluded that there is a highly significant difference between the pretest and posttest scores. Thus,  $H_0$  is rejected and  $H_1$  is accepted. This indicates that the implementation of the Argument-Driven Inquiry (ADI) model based on the Toulmin Argumentation Pattern (TAP) is effective in improving students' ability to write argumentative texts.

To determine the improvement of students' abilities after implementing the ADI-TAP model, the N-Gain was calculated. The N-Gain was computed based on the difference between the pretest and posttest scores normalized against the maximum possible score. The following presents a distribution graph of the N-Gain category results.

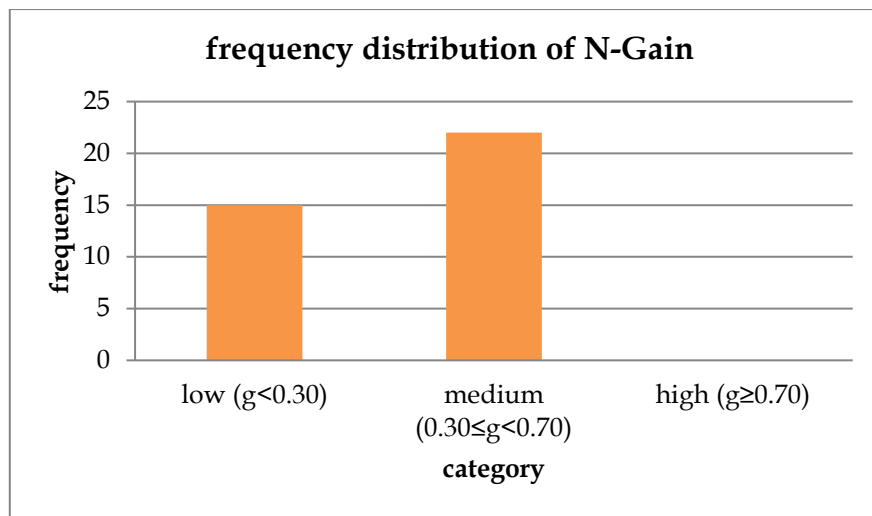


Figure 2. Histogram of N-gain scores frequency distribution

After calculating the N-gain value for each student, the next step is to calculate the overall N-gain to determine the effectiveness of the treatment. The results are shown in the following table.

Table 6. Results of N-Gain Analysis

	N	Minimum	Maximum	Mean	Std. Deviation
ngain	37	.11	.47	.3111	.09096
valid N (listwise)	37				

Based on the results, the 37 respondents had N-Gain values ranging from 0.11 to 0.47. The mean N-Gain value was 0.3111 with a standard deviation of 0.09096. According to Hake's classification, the mean value of 0.3111 falls into the medium category ( $0.3 \leq g \leq 0.7$ ). This indicates that learning using the ADI-TAP model was moderately effective in improving students' ability to write argumentative texts. Thus, it can be concluded that the ADI-TAP model is sufficiently effective for enhancing students' argumentative writing skills.

In implementing the ADI-TAP model, the learning process began with the task identification stage, in which the teacher introduced the subtopic and provided worksheets containing brief materials and guiding questions. This stage helped students focus on the problem to be investigated while preparing the basic components of Toulmin's argumentation, particularly the initial claim to be justified. In the data collection stage, students worked in groups to conduct observations or gather relevant data that served as grounds for constructing their arguments. The collected data were then used in the argument production stage, during which students developed argumentative texts based on Toulmin's components: claim, data, warrant, backing, qualifier, and rebuttal. After drafting their arguments, students discussed them within their groups to ensure logical coherence among all components.

In the argumentative interaction stage, students presented their arguments to other groups to receive feedback in the form of critiques or questions, which served as potential rebuttals within the Toulmin model. This process strengthened students' argumentation by requiring them to defend their claims using evidence. The next stage involved writing investigation reports, in which students presented the complete analysis, procedures, and conclusions based on the Toulmin structure. These reports were then reviewed during the report review stage, where students assessed the quality of other groups' arguments. Based on this review, students revised their reports to improve the strength of their warrants, add backing, or clarify qualifiers. The learning process concluded with a

reflective discussion, allowing students to reflect on both the inquiry process and the construction of arguments.

The findings of this study show that the implementation of the ADI-TAP model significantly improves students' ability to write argumentative texts. This improvement is evident from the medium category of N-Gain values and the significant difference between pretest and posttest scores. The improvement occurs because the ADI syntax – task identification, data collection, argument production, argumentative interaction, and revision – systematically encourages students to construct evidence-based arguments aligned with the Toulmin framework. Toulmin's model provides a structured way of thinking that helps students understand the logical relationships between data and claims, leading to more coherent and analytical argumentative writing.

These findings align with Osborne, Erduran, and Simon (2004), who found that the Toulmin argumentation pattern effectively enhances students' ability to produce complete and high-quality scientific arguments. Moreover, Sampson and Walker (2012) reported that the ADI model provides authentic opportunities for students to develop argumentative skills through evidence-based inquiry and discussion. Similarly, Nurdiana (2020) showed that integrating TAP into writing activities improves the coherence and logical strength of students' argumentative texts. Thus, the findings of this study support previous empirical evidence that the ADI-TAP model is effective not only in science learning but also in language learning, particularly in argumentative writing.

In addition, Ginanjar et al. (2015) found that the ADI model trains students' scientific argumentation skills. Zahara et al. (2018) also noted that active engagement in argumentative sessions helps students better master the content necessary for building strong arguments. Kurniasari & Woro (2017) reported that students' scientific argumentation abilities improved significantly before and after being taught using the ADI model. Similarly, Marhamah et al. (2017) found that the ADI model enhances the levels of students' argumentation skills, from level 1 before implementation to level 3 after implementation.

Furthermore, the medium category of N-Gain indicates that this approach not only improves conceptual understanding but also provides space for students to develop sustained argumentative literacy. This is supported by Nuryanti, Zubaidah, and Susilo (2018), who state that argumentation-based learning improves students' critical thinking skills through collaborative processes that position students as active constructors of knowledge. Therefore, the implementation of the ADI-TAP model in teaching argumentative writing can be recommended as an innovative learning approach that effectively improves students' writing and argumentation skills at the senior high school level.

One of the main limitations of this study is the use of a pre-experimental one-group pretest-posttest design that does not involve a control group. The absence of a comparison group makes it difficult to determine whether the improvement in students' argumentative writing skills is solely attributable to the implementation of the ADI-TAP model. Although several threats to internal validity have been controlled, the potential influence of external factors such as students' learning motivation, prior learning experiences, or other interventions outside the instructional process cannot be fully eliminated. In addition, without a control group, the natural learning progression over time cannot be clearly distinguished from the treatment effect. Therefore, the results of this study should be interpreted cautiously and are limited to the specific classroom context examined. Further research using stronger experimental designs, such as quasi-experimental or true experimental designs, is recommended to obtain more valid and generalizable conclusions.

## CONCLUSION

Based on the findings of the research, several conclusions can be formulated. First, the average score of eleventh-grade students at SMA N 3 Padang in writing argumentative texts prior to the implementation of the Argument-Driven Inquiry (ADI) model integrated with the Toulmin Argumentation Pattern (TAP) was 59.6. Second, their average score increased to 72.3 after the application of the ADI model based on TAP. Third, the ADI-TAP learning model proved effective in enhancing students' argumentative writing performance. This conclusion is supported by the t-

test result of  $-18.714$  with a degree of freedom ( $df$ ) = 36 and a significance level of Sig. (2-tailed) =  $0.000 < 0.05$ , showing that  $H_0$  is rejected and  $H_1$  is accepted. Furthermore, the N-Gain analysis indicates that the improvement achieved through the use of the ADI-TAP model falls within the medium effectiveness category. Therefore, the Argument-Driven Inquiry (ADI) model based on the Toulmin Argumentation Pattern (TAP) can be considered moderately effective in improving the argumentative writing skills of grade XI students at SMA N 3 Padang. Practical implications of these findings are highly significant for teachers and schools, where the Argument-Driven Inquiry - Toulmin's Argument Pattern (ADI-TAP) model is proven to provide an effective framework for explicitly teaching argument structure, thereby improving the quality of students' argumentative writing, especially in constructing claims, evidence, and warrants. Therefore, the adoption of the ADI-TAP model and the provision of adequate teacher training are highly recommended to maximize the model's potential within the curriculum. However, to strengthen the validity of the conclusion, suggestions for further research include using a true experimental design to definitively prove the causal relationship, as well as conducting longitudinal studies to assess the long-term retention of students' skills. Furthermore, exploring ADI-TAP across different educational levels or subject matters, coupled with the integration of qualitative methods, could provide a more comprehensive understanding of its effectiveness and implementation challenges.

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