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The Effectiveness of Structured and Guided Inquiry Learning Models in Enhancing Students' Science Process Skills on Acid-Base Topics in Senior High School

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Abstract: Education is a key factor in shaping students' character and competence. The 2013 Curriculum highlights not only the development of student character but also the enhancement of scientific competence, including science process skills (SPS). One effective approach to developing SPS is through the application of inquiry-based learning models. This study investigates the differences in students' SPS on acid-base topics by comparing the use of structured inquiry and guided inquiry models. The research employed a random sampling technique, and data were collected using observation sheets and field notes. Field notes were analyzed qualitatively to support and enrich the interpretation of observational and quantitative findings. The quantitative data, obtained from essay-based tests, were analyzed using inferential statistics such as the Shapiro-Wilk normality test, homogeneity test, independent t-test, paired t-test, and N-Gain to evaluate learning improvement in both groups. The effectiveness of each model was determined based on the increase in N-Gain scores from pretest to posttest. The results revealed that inquiry-based learning significantly improved students' SPS, with an increase in the average score from 35.18 to 78.33. Additionally, observation data indicated a steady increase in students' engagement and participation throughout the learning sessions, highlighting the benefits of inquiry approaches in science education.

Keywords: Acid-base; Inquiry learning; Science process skills

Introduction

Education serves as a crucial foundation for creating high-quality, creative human resources who are capable of adapting to the evolving times. Amid the era of globalization and the Fourth Industrial Revolution, the field of education faces increasingly diverse and complex challenges, requiring transformation in curricula, teaching methods, and the development of students' competencies and world demands require the education sector to carry out various innovations (Dewi et al., 2024). Activities that are carried out consciously and systematically to enhance knowledge, skills, intelligence, optimize personal potential, and improve student behavior are also referred to as education (Dwiyanti & Setyasto, 2025; Napitupulu et al., 2024).

The goal of education is to form students who have strong science process skills, critical and analytical thinking, and are able to apply scientific methods in understanding acid-base concepts through structured inquiry and guided inquiry-based learning, so that they can become intelligent, skilled individuals and contribute positively to society through understanding and applying science responsibly. In an effort to

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improve the quality of education, the Indonesian government has revised the curriculum, one of which is through the 2013 Curriculum. This curriculum emphasizes the balance between soft skills and hard skills through the development of attitudes, skills, and knowledge. The 2013 Curriculum also supports the development of science process skills through active learning approaches such as the scientific approach and inquiry learning, which focus on students' skills in observing, classifying, formulating hypotheses, and conducting experiments, As well asstudents are required to distinguish between facts and opinions when understanding problem situations (Abdjul et al., 2024; Zakiyah et al., 2024). This provides a strong foundation for implementing learning models such as structured inquiry and guided inquiry in improving science process skills, especially on the topic of acids and bases.

Mastery of scientific concepts plays an important role in everyday life as it enables individuals to understand various natural phenomena logically and scientifically. Science education not only emphasizes cognitive knowledge but also promotes the development of critical thinking and problem-solving skills, which are essential for addressing challenges in the modern era (Haryono et al., 2024; Kriswantoro; et al., 2021; Y. Lestari & Sunarso, 2024; O'Reilly et al., 2022; Pratiwi et al., 2019). In this context, chemistry education, as a part of science, plays a crucial role in shaping students' scientific thinking through systematic investigation and experimentation. However, chemistry learning often encounters challenges due to its abstract nature and the difficulty of being directly understood, especially on certain topics such as acid-base material (S. Lestari et al., 2025; Lumadya & Wiyarsi, 2024). Concepts such as ionization, pH, and neutralization reactions are microscopic and cannot be observed directly, which creates challenges in building students' conceptual understanding (Astuti & Marzuki, 2018). Therefore, a teaching method is needed that can connect theoretical concepts with real-life experiences, making the learning process more meaningful and easier to understand.

Many students face difficulties in deeply understanding acid-base concepts because this material involves a microscopic level of understanding that cannot be directly observed. Concepts such as pH, degree of ionization, and the difference between strong and weak acids require a high level of abstract thinking, making them a frequent obstacle in students' learning process (Fitria et al., 2022; Jacinda et al., 2024; Laliyo et al., 2023; Siska & Ritonga, 2021). This difficulty is further exacerbated by the continued dominance of the conventional, teacher-centered approach, where the teacher plays the central role in delivering information, while students remain largely passive in receiving the material. This approach limits students' opportunities to actively participate in scientific and exploratory thinking processes (Irawan & Ariani, 2024). As a result, students' science process skills, such as the ability to observe, formulate questions, conduct experiments, analyze data, and communicate results, are underdeveloped. However, science process skills are crucial for shaping scientific thinking and supporting comprehensive conceptual understanding (Dariansyah et al., 2023; Ginting et al., 2022). Therefore, there is a need for a more participatory and contextual learning model to enhance student engagement while maximizing the development of their science process skills.

An interview with a chemistry teacher at SMAN 9 Jambi revealed issues in the teaching of acid-base topics, where, despite using the PBL model, the implementation was still dominated by lectures, resulting in passive student participation. This approach tends to be one-way and does not take into account students varying interests, talents, and learning styles. Additionally, laboratory work on acid-base topics is seldom conducted, meaning students' science process skills have not developed optimally. In fact, the 2013 Curriculum emphasizes the balance between soft skills and hard skills through active learning aimed at developing students' attitudes, knowledge, and science process skills.

Science process skills are an essential element in 21st-century learning, as they play a key role in developing critical thinking, creativity, and problem-solving skills, which are highly needed in the modern era. These skills encompass various abilities such as observing, asking questions, designing and conducting experiments, collecting and analyzing data, and communicating results scientifically (Nugroho et al., 2023; Pradana et al., 2020; Wahyuni & Sinyo, 2024). In the context of chemistry learning, science process skills play a significant role in building deep conceptual understanding, as they allow students to directly engage in scientific processes rather than simply receiving information passively. Research shows that students with strong science process skills tend to better understand complex and abstract chemistry concepts, such as those related to acids and bases (Buhera et al., 2024; Salosso et al., 2018; Serhan et al., 2019). Therefore, the development of science process skills becomes an integral part of improving the quality of chemistry education in schools and preparing students to become lifelong learners who can think and act scientifically (Arnun et al., 2022; Maulana et al., 2023; Nurtikasari et al., 2023).

One solution to improve students' understanding of chemistry concepts and science process skills is by implementing the inquiry learning model (Juniar & Sianipar, 2022; Panjaitan & Siagian, 2020; Suryati et al., 2024). Inquiry learning is an active learning approach that positions students as the main subjects in the process of discovering and constructing knowledge through scientific investigation activities (Ferreira et al., 2021; Orosz et al., 2022; Fitriani & Subekti, 2020). This model encourages students to ask questions, design experiments, collect data, and draw conclusions based on their observations. In its implementation, inquiry learning is divided into several types, namely open inquiry, guided inquiry, and structured inquiry (El-Haqq & Mitarlis, 2024; Lubis et al., 2023). For high school level, guided and structured inquiry are considered the most suitable because they provide a balance between freedom of thought and guidance from the teacher. The structured inquiry type is suitable for students who are new to the scientific approach, while the guided inquiry type offers a greater challenge but still within a range that can be controlled by the teacher (Handriani et al., 2017; Santi et al., 2016). Through this approach, students not only master the material conceptually but are also trained to think critically, analytically, and systematically, in line with the demands of 21st-century learning.

Choosing an appropriate learning model is crucial for enhancing the effectiveness of the teaching and learning process, especially for complex chemistry topics like acids and bases. The structured and guided inquiry learning models are considered highly urgent to be applied at the high school level, as they align with the nature and learning needs of students. The structured inquiry type is very suitable for the early stages of learning or for students whose inquiry skills are still low, because in this model, students follow investigation steps determined by the teacher, allowing them to learn to think scientifically step by step without feeling overwhelmed (Damhuri et al., 2020). Therefore, the guided inquiry type provides students with a wider space for exploration while still receiving guidance from the teacher, allowing students to develop creativity, critical thinking skills, and independence in the learning process (Cahaya et al., 2024). Both of these models have been proven effective in enhancing students' science process skills, such as the ability to observe, formulate hypotheses, design experiments, as well as analyze and communicate scientific data (Zahrotin et al., 2021). Given the complexity of acid-base material, which includes microscopic and abstract concepts, the implementation of structured and guided inquiry learning becomes a strategic solution to bridge conceptual understanding while also developing students' scientific skills.

Although inquiry learning models have been widely applied in science education, research specifically comparing the effectiveness of structured and guided inquiry types is still relatively limited, especially in the context of developing science process skills in acid-base material at the high school level. Most studies tend to focus on the application of one inquiry type separately, without considering the potential comparison of both in the context of complex and conceptual material like acid-base (Anzani & Ismono, 2020). However, a deep understanding of the effectiveness of each model is crucial to determining the most appropriate teaching method in accordance with the needs and characteristics of students. Furthermore, there is a lack of research that explicitly examines the contributions of both models to the comprehensive development of science process skills, such as observation, experimentation, data analysis, and scientific communication (Ariyansyah & Nurfathurrahmah, 2022; Wismaningati et al., 2019). Based on this background, this study aims to measure the effectiveness of the structured and guided inquiry learning models in improving high school students' science process skills in the topic of acids and bases. It is expected that the results of this study will contribute to the development of more targeted chemistry teaching strategies, based on active and meaningful scientific approaches.

Method

This study utilized a mixed methods approach, combining both quantitative and qualitative techniques to gain a deeper and more comprehensive understanding. The design used was concurrent triangulation, where both types of data were collected simultaneously. The research was a quasi-experimental study utilizing the Non-Equivalent Control Group Design, which involved two groups (experimental and control) without random assignment. Both groups took a pretest and posttest to assess their science process skills.

The research was carried out at SMAN 9 Jambi City. The sample was chosen using random sampling, and qualitative data were gathered through observation sheets on the implementation of the learning model, complemented by field notes. Observations are conducted directly by trained researchers or observers. Field notes are analyzed qualitatively to deepen the interpretation of observation data and confirm or clarify quantitative data. Quantitative data, in the form of essay test results, were analyzed using inferential statistical tests, including: Normality test (Shapiro-Wilk), Homogeneity test, Independent t-test (for comparing two distinct groups), Paired t-test to compare pretest and posttest in guided inquiry group and pretest and posttest in structured inquiry group, and the N-Gain test was used to assess the effectiveness of learning improvement in the structured inquiry group and the guided inquiry group. Each group was given a pretest and posttest.

The N-Gain analysis was used to evaluate how the structured and guided inquiry learning models enhanced students' science process skills. The normalized gain (N-gain) (Hake, 1998; Pebrianti et al., 2024) is calculated using the following equation:

$$g = \frac{S_{post} - S_{pre}}{S_{maks} - S_{pre}} \quad (1)$$

Explanation:
G = Normalized gain score
Spost = Posttest score
Spre = Pretest score
Smaks = Maximum score

Gain Test Classification

Table 1. Gain Score Classification

Value (g)	Classification
(N-gain) ≥ 0.7	High
0.7 > (N-gain) ≥ 0.3	Medium
(N-gain) < 0.3	Low

Result and Discussion

The essay test consists of 6 questions, namely 3 pretest questions and 3 posttest questions. The pretest is given before the lesson in each session, while the posttest is given after the learning process in each session. The purpose is to observe the difference in students' science process skills between the structured inquiry class and the guided inquiry class in each session.

Table 2. Structured Inquiry Science Process Skills Scale Data

Learning Strategies	Mean Score	Science process skills scale (% ofstudents) 1	2	3	4	5
Pretest	35.55	43.52	35.18	21.30	-	-
Posttest	71.66	-	9.26	46.30	21.30	23.14

Table **3.** Data on the Scale of Guided Inquiry Science Process Skills

Learning Strategies	Mean Score	Science Process Skills Scale (% of students) 1	2	3	4	5
Pretest	35.18	41.67	40.74	17.59	-	-
Posttest	78.33	-	9.26	22.22	33.33	35.19

Based on Tables 2 and 3, the posttest data on science process skills show that the science process skills scores of students in the Guided Inquiry class are higher compared to those in the Structured Inquiry class. The class using the Guided Inquiry model has an average score of 78.33, while the class with the Structured Inquiry model has an average score of 71.66. These results are consistent with the research conducted by Zahroh et al. (2017) and Puspito et al. (2021) this is in line with the research which states that learning using the guided inquiry approach can enhance students' science process skills as it provides opportunities for students to be more active in discovering concepts through scientific activities.

Besides that Zahrotin et al. (2021) stated that "the guided inquiry model makes a significant contribution to improving students' critical thinking skills and science process skills due to active involvement in experimentation and drawing conclusions." Therefore, it can be concluded that the Guided Inquiry model is more effective in enhancing students' science process skills compared to the Structured Inquiry model, particularly in chemistry learning on abstract topics such as acids and bases. A comparison of pretest and posttest scores between the Structured Inquiry and Guided Inquiry classes is shown in Figure 1.

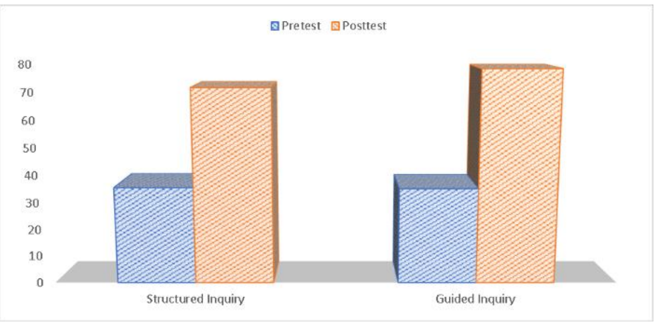

Figure 1. Average pretest and posttest scores

The following is an illustration showing the differences in the scale of students' science process skills between the Guided Inquiry and Structured Inquiry classes, as shown in Figure 2.

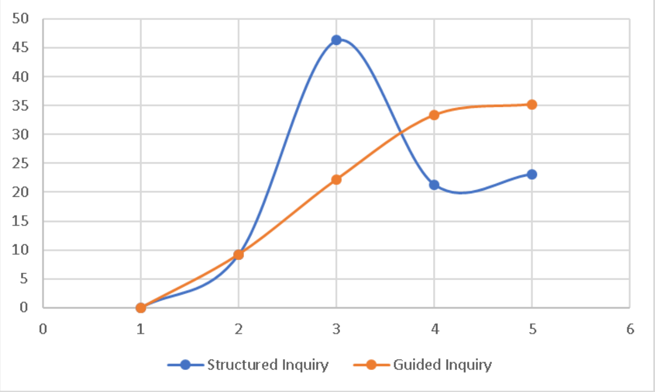

Figure 2. Posttest results scale of students' science process skills in structured inquiry and guided inquiry classes

Based on Figure 2, it can be concluded that the experimental class using the Guided Inquiry model demonstrated a higher level of science process skills at

Level 5 compared to the Structured Inquiry experimental class. At Level 4, the students' science process skills in the Guided Inquiry class reached 33.33%, while in the Structured Inquiry class it was only 21.3%. However, at Level 3, the percentage in the Guided Inquiry class was 22.22%, whereas in the Structured Inquiry class it was 46.3%. At Level 2, both the Guided Inquiry and Structured Inquiry classes had the same percentage of 9.26%.

Normality Test

The data on students' science process skills were analyzed using a normality test, with the Shapiro-Wilk test applied because the sample size was 36. The confidence level used was 95%, or a significance level of 5%. In this test, the data are considered normally distributed if the significance value (sig) is greater than 0.05 (Ghasemi & Zahediasl, 2012; Sari et al., 2024). The following is the normality test data for students' science process skills scores in Table 4.

The normality test was conducted to examine whether the pretest and posttest data on students' science process skills from each class followed a normal distribution. This test is essential to determine whether parametric or non-parametric statistical tests should be used in subsequent analyses. The data were tested using two methods, namely the Kolmogorov-Smirnov and Shapiro-Wilk tests, with the results presented in Table 4. Based on the normality test results, it was found that for the pretest data of both the Guided Inquiry and Structured Inquiry classes, the Kolmogorov-Smirnov significance values were below 0.05 (0.012 and 0.006, respectively), indicating that the data were not normally distributed according to this test. However, based on the Shapiro-Wilk test, the significance values for both groups were above 0.05 (0.055 and 0.065, respectively), indicating that the data were normally distributed.

Table 4. Normality Test Result Data

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Guided Inquiry Pretest	.168	36	.012	.941	36	.055
Structured Inquiry Pretest	.178	36	.006	.943	36	.065
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Guided Inquiry Posttest	.158	36	.024	.940	36	.051
Structured Inquiry Posttest	.146	36	.049	.951	36	.116

Similarly, for the posttest data, the Kolmogorov-Smirnov significance value for the Guided Inquiry class was 0.024 and for the Structured Inquiry class was 0.049, both of which are less than 0.05. However, the Shapiro-Wilk test significance value for the Guided Inquiry posttest was 0.051 and for the Structured Inquiry class was 0.116, both greater than 0.05. Since the sample size for each group was 36, the Shapiro-Wilk test was used as the primary reference, as "the Shapiro-Wilk test is more appropriate for small sample sizes (n < 50) and has greater detection power compared to the Kolmogorov-Smirnov test" (Habibzadeh, 2024; Oktaviani & Notobroto, 2014; Sintia et al., 2022; Souza et al., 2023). Thus, it can be concluded that the data in this study follows a normal distribution, so that subsequent analysis can use parametric statistical tests.

Homogeneity Test

The data on students' argumentation skills were analyzed using a homogeneity test, based on the variance (F-test) results from SPSS. All data from the Structured Inquiry and Guided Inquiry classes, totaling 66 students, were tested, and the Levene's statistic was obtained. The results of the Levene's test were determined by the p-value (sig.) for each variable; if the p-value is greater than 0.05, then H_1 is accepted, indicating that the variable is homogeneous (Hayati, 2020; Zhou et al., 2023).

Table 5. Data from the Results of Homogeneity Tests in Structured Inquiry and Guided Inquiry Classes

		Levene Statistic	df1	df2	Sig.
Structured-Guided Pretest Results	Based on Mean	.122	1	70	.728
	Based on Median	.067	1	70	.796
	Based on Median and with adjusted df	.067	1	69.282	.796
	Based on trimmed mean	.105	1	70	.747
		Levene Statistic	df1	df2	Sig.
Guided-Structured Posttest Results	Based on Mean	1.289	1	70	.260
	Based on Median	1.042	1	70	.311
	Based on Median and with adjusted df	1.042	1	69.354	.311
	Based on trimmed mean	1.340	1	70	.251

Based on the results of the variance homogeneity test presented in Table 5, it can be concluded that the pretest and posttest data from both the Structured Inquiry and Guided Inquiry classes meet the homogeneity assumption. The homogeneity test was conducted using Levene's Test with four approaches: based on the mean, the median, the median with adjusted degrees of freedom (adjusted df), and the trimmed mean. In the pretest results, all significance (Sig.) values were above 0.05. Similarly, in the posttest results, the significance values were also greater than 0.05.

A significance value greater than 0.05 indicates that there is no significant difference in the variances between the groups being compared. This means that the data obtained from both classes can be considered homogeneous, thus meeting one of the key assumptions for conducting parametric statistical analyses such as the t-test or ANOVA. This is in line with the statement from Ali and Khan (2021) that Levene's test is a reliable method for assessing the equality of variances between groups, especially before conducting parametric analyses. In the context of educational research, the homogeneity test is crucial to ensure that comparisons of learning outcomes between groups are not influenced by differences in data variability (Sianturi, 2022). By fulfilling this homogeneity assumption, further statistical analysis such as the t-test can be applied validly, because the data from both classes have a balanced variance distribution.

Independent t-Test

An independent t-test needs to be conducted to determine whether the effectiveness between the Structured Inquiry and Guided Inquiry learning models is statistically significant or not in the two experimental classes, based on the pretest and posttest scores. The prerequisite for conducting an independent t-test is that the data must be normally distributed (Noviati et al., 2023; Sari et al., 2024).

Table 6. Pretest Result Data for the Independent T-test of the Guided Inquiry and Structured Inquiry Models

		Equality of Variances								t-test for Equality of Mean	
						Significance				Interval of the	
		F	Sig.	t	df	One Sided p	Two Sided p	Mean Differences	Std.Error Differences	Lower	Upper
Structured Guided Inquiry	Equal variances as sumed	0.122	0.728	-0.175	70	0.431	0.862	-0.370	2.118	-4.595	3.855
Pretest Results	Equal variances not as sumed			-0.175	69.688	0.431	0.862	-0.370	2.118	-4.595	3.855
Structured Guided Inquiry	Equal variances as sumed	1.289	0.260	2.903	70	0.002	0.005	6.667	2.296	2.086	11.25
Posttest Results	Equal variances not as summed			2.903	68.242	0.002	0.005	6.667	2.296	2.086	11.25

Based on the results of the independent t-test shown in Table 6, it was found that the significance value of Levene's Test for the pretest was 0.728 (> 0.05), indicating that the data had homogeneous variances. Therefore, the interpretation of the t-test results was conducted under the assumption of equal variances (equal variances assumed). The t-test results for the pretest data produced a t-value of -0.175 with a significance value (two-tailed) of 0.862. Since the p-value is greater than 0.05, it can be concluded that there was no significant difference between the pretest results of students who learned using the Guided Inquiry model and those who learned using the Structured Inquiry model. This indicates that the initial abilities of students in both groups were balanced before the treatment was applied.

Meanwhile, for the posttest results, the significance value of Levene's Test was 0.260 (> 0.05), indicating that the data met the homogeneity assumption. The t-test results yielded a t-value of 2.903 with a significance value (two-tailed) of 0.005 (< 0.05). Thus, it can be concluded that there was a significant difference between the posttest results of the two groups. The average learning outcome of students in the Guided Inquiry group was higher than that of the Structured Inquiry group, with a Mean Difference of 6.66667. This finding suggests that the Guided Inquiry model is more effective in improving student learning outcomes compared to the Structured Inquiry model. This may be due to the guidance provided by the teacher during the inquiry process, which helps students to understand concepts more deeply without diminishing their active participation in the learning process (Nurhaedah et al., 2022).

This study supports the findings of previous studies which show that the guided inquiry model can significantly improve student learning outcomes, thanks to systematic guidance from teachers during the learning process (Pradita, 2019). In addition, the application of guided inquiry can improve students' critical thinking skills in learning based on problem solving (Putra, 2021). Thus, the Guided Inquiry learning model can be an alternative effective active learning strategy to improve student learning outcomes, especially in learning that focuses on exploration and in-depth understanding of concepts.

Dependent t-Test

The t-dependent test was conducted to measure the effectiveness of the Structured Inquiry and Guided Inquiry models, whether the differences were significant (real) or not in both experimental classes based on the pretest and posttest values. The prerequisite test for the t-dependent test is normally distributed data.

Table 7. Dependent t-test Pretest-posttest Values of Structured Inquiry and Guided Inquiry Models

		Paired Differences								
		Mean	Std. Deviation	Std. eror	Of the Difference Lower	Upper	t	df	Significance One-Sided p	Two-Sided p
Pair 1	Pretest Structured Inquiry -	-36.111	14.286	2.381	-40.945	-31.277	-15.166	35	0.000	0.000
Pair 1	Guided Inquiry Pretest	43.15	4.91	0.82	44.81	41.49	-52.744	35	0.000	0.000

Table 7 presents the results of the paired sample t-test, which was used to measure the effect of the implementation of the learning models on students' learning outcomes, both before and after the treatment (pretest and posttest), for both the Structured Inquiry and Guided Inquiry models. In the Structured Inquiry model, the mean difference between the pretest and posttest scores was -36.11139, with a t-value of -15.166 and a significance level of 0.000 ($p < 0.05$). This indicates a highly significant difference between the pretest and posttest scores. The negative value indicates that the posttest scores were higher than the pretest scores, suggesting that the Structured Inquiry model successfully improved learning outcomes. In the Guided Inquiry model, the mean difference between the pretest and posttest scores was -43.15, with a t-value of -52.744 and a significance level of 0.000. The highly significant difference between the pretest and posttest scores, along with a greater mean difference compared to the Structured Inquiry model, indicates that the Guided Inquiry model had a stronger impact on improving students' learning outcomes.

The comparison between the two models shows that both are effective; however, the Guided Inquiry model demonstrates a greater impact. This can be explained by the fact that in guided inquiry, students are not only actively involved in discovering concepts but also receive clear guidance from the teacher. Such guidance minimizes misconceptions and promotes a deeper understanding. Iswatun et al. (2017) in his research stated that the application of the guided inquiry model significantly improved learning outcomes because students were given guidance to understand the scientific process in a structured manner. Suarsana et al. (2017) adding that the structured inquiry model is suitable for students with lower levels of learning independence because it provides explicit steps, but the results are still below guided inquiry in terms of influence on conceptual understanding.

N-Gain Test

The normalized N-gain test was used to evaluate the improvement of students' cognitive learning outcomes of science process skills after being given treatment. The improvement in both experimental classes, Structured Inquiry and Guided Inquiry, can be seen through the comparison of the pretest and posttest scores of students' science process skills. The results of the N-gain test can be seen in Table 8. N-gain calculation for Structured Inquiry class:

$$\mathbf{g} = \frac{S_{post} - S_{pre}}{S_{maks} - S_{pre}} = \frac{71.66 - 35.55}{100 - 35.55} = \frac{36.11}{64.45} = 0.56 \times 100\% = 56\%$$

Calculation of the N-gain test in guided inquiry classes:

$$\mathbf{g} = \frac{S_{post} - S_{pre}}{S_{maks} - S_{pre}} = \frac{78.33 - 35.18}{100 - 35.18} = \frac{43.15}{64.82} = 0.66 \times 100\% = 66\%$$

One commonly used approach to measure the effectiveness of learning models in improving student learning outcomes is the N-Gain analysis. This analysis illustrates the extent of improvement in student learning outcomes compared to the maximum possible improvement that could be achieved. In this study, the N-Gain was calculated based on the pretest and posttest scores from two classes implementing the Structured

Inquiry and Guided Inquiry models. In the Structured Inquiry class, the calculation showed an N-Gain score of 0.56 or 56%, which falls into the "Moderate" category. According to Hake's (1998) classification of effectiveness, an N-Gain score between 0.3 and 0.7 is considered a moderate improvement. However, in the context of interpreting learning effectiveness, this result is still categorized as "Less Effective," as shown in Table 8. In the Guided Inquiry class, an N-Gain score of 0.66 or 66% was obtained, which also falls into the "Moderate" category but with a more favorable interpretation of being "Fairly Effective." These findings indicate that the Guided Inquiry model was able to produce a higher improvement in learning outcomes compared to the Structured Inquiry model.

Table 8. Data on the Results of the N-gain Test of Pretest and Posttest Values in Structured and Guided Inquiry Classes

Learning model	N-Gain Score	Category	N-Gain Percent	Category
Structured Inquiry	0.56	Moderate	56	Less Effective
Guided Inquiry	0.66	Moderate	66	Quite Effective

The difference in N-Gain values further supports the previous findings (in Table 6 and Table 7), indicating that the Guided Inquiry model has a greater impact on improving learning outcomes. The direct guidance provided by the teacher at each stage of the inquiry process enables students to develop a deeper understanding of the material and avoid misconceptions, compared to the Structured Inquiry model, which emphasizes independent exploration with limited guidance. Anzani et al. (2020), found that the guided inquiry model proved to be more effective in improving students' learning outcomes and critical thinking skills compared to other inquiry models. Fa'idah et al. (2018) also reported that the level of learning effectiveness can be significantly increased through the use of guided inquiry-based learning strategies, especially for students with moderate to low initial abilities.

Conclusion

Based on the results of the study, it can be concluded that the Guided Inquiry learning model is more effective than Structured Inquiry in improving students' science process skills. This is evidenced by the results of the t-test and N-Gain scores which are consistently higher in classes that implement guided inquiry. This effectiveness is most likely due to the more active role of teachers in guiding the learning process, thus helping students build conceptual understanding that is more organized and meaningful. In addition, the dynamics of improving science process skills also differ between the two models. In the structured classroom inquiry, the increase was stronger in the last session, indicating a gradual adaptation process from students. Meanwhile, the guided classroom inquiry showed significant improvement from the beginning, especially in the stages of data collection, hypothesis testing, and presentation of conclusions. These findings provide an important impression for science learning, especially in the topic of acids and bases, which requires conceptual understanding and experimental skills. The application of the guided inquiry model allows students to conduct experiments, analyze data, and draw scientific conclusions with adequate guidance, thereby improving the quality of learning. For further research, it is recommended to conduct long-term research to see the desire for the development of science process skills, as well as to examine the application of this model to other chemistry topics and to various student ability backgrounds. In addition, students' metacognitive aspects also need to be explored to understand the relationship between learning awareness and the success of the inquiry process.

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