THE EFFECT OF SCAFFOLDING GUIDANCE PROMPTING TECHNIQUE IN GUIDED-INQUIRY LEARNING ON STUDENTS' SCIENCE PROCESS SKILLS IN BUFFER SOLUTION CONCEPTS

Cintia Marini[a], Aulia Sanova[a], Muhammad Haris Effendi Hasibuan[a*]
[a]*Department of Chemistry Education, The University of Jambi, Muaro Jambi, Jambi, Indonesia*
**Corresponding author: hariseffendi@unja.ac.id*

Abstract
The purpose of this study is to determine the influence of applying a scaffolding Guidance prompting strategy in the guided-inquiry learning model on senior high school students' science process skills (SPS) in buffer solution concepts. This study also examined how the prompting technique affected the SPS. Hence, the study employed a mixed-methods research methodology with a sequential explanatory approach, integrating quantitative and qualitative data to address the aims. An SPS-related observational sheet was used to collect data on the two classes of students' skills in conducting the practicum. A SPS-oriented test was used to collect data about the students' understanding of SPS. In addition, a field notes observational sheet was used to collect data on factors contributing to the development of students' SPS. The results showed that the experiment group's SPS score was higher than the control group's SPS score (77.57 and 82.50) in observing skill, and this was the same with the experiment group's SPS, which had higher classifying skill compared to the control group's SPS (64.70 and 70.33). The T-test results verified that there was a difference between the two groups' test indicated by the p-value (sig) < 0.05. This means the use of the prompting technique was effective in nurturing the experimental group's SPS. Based on field observation, it was clear that the use of the prompting technique was beneficial for the experimental group.

Keywords: *Scaffolding; Prompting-Technique; Guided-Inquiry; Science-Process-Skills; Buffer Solution*
https://doi.org/10.24815/jcd.v13i1.46039

Received: *May 12, 2025*; ***Revised:*** *May 27, 2025*; ***Accepted****: May 28, 2025;* ***Published****: 5 June 2025.*

Citation IEEE style: C. Marini, A. Sanova and M.H.E. Hasibuan, "The effect of scaffolding guidance prompting technique in guided-inquiry learning on students' science process skills in buffer solution concepts," *Chimica Didactica Acta*, vol. 13, no. 1, pp. 66-74, 2025, doi: 10.24815/jcd.v13i1.46039

INTRODUCTION

Science process skills are a sequence of mental and physical tasks used to collect and organize information for making predictions, explaining phenomena, solving problems, understanding the scientific process, and exploring science [1].[2] Science process skills are considered essential for providing meaningful learning experiences for students, as they help students develop higher-order thinking. However, Students' science process skills are still low in Indonesia, which is influenced by various factors, such as a lack of encouragement to learn independently, limited student involvement in learning, and the continued application of teacher-centered teaching methods [3].

According to PISA 2018, Indonesia's science score is 37 points lower than the OECD average, lagging behind ASEAN countries and countries with similar characteristics, such as Peru and Brazil. This reflects that Students' science process skills are still low in Indonesia. This is in line with the results of preliminary observations at Alfalah Jambi Islamic High School during the practicum; students' science process skills are very low, at around 40%. This is indicated by the results of the observation sheet for students who have difficulty in proposing hypotheses, formulating questions, observing changes that occur during the practicum, using accurate measurements, classifying data, and analyzing the results of the practicum.

Students' low science process skills can be overcome through the application of various learning models, one of which is the guided inquiry framework [4]. The guided inquiry framework emphasizes the concept discovery process, which encourages the formation of scientific attitudes in students [5]. However, its application often faces obstacles such as the incompatibility of the method with classroom conditions, the dominance of lectures, and students' difficulties in understanding the material [6]. Therefore, the effectiveness of guided inquiry can be improved with strategies such as scaffolding that support student development in the zone of proximal development and improve science process skills.

Scaffolding encompasses a range of techniques, including questioning, prompting, cueing, and explaining.

Prompting techniques can be applied through a learner worksheet to help students formulate problems in simple practicum and effectively improve science process skills [9]. This aligns with the findings of [8], which indicate that scaffolding strategies have a positive impact on improving science process skills.

The results of interviews at Alfalah Jambi Islamic High School indicate that, despite the implementation of the Merdeka Curriculum, learning remains conventional, with lectures still dominating the learning process. Teachers have not implemented gradual guidance such as scaffolding, so it is necessary to apply prompting techniques to enhance pupils' scientific process competencies in learning chemistry.

Chemistry is one of the science subjects that requires a learning approach consistent with the characteristics of science learning [9]. The practicum provides students with direct experience in observing and conducting chemical experiments. According to [10], improving science process skills can be achieved through learning that prioritizes direct experience, one of which is by doing a practicum. Science process skills are also a significant ability that can be taught in practice and must be acquired by students. One of the chemistry topics that can be used as the object of this research is buffer solution. This topic is very likely to be practiced directly by students using simple equipment and materials. The buffer solution is suitable for use in practicum because it can maintain the pH of the solution, remaining stable despite the addition of acids or bases, allowing for more accurate observations in chemical experiments.

This research offers novelty in the integration of scaffolding learning strategies with prompting techniques into guided inquiry learning, an area that has not been widely researched, particularly in the context of learning chemistry buffer solution material. In addition, the focus on developing science process skills through the design of prompting-based Learner Worksheets shows an innovative and applicable approach. Another uniqueness lies in the application of this technique in the context of real classes and adaptation to student characteristics, which makes the results of this study potentially replicable in the practice of chemistry education in Indonesia. Based on the description above, it is considered essential to enhance pupils' scientific process competencies on buffer solution material, so the researcher wants to investigate "The Effect of Scaffolding Guidance Application of Prompting Techniques on Science Process Skills in Guided Inquiry Learning on Buffer Solution Material".

METHOD

The sequential explanatory approach was used in this research. This research employs the Quasi-Experimental method with a post-test-only control group design. In this design, the experimental group and the comparison/control group are randomly selected. The population of this study comprises students in class XI/phase F at Alfalah Jambi Islamic High School in the even semester of the 2024/2025 academic year. The sampling technique in this study was purposive sampling. The samples in this study were phase F1 (N=30) as an experimental group and F2 (N=30) as a control group.

The independent variable and the dependent variable are the two variables in this study. The independent variable in this research is scaffolding, which includes prompting and conventional techniques. Science process skills are the dependent variable in this study. Techniques for gathering data were used; Qualitative data can be obtained through observation and interviews with teachers and students.

The tools employed for data acquisition include interview results, observation sheets, and assessment rubrics. Meanwhile, quantitative data in the form of observation sheets on science process abilities, both before and after the use of guidance sourced from students, were collected using an assessment rubric. To determine the students' science process skills score using the formula:

$$\text{Percentage} = \frac{\sum observation\ score}{\max score}\ x\ 100\%$$

The research categories for the observation sheet are presented in Table 1.

Table 1. Student activity observation sheet rating category

Score	Scale	Score range (%)	Category
4	13-16	> 81,5	Skilled
3	9-12	56.25 - 81.25	Skilled enough
2	5-8	31.25 - 56.26	Less Skilled
1	1-4	< 31.25	Not Skilled

Additionally, a test is administered at the end of each post-test meeting using an assessment rubric. Post-test questions, in the form of essay questions, were given at the end of each meeting, with three questions provided at the end of the lesson.

Data were analyzed using quantitative descriptive statistics, followed by hypothesis testing, which included homogeneity and normalcy tests, an independent t-test, and calculation of effect size on post-test results to measure the improvement of students' science process abilities.

RESULTS AND DISCUSSION

In this case, the discussion will focus on the effect of applying scaffolding guidance and prompting techniques in the experimental class versus conventional guidance in the control class. The observation sheet is used to determine the extent to which the difference in guidance can affect students' science process skills. The following is a recap of the average scores for science process skills in experimental and control classes at meetings 1 to 3, based on the science process skills observation sheet.

Table 2. Recapitulation of SPS scores of both groups

Groups	Observing (Mean)	%	Classifying (Mean)	%
Experiment	3.1	77.50	3.08	77.00
Control	2.7	67.50	2.85	71.25

Table 2 illustrates the recapitulation of the average score of science process skills for observing and classifying indicators in both classes. In the experimental class, the observing indicator achieved an average of 3.1, which falls within a reasonably skilled category. In contrast, the control class only achieved an average score of 2.7, with the same category being quite skillful. Observing activities can provide more meaningful learning because students directly observe events in their environment. Bundu states that "the ability to observe is the most basic skill in science, and is important for developing other process skills". Therefore, observation skills can be a fulcrum for the development of other science process skills [11]. In the experimental class, the grouping indicator reached an average of 3.08, while the control class scored 2.85, which falls within the moderately skilled category. Based on the results of the independent t-test of science process skills both on observing and classifying indicators, it shows that there is a significant difference between the experimental and control classes. In observing skills. The experimental class had a higher average score (77.67) than the control class (68.33), with a significance value of 0.000 (<0.05), indicating a significant difference. Similarly, in grouping skills, the average score of the experimental class of 77.33 was also higher than the control class of 71.80, with a significance value of 0.006 (<0.05). These results show that the application of the prompting technique, scaffolding guidance, is more effective in improving students' science process skills compared to conventional guidance, both in the aspects of observing and classifying.

The opinions of experts reinforce these results, including Rahmasiwi [12], who states that the application of scaffolding and prompting techniques can improve science process skills by providing gradual structured assistance until students can be independent. In addition, it is reinforced by the opinion of another researcher, who states that the application of the scaffolding approach in the Learner Worksheet enables gradual assistance until students no longer require it, allowing them to complete tasks independently and understand the material's concepts automatically [13]. Another report also stated that the guided inquiry-based learning model effectively improves students' science process skills, as it trains them to make observations, conduct experiments, analyze data, and draw conclusions actively [14].

To assess the science process skills of students observing and classifying indicators in experimental and control classes using buffer solution material, post-test questions were administered to the two sample classes at the end of each meeting. These questions were in the form of essay test questions. Results of the descriptive statistical test of students' The table below shows scientific process skills.

Table 3 Average Score of Each Question on the Cognitive Assessment of the Essay Test on the Science Process Skills Indicator

Indicator	No. Question	Experiment Groups' SPS	Control Groups' SPS
Observing	1	66.67	49.17
	3	70.00	50.83
	5	82.50	72.50
	9	94.17	85.83
Means		77.57	64.70
SD		8.93	10.46
Classifying	2	69.17	47.50
	4	81.67	70.83
	6	83.33	70.83
	7	88.33	80.83
	8	90.00	81.67
Mean		82.50	70.33
SD		7.16	9.27

Based on the results of the descriptive test in table 3, the data obtained by researchers that the post-test with observing indicators in learning using scaffolding prompting techniques obtained an average value of 77.57 with a standard deviation of 8.93, while the conventional obtained an average value of 64.70 with a standard deviation of 10.46. It can be explained that the science process skills of students observing indicators in classes that use scaffolding guidance and prompting techniques are higher than in classes that use conventional guidance.

Based on the results of the descriptive test in Table 3 the data obtained by researchers showed that the post-test with the indicator of grouping in learning using scaffolding prompting techniques obtained an average value of 82.50 with a standard deviation of 7.162. In contrast, the conventional obtained an average value of 70.33 with a standard deviation of 9.279. It can be explained that the science process skills of students in classes that use the prompting technique, scaffolding, and guidance are higher than in classes that use conventional guidance. The difference in average scores with indicators of observing and classifying in students in the experimental class used scaffolding guidance prompting techniques in the form of a Learner Worksheet higher than students who followed learning with conventional guidance.

Students can observe, feel, classify and think according to their experiences, do the tasks listed in the Learner Worksheet, are able to have good group discussions and do practicum on buffer solution material. Additionally, students can analyze the learning gained from the experience. This is indicated by students telling experiences in doing practicum activities. This means that students have undergone the concrete experience stage [15]. [16] Explained that scaffolding strategies in science learning play a role in facilitating the learning process by assisting at an early stage, which is then gradually reduced as students' abilities increase. This assistance aims to enable Students to take responsibility for their learning, thus encouraging active learning that focuses on improving higher-order thinking abilities and collaboration abilities.

This finding aligns with the statement by Gusmardin et al. (2019) [17], who noted that scaffolding prompting techniques, combined with a Learner Worksheet, enable teachers to guide students intensively, thereby facilitating the development of both practical scientific process abilities and cognitive knowledge in balance. The success of this learning strategy can be understood from several theoretical perspectives. Meanwhile, in terms of cognitivism, prompting helps manage students' cognitive load and enhances their metacognitive processes by organizing information and encouraging reflection. Therefore, the scaffolding prompting technique effectively integrates aspects of behaviorism, constructivism, and cognitivism to improve Students' scientific process skills with buffer solution material.

This support facilitates the inquiry process and helps students construct their knowledge. The post-test values obtained were then tested for normality, homogeneity, and independent t-tests per indicator of observing and analyzing science process skills using SPSS 27. Data on the results of students' science process skills using normality test analysis, taken from Shapiro-Wilk data, because the number <50. The confidence level used is 95% or the significance level is 5%. In line with the opinion (Fitri et al., 2024), the Kolmogorov-Smirnov (KS) test works well for samples with numbers between 20 and 100. However, in research, this test is generally more effective for samples with numbers greater than 2000. Therefore, if the sample of data being analyzed has less than 50 (N < 50), it is recommended to use the Shapiro-Wilk test. In this test, data is considered normal if The significance level (p-value) is higher than 0.05. The table below shows the normality test results for Science process skills of students values derived from observational post-test scores.

Table 4. Test of Normality

Test of Normality						
	Kolmogrov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	Df	Sig.
Experiment-Observing	.154	30	.068	.953	30	.201
Control-Observing	.130	30	.200	.959	30	.288
a. Lilliefors Significance Correction						

Based on Table 4, the significance value> 0.05 is obtained. It is clear that in the experimental class, which uses scaffolding guidance and prompting technique, science process skills observing indicators have a significance value of 0.201 (0.201 < 0.05), while in the control class, which uses conventional guidance, science process skills observing indicators have a significance value of 0.288 (0.288 > 0.05). Therefore, it can be concluded that the post-test values from the experimental and control classes of observing indicators are normally distributed. The normality test data on the value of science process skills of students, obtained from the post-test value of the grouping indicator, are presented in Table 5.

Table 5. Test of Normality indicator Classifying

Test of Normality						
	Kolmogrov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	Df	Sig.
Experiment	.136	30	.161	.941	30	.097
Control	.126	30	.200	.960	30	.307
b. Lilliefors Significance Correction						

Based also on table 5, the significance value> 0.05 is obtained. It is clear that in the experimental group using scaffolding guidance prompting technique, science process skills indicator grouping has a significance value of 0.097 (0.097 > 0.05), while in the control group using conventional guidance, science process skills indicator grouping has a significant value of 0.307 (0.307 > 0.05). So it can be concluded that the post-test score data from the experimental class and control group indicate a normally distributed grouping.

The data on the results of students' science process skills is also called the homogeneity test, taken from the variance data on SPSS. All student data from experimental and control classes were tested for homogeneity and obtained Levene's statistics. The results of the Levene test calculation are reviewed through the ρ-value sig. all variables are homogeneous. The homogeneity test is only used in parametric tests. The second parametric test requirement is the homogeneity of the data as can be seen in Table 6.

Table 6. Test of Homogeneity

Test of Homogeneity of Variances					
		Levene Statistic	df1	df2	Sig.
Post-test	Based on Mean	.983	1	58	.326

Experiment and control Observing	Based on Medium	.773	1	58	.383
	Based on Median and with adjusted df	.733	1	56.520	.383
	Based on trimed mean	.981	1	58	.326

Based on Table 6, the homogeneity test results obtained a value of 0.326 (0.326> 0.05). It can be seen that the results of the significant value and Levene's statistic are significant, with a value> 0.05. It can be concluded that the post-test value data for science process skills in the experimental and control groups, as observed indicators, are homogeneous.

Table 7. Test of Homogeneity for the Indicator of Classfying

Test of Homogeneity of Variances					
		Levene Statistic	df1	df2	Sig.
Post-test Experiment and control Classifying	Based on Mean	1.560	1	58	.217
	Based on Medium	1.446	1	58	.234
	Based on Median and with adjusted df	1.446	1	56.905	.234
	Based on trimed mean	1.635	1	58	.206

Based on Table 7, the homogeneity test results obtained a value of 0.217 (0.326> 0.05), indicating that the results of the significant value and Levene statistic are significant, with a value> 0.05. It can be concluded that the post-test value data in the experimental class and control class science process skills indicators are homogeneous..

Independent t-test that the significance value of the observation indicator in the Sig. (2-tailed) equal variances assumed section is <0.001 <0.005. While the significance of the indicator grouping the Sig. (2-tailed) value in the equal variances assumed section is <0.001 <0.005. According to Krisanti, (2019) if the significant value <0.05 then there is a diffecerence between the SPS of the both groups. So that partially the independent t-test shows a significant effect of the prompting technique use.

Table 8. Test T-Independent Indicator Observing

		Levene's Test for Equality of Variances	t-test for Equality of Means	
		Sig.	df	Sig,(2-tailed)
Post-test Observing	Equal variance s assumed	.326	58	<.001
	Equal variance s not assumed		56.616	<.001

The results of the t-test on the data of the post-test results of the science process skills indicator, observing the essay test, known sig value of 0.326 > 0.05, indicating that the data is homogeneous. (2-tailed) The value in the equal variances assumed part is <0.001 <0.005, rejecting H0 and accepting Ha. This suggests that the scaffolding guidance prompting technique with the guided inquiry model has an impact on science process skills, observing indicators on buffer solution material.

Table 9. Test T-Independent Indicator Classifying

		Levene's Test for Equality of Variances	t-test for Equality of Means	
		Sig.	df	Sig,(2-tailed)
Post-test Classifying	Equal variance s assumed	.217	58	<.001
	Equal variance s not assumed		54.503	<.001

The results of the t-test on the data of the post-test results of the science process skills indicator, observing the essay test, show a known Sig value at equal variances, assump. 0.217 > 0.05; it can be interpreted that the data is homogeneous, as indicated by the known Sig. (2-tailed) The value in the equal variances assumed part is <0.001 <0.005, rejecting H0 and accepting Ha. This suggests that the scaffolding guidance prompting technique with the guided inquiry model has an impact on science process skills, observing indicators on buffer solution material. This is supported by [18] who stated that scaffolding helps students be more active in observation and classification. According [19] who found that prompting improves scientific thinking skills, especially in the early stages of the science process. [20] also added that systematic scaffolding in guided inquiry facilitates concept understanding through gradual exploration. Thus, scaffolding prompting techniques are proven effective in improving students' science process skills, especially in the aspects of observing and classifying.

Table 10. Effect Size Indicator Observing

Independent sampeles Effect Size		
		Point Estimate
Post-test Observing	Cohen's	1322
	Hedges' correction	1.305
	Glass's delta	1.229

The results of the analysis showed that the effect sizes of the two-group comparisons were in the large category. The values of Cohen's d of 1.322, Hedges' g of 1.305, and Glass's delta of 1.229, all exceeded the threshold of 0.8 which indicates a large effect according to Cohen (1988). These three measures also have 95% confidence intervals that do not include zeros, thus reinforcing that the difference between the experimental class with scaffolding prompting techniques and the control class with conventional observational science process skills. Thus, the treatment given has a significant influence on the results of the study

Table 11. Effect Size Indicator Classifying

Independent samples Effect Size		
		Point Estimate
Post-test Observing	Cohen's	1322
	Hedges' correction	1.305
	Glass's delta	1.229

The analysis revealed that the effect sizes of the two-group comparisons fell into the large category. The values of Cohen's d (1.468), Hedges' g (1.449), and Glass's delta (1.311) all exceeded the threshold of 0.8, indicating a significant effect according to Cohen (1988). These three measures also have 95% confidence intervals that do not include zero, thus reinforcing that the difference between the experimental class with the scaffolding prompting technique and the control class with conventional instruction on the science process skills of the grouping indicator is statistically significant. Thus, the treatment administered has a substantial impact on the study's results.

This indicates a significant difference in the post-test scores of the two classes, particularly in terms of observing and classifying. This demonstrates that scaffolding guidance, using a model of guided inquiry, affects the science process skills of observing and grouping indicators related to buffer solution material. The effect size showed a significant impact of the intervention, with Cohen's d, Hedges' g, and Glass's delta values exceeding 0.8 on both indicators. All values fell into the large effect category and were statistically significant, indicating that the scaffolding technique had a substantial impact on improving students' science process skills. These results align with the research of [21], which suggests that providing gradual assistance or scaffolding can help students develop independence and confidence in solving problems, ultimately improving their skills and learning outcomes.

The observation sheet serves as a key instrument for gathering data regarding the implementation of scaffolding guidance prompting techniques as well as conventional guidance methods, with the primary objective of enhancing science process skills. This data collection tool is specifically designed to capture qualitative data, which provides detailed and descriptive insights rather than numerical measurements.

The qualitative data is derived from the comments and observations documented by the observer on the observation sheet. These comments reflect the observer's perceptions, interpretations, and evaluations of how effectively the scaffolding techniques or conventional methods are applied during the instructional process. By focusing on these detailed accounts, the observation sheet enables a deeper understanding of the teaching strategies employed, their execution, and their impact on fostering science process skills among learners.

Table 12. Number of Activities Carried Out and Not Carried Out in Scaffolding Class Prompting and Conventional Techniques

Meeting	Scaffolding Prompting		Conventional	
	Number of executed activities (+)	Number of unexecuted activities (-)	Number of executed activities (+)	Number of unexecuted activities (-)
1	2	4	0	6
2	5	2	3	4
3	7	0	5	2
Total	14	6	8	12

From the table above, we can see that there are differences in the number of well-done and poorly done activities among the prompting techniques, the scaffolding class, and the conventional class. Activities that are well done are activities that can shape the Science process skills of students. For more details, the differences in activities at each meeting are evident from Figures 1 and 2.

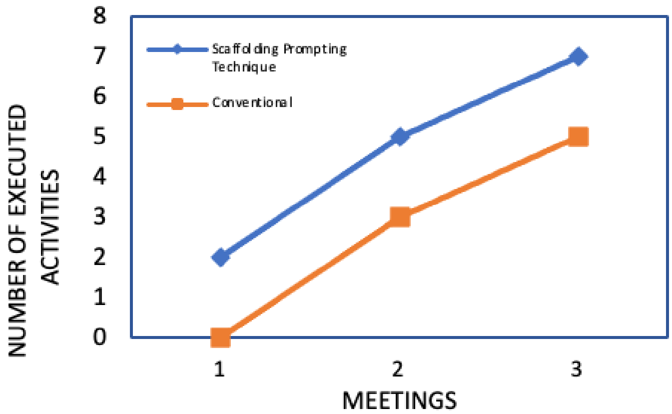

Figure 1 Number of executed activities carried out by students' science process abilities in the application of scaffolding guidance, prompting vs conventional techniques

The number of activities carried out in the prompting technique scaffolding class is higher than in the conventional class. In the prompting technique, the scaffolding class 14 activities were well done, and in the traditional class, eight activities were also well done. This difference shows that the application of prompting techniques in the scaffolding strategy has a positive influence on the successful implementation of learning activities. Prompting techniques, which provide hints, questions, or directions in a gradual and directed manner, help students understand each step in the learning activity, enabling them to carry it out more effectively. This is in line with [13]. Scaffolding is a method of providing temporary support to children as they begin learning something new. Implementation of the Zone of Proximal Development (ZPD) Approach This assistance can be in the form of direction, explanation, or demonstration from a more experienced person. Over time, as the child begins to understand the concept or skill being learned, the assistance is gradually reduced.

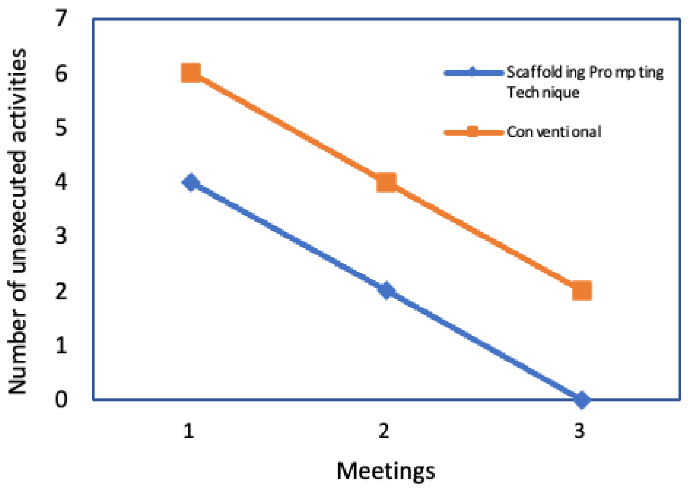

Figure 2. Number of unexecuted activities carried out by students in the science process skills in the application of scaffolding guidance, prompting, and conventional techniques.

In the number of activities that were not well implemented in the scaffolding class, the prompting technique was lower than in the conventional class. In the prompting technique, scaffolding class 6 activities was not well done, and in the traditional class, 12 activities were not well done.

This finding indicates that the application of scaffolding with prompting techniques can have a positive impact on the implementation of learning activities. The prompting technique enables teachers to provide structured instructions or directions to students in stages, making it easier for students to understand and carry out the given instructions. Thus, potential errors or obstacles in implementing activities can be minimized. Additionally, the assistance provided through prompting also helps students become more focused, directed, and independent in carrying out their tasks. This is different from the conventional approach, which tends to provide less gradual support, so students may have difficulty in following the activity optimally. With fewer activities that are not well implemented in the scaffolding class, it can be concluded that the prompting technique plays a role in increasing the effectiveness of learning implementation and encouraging more active and productive student involvement.

As for what causes differences in students' science process skills based on field notes in classes that use scaffolding guidance, prompting techniques with conventional guidance, it can be seen that there are differences in the intensity level of students taught with two different guidance techniques. In the scaffolding guidance for prompting techniques, students are assisted through a learner worksheet to participate in a practicum that improves science process skills using guided inquiry syntax. In conventional guidance, the teacher only teaches as usual and uses the guided inquiry model.

The qualitative observation sheet in the form of field notes evidences this. According to the observation sheet data, the use of learner worksheet-based prompting techniques in scaffolding guided inquiry learning has a significant impact on improving students' science process skills, particularly in the aspects of observing and classifying. Students in the experimental class showed better progress than those in the control class, as they received gradual guidance through the use of a learner worksheet, which helped them build scientific understanding independently.

Haidar (2020) [22] stated that scaffolding with prompting techniques effectively encourages student involvement in science process skills. The low activity in conventional learning shows the importance of directed guidance. Aprian et al (2017) [8] emphasized that science process skills are better developed through active learning and feedback. As explained by Vygotsky through the concept of the zone of proximal development (ZPD), prompting techniques in learner worksheets, such as providing questions or instructions, encourage students to think critically, propose hypotheses, and develop scientific skills [23].

This approach aligns with the guided inquiry model, where teachers guide students' scientific investigations in a structured and directed manner. Ambarsari (2012) [24] stated that the application of guided inquiry involving scientific experiments to prove concepts was able to improve students' science process skills. Iswatun et al (2017) [25] also indicated that the guided inquiry methodology improves science process skills. The guided inquiry learning model considerably improved students' science process skills.

The difference in science process skills was evident between the experimental and control classes. In the experimental class, students received treatment in the form of scaffolding with prompting techniques integrated in the learner worksheet. This learner worksheet is designed to guide students in improving skills, especially in the aspects of observing and classifying data when designing and implementing a practicum. The application of prompting enables teachers to provide gradual direction, allowing pupils to develop both practical and cognitive skills in a balanced manner. The scaffolding supports the smooth process of inquiry, helping students build knowledge independently. In contrast, students in the control class received only conventional guidance from the teacher, which made them more passive and dependent on explanations without encouraging them to search for solutions independently [17].

Based on the difference, the experimental and control classes differ in their science process skills, which is obvious. Students in the experimental classroom are guided through scaffolding prompting techniques in the learner worksheet, which are designed to help them observe and group data during practicum. The prompting technique enables the teacher to provide gradual directions, allowing students to develop both practical and cognitive skills in a balanced manner. According to Gusmardin et al (2019) [17], support that scaffolding facilitates inquiry and learning independence. In contrast, students in the control class received only conventional guidance, which tended to make them passive and dependent on their teachers.

CONCLUSION

The research findings indicate that the scaffolding prompting technique significantly enhances students' science process skills in buffer solution material at Al-Falah Jambi Islamic High School. The experimental class (scaffolding prompting technique) demonstrated higher average scores in observing (77.57) and classifying (82.50) compared to the control class (conventional method), which scored 64.70 and 70.33, respectively. The post-test results, with a significance value of <0.001, confirm the superior effectiveness of the scaffolding approach. Utilizing guided worksheets, students in the experimental group engaged actively in the learning process, fostering scientific thinking and problem-solving skills. In contrast, the conventional approach resulted in more passive learning, with students relying primarily on teacher-led instruction.

REFERENCES

[1] G. Gizaw, & S. Sota, "Improving science process skills of students: A review of literature," *Science Education International*, vol. *34*, no. 3, pp. 216–224, 2023, doi:10.33828/sei.v34.i3.5

[2] D. Darmaji, D.A. Kurniawan, & I. Irdianti, "Physics Education Students' Science Process Skills," *International Journal of Evaluation and Research in Education*, vol. *8, no.* 2, pp. 293–298, 2019, doi:10.11591/ijere.v8i2.16401

[3] E. Sulistri, H. Rosdianto, & W. Lestari, "Keterampilan Proses Sains Siswa (KPS) dengan Model Predict Observe and Explain (POE) pada Materi Energi", *Variabel*, vol. *1*, no. 2, pp. 66–72, 2018, doi: 10.26737/var.v1i2.812

[4] W. Andarie, "Application of Guided Inquiry Learning to Improve Science Process Skills of Grade VII Students,"*Educative: A Journal of Educational Science*, vol. *5*, no. 2, pp. 1363–1375, 2023.

[5] E.C Sitio, D.A. Kurniawan, & W. Kalpatari, "Penerapan model pembelajaran inkuiri terbimbing dan korelasinya dengan keterampilan proses sains siswa pada materi fluida statis kelas XI MIPA 4 SMAN 2 Muara Bungo," *SENRIABDI*, 195–212,2021.

[6] D.H. Simbolon, "Pengaruh model pembelajaran inkuiri terbimbing berbasis eksperimen riil dan laboratorium virtual terhadap hasil belajar fisika siswa," *Jurnal Pendidikan Dan Kebudayaan*, vol. *21, no.*3, pp. 299–316, 2015, doi:10.24832/jpnk.v21i3.192

[7] D. Fisher, & N. Frey, "Gradual release of responsibility instructional framework," *IRA E-Ssentials*, pp. 1–8, 2013.

[8] R. D. Aprian, S. Sunyono, & T. Efkar, " The Effect of Scaffolding Strategy on SiMaYang Learning in Improving Science Process Skills," *Journal of Chemical Education and Learning*, vol. *6*, no. 1, pp. 139-670, 2017.

[9] M.I. Putri, H. Hartatiana, H., & R.T. Astuti, "engaruh Model Pembelajaran Discovery Learning Terhadap Keterampilan Proses Sains Pada Materi Hidrolisis Garam Di MA Patra Mandiri. ORBITAL; Jurnal Pendidikan Kimia, vol. 03 no. 02, pp. 104-113, 2019.

[10] T. Haryati, R. D. Gusti, M. H. E. Hasibuan, & M. Rusdi, "The Implementation of Scaffolding In Project-Based Learning To Improve Students' Science Process Skills In Buffer Concept," *Jurnal Kimia Dan Pendidikan Kimia*, vol *5*, no. 2, pp. 187–200, 2020, doi:10.20961/jkpk.v5i2.42263

[11] N. Yulianti, "Pengaruh Model Inkuiri Terbimbing Berbasis Lingkungan terhadap Kemampuan Pemahaman Konsep dan Karakter," *Jurnal Cakrawala Pendas., vol.* 2 no. 2, pp. 2442-7470, 2016, doi:10.31949/jcp.v2i2.329

[12] Rahmasiwi, Amining, and Slamet S. D. P. Sari. "Improving Student's Science Proces Skill in Biology Through the Inquiry Learning Model in Grade XI MIA 9 (ICT) SMA Negeri 1 Karanganyar Academic Year 2014/2015." Seminar Nasional XII Pendidikan Biologi FKIP UNS 2015, Surakarta, Indonesia, November 2015. Universitas Sebelas Maret, 2015.

[13] U. Nuha, R.E. Fadilah, & A. Irawan "The Effect Of Question Prompt Scaffolding-Based Student worksheet On Scientific Writing Skills Of Junior High

School Students In Science Learning," *Jurnal Penelitian Pendidikan IPA*, vol 10, no. 7, pp. 3998–4003, 2024, doi:10.29303/jppipa.v10i7.8091
[14] T. D. Jaya, M. B. Tukan, & F. Komisia, "Penerapan Pendekatan Inkuiri Terbimbing Untuk Melatih Keterampilan Proses Sains Siswa Materi Larutan Penyangga. *Educativo: Jurnal Pendidikan*, vol. 1, no. 2, pp. 359–366, 2022, doi:10.56248/educativo.v1i2.44
[15] S. Sulistiyono, "Efektivitas model pembelajaran inkuiri terbimbing terhadap keterampilan proses sains dan pemahaman konsep fisika siswa ma riyadhus solihin," *Jurnal Pendidikan Fisika Undiksha*, vol. 10, no. 2, pp. 61–73, 2020, doi:10.23887/jjpf.v10i2.27826
[16] Y. Gusmardin, S. Bektiarso & I. Wicaksono, "The effect of guided inquiry learning model accompanied by scaffolding prompting questioning on students' science process skills on straight motion material in high school," Journal of Physics Learning, *8*(2), 93–100, 2019.
[17] T. A. M. R. Guritno, M. Masykuri, & A. Ashadi, Chemistry learning through problem solving and guided inquiry models in terms of stud.ents' basic science process skills and scientific attitudes. *Inkuiri: Jurnal Pendidikan IPA*, *4*(2), 1–9, 2016.
[18] A, Rahma, "Pengembangan Media Pembelajaran Comic Math Berbantuan Whiteboard Animation Dengan Menggunakan Pendekatan Realistic Mathematics Education Untuk Meningkatkan Kemampuan Pemahaman Konsep Matematis Siswa Kelas VII SMPN 9 Sarolangun," *Pendidikan Matematika*. 2024.
[19] W. P. Siregar, D. Jumiarni, A. S. Husein, I. Ansori, & S. Hidayat, "Rancangan Perangkat Pembelajaran Model Inkuiri Terbimbing Untuk Meningkatkan Literasi Sains," *Diklabio: Jurnal Pendidikan Dan Pembelajaran Biologi*, pp. 1–8, 2023.
[20] R. Alipvia, S. Sripatmi, B. Baidowi, & A. Arjudin, "The Effect Of Scaffolding In Problem Solving On Distance In Space On Motivation And Learning Outcomes," Scientific Journal of Education Profession., vol. 1 no.3c, pp. 1905–1912, 2022.
[21] A. D. Haidar, Y. L. . H. K. S, "The Effect of Inquiry Learning with Scaffolding on Students' Science Process Skills and Concept Understanding on Light Material," Journal of Education: Theory, Research, and Development, vol. *5*, no.12, 2020.
[22] Y. R. Salsabila, & M. Muqowim, "Korelasi Antara Teori Belajar Konstruktivisme Lev Vygotsky Dengan Model Pembelajaran Problem Based Learning (Pbl). *Learning: Jurnal Inovasi Penelitian Pendidikan Dan Pembelajaran*, vol. *4*, no. 3, 813–827, 2024.
[23] W. Ambarsari, "Application of guided inquiry learning to basic science process skills in biology class VIII students of SMP Negeri 7 Surakarta, *Pendidikan Biologi*, vol. 5, no. 1, pp. 81-95, 2012.
[24] I. Iswatun, M. Mosik, & B. Subali, "Application of Guided Inquiry Learning Model to Improve SPS and Student Learning Outcomes for Junior High School Grade VIII," *Jurnal Inovasi Pendidikan IPA*, vol. 3, no. 2, pp. 150–160, 2017, doi:.21831/jipi.v3i2.14871
[25] S. Wulanningsih, "The Influence of Guided Inquiry Learning Model toward Science Process Skills Viewed from Student's Academic Ability of Sma Negeri 5 Surakarta, vol. 4, no. 2, pp. 33-43, 2012.