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The Effect Of Question Prompt Scaffolding-Based Student worksheet On Scientific Writing Skills Of Junior High School Students In Science Learning

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Abstract: Science learning is closely linked to students' scientific writing skills. While science education imparts scientific concepts and theories, scientific writing enables students to structure and express their understanding of these concepts and theories. Despite this, scientific writing skills among junior high school students tend to be in the low category. This study aimed to investigate the impact of using student worksheets based on question prompt scaffolding on the scientific writing skills of junior high school students. The research employed a quasi-experimental design with a post-test only control group. Data were collected using tests, with essay tests assessing scientific writing skills across various indicators such as clarification, observation, measurement, claims, causation, argumentation, and generalization. The results from an independent sample t-test indicated a significance value of p Sig. (2-tailed) of 0.028, which is less than 0.05, suggesting a significant difference in the average scientific writing scores between the experimental and control groups. Thus, it can be concluded that student worksheets based on question prompt scaffolding significantly enhance the scientific writing skills of junior high school students in science learning.

Keywords: Scientific writing skills; Question prompt scaffolding; Science learning; Student worksheet

Introduction

Science learning is a teaching and learning process to learn science concepts, principles, and theories that are carried out scientifically. Science learning is inseparable from the activity of investigating a phenomenon that is carried out scientifically and systematically (Masruhah et al., 2022). Understanding concepts and principles in science education is crucial for developing students' skills and cognitive abilities (Sintiawati et al., 2021). Science learning develops the skills of junior high school students with the aim of communicating as an important aspect of life (Putri et al., 2023). One of the communication skills that is important to master in science learning is scientific writing skills.

Scientific writing skills are essential competencies that students must master. Scientific writing skills are skills in writing reports of experimental results in accordance with the rules of scientific work (Jannah et al., 2021). The purpose of scientific writing is to solve and analyze problems using the framework of scientific writing methods. Through writing activities, students express their ideas and thoughts in written form logically and systematically (Oktavia & Simanjuntak, 2022). Someone who has scientific writing skills can solve various problems they encounter scientifically and communicate them.

Science learning in the process does a lot of practicum activities so it is necessary to have scientific writing skills so that they can pour their understanding in the form of reports (Faurisiawati et al., 2022). Writing down practicum findings in the form of a report is a

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manifestation of written communication skills. This communication skill is an important element in science learning so that students can express the results of practicum in the form of charts, tables, diagrams, and graphs and explain their findings clearly (Safitri et al., 2022). Scientific writing skills need to be trained to students in learning so that students are able to communicate their intended ideas or ideas through scientific writing.

In reality, junior high school students' have low scientific writing skill. This statement is supported by Budiaty (2018), who found that the measurement results of scientific writing skills in science learning were 41.37%, which is considered low. Research Suprayogi et al., (2021) revealed that many students still experience problems in scientific writing because scientific writing is considered a difficult activity and students do not like it. In addition, Septafi (2021), in his research explained that there are still many students who only copy and paste other people's published writings, even though these writings should be understood and developed.

The cause of low scientific writing skills in science learning in junior high school is closely related to the quality and availability of teaching materials used in the learning process. The teaching materials used do not facilitate students to practice their scientific writing skills. In addition, the limited teaching materials available also play an important role in students' scientific writing skills such as scientific writing guidebooks, journals, and examples of scientific writing are often not available sufficiently. The lack of adequate guidance from teachers also contributes to the low level of scientific writing skills. Classroom learning focuses more on theory than writing practice and teachers are poorly trained in teaching scientific writing skills effectively. Without proper guidance, students do not get the direction they need to develop scientific writing skills. Therefore, teachers need to innovate the learning process to develop students' scientific writing skills, such as by using student worksheets designed to enhance these skills.

A student worksheet is a printed educational resource that includes material, summaries, and instructions for tasks that students need to complete, aligned with the basic competencies to be achieved. A student worksheet incorporating scaffolding can effectively guide students toward developing scientific writing skills. According to Fajriani et al., (2021), when teaching materials like student worksheets are enhanced with scaffolding, they can help optimize learning activities and enhance students' higher-level thinking skills.

Many previous studies have focused on developing writing skills in general and scientific writing skills, but research that specifically examines the effect of question-prompt scaffolding-based students worksheet on scientific writing skills is still limited. Student worksheet based on question prompt scaffolding is a student worksheet that contains assistance in the form of procedural questions to guide students to solve problems. According to Mardiani et al., (2018), question prompt scaffolding *is in* the form of questions that must be answered briefly to identify problems. The use of question prompt scaffolding helps students concentrate more on writing reports about their science experiment results, as they only need to fill in the required information within the provided framework (Gobert et al., 2018). The scaffolding assists students in creating more structured reports and educates them on the cognitive strategies involved in inquiry activities (Bauer & Amy E. Booth, 2018). Question prompt scaffolding in the student worksheet can provide assistance to students in order to solve problems in the student worksheet so that learning objectives can be achieved (El Widad et al., 2023).

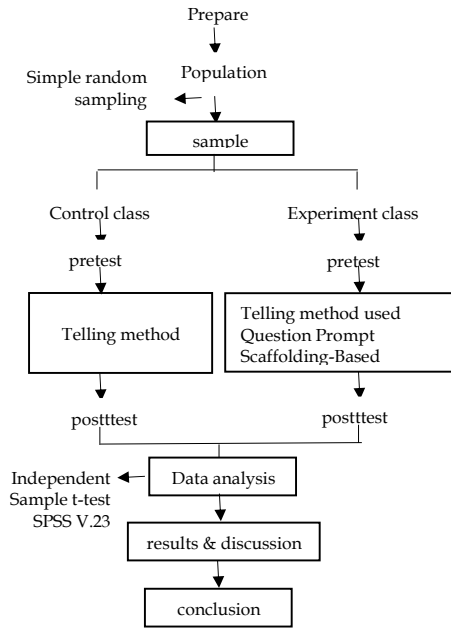
Based on the description above, researchers aim to investigate the impact of student worksheets based on question prompt scaffolding on the scientific writing skills of junior high school students. The objective is to determine how this instructional approach influences students' ability to organize and communicate their understanding of scientific concepts and theories. Scientific learning is inherently tied to developing scientific writing skills, yet these skills are generally low among junior high students. This study seeks to address this issue by evaluating the effectiveness of a targeted intervention designed to enhance scientific writing proficiency in the context of science education

Method

This research is a quasi-experimental study with a posttest-only control group design. It was conducted at SMPN 7 Jember, involving all active eighth-grade students. One class was designated as the experimental group and another as the control group. The sampling technique used was random sampling through a draw method. During the learning process, class VIII-G received treatment by using student worksheets based on question prompt scaffolding, while class VIII-H used the activity guide from the student book.

Table 1. The Pretest-Posttest Control Group Design

Class	Pretest	Treatment	Posttest
Eksperiment	O ₁	X ₁	O ₂
Control	O ₁	X ₂	O ₂



Gambar 1. Flowchart of research

Data collection techniques were carried out with tests in the form of posttests using scientific writing skills indicators, namely clarification, observation, measurement, claims, cause/effect, argumentation and generalization. For the data analysis technique of scientific writing skills, researchers used the Independent Sample t-test with the help of SPSS, which previously conducted a prerequisite test in the form of a data normality test using the Shapiro-wilk test. For detail:

- 1) Normality Test is used to determine if the data follows a normal distribution. This test was performed using SPSS software with the Shapiro-Wilk test. If the significance value (sig.) is above 0.05, the data is considered normally distributed; if the sig. value is below 0.05, the data is not normally distributed. If the data is normally distributed, the researcher will use the Independent Sample t-test. However, if the data is not normally distributed, the researcher will use the nonparametric Mann-Whitney U test.
- 2) Independent Sample t-test is used to determine whether there is an average difference between the evaluation scores of the scientific writing skills of classes VIII-G and VIII-H so that researchers can find out whether significantly the two classes have the

same average or not. Researchers conducted an Independent Sample t-test using SPSS software with a right party test at a significant level of 5%. The following is the Independent Sample t-test statistical hypothesis:

H0: The average score for evaluating scientific writing skills in class VIII-G is equal to the average score in class VIII-H.

Ha: The average score for evaluating scientific writing skills in class VIII-G differs from the average score in class VIII-H.

The statistical testing criteria for the Independent Sample t-test are as follows:

H0 is accepted, and Ha is rejected if p (significance) > 0.05 (if $p \leq 0.05$, reject Ho and accept Ha)

Result and Discussion

Researchers conducted a test assessment to determine students' scientific writing skills. Evaluation of scientific writing skills based on indicators on the *universal scientific writing* rubric (Grimberg & Hand, 2009). Which has been adjusted, namely clarification, observation, claim, cause/effect, argumentation, and generalization. Data on the evaluation scores of students' scientific writing skills is evident in Table 2.

Table 2. Evaluation scores of students' scientific writing skills

Indicators	Average score of class VIII-G	Average score of class VIII-H
Clarification	71.42	53.57
Observation	98.21	88.39
Claim	92.85	82.14
cause/effect	51.78	50.00
Argumentation	38.39	35.71
generalization	55.35	41.96
Overall average	68.03	58.67
Standard Deviation	13.16	17.52

It is evident that the average score for evaluating scientific writing skills is higher in class VIII-G than in class VIII-H, with class VIII-G scoring 68.03 and class VIII-H scoring 58.67. The indicator that obtained the highest score was the observation indicator, which was 98.21 for class VIII-G and 88.39 for class VIII-H. Meanwhile, the indicator that obtained the lowest score was the argumentation indicator, which was 38.39 for class VIII-G and 35.71 for class VIII-H. Meanwhile, the indicator that obtained the lowest score was the argumentation indicator, which amounted to 38.39 for class VIII-G and 35.71 for class VIII-H.

The data on students' scientific writing skills were analyzed using an independent samples t-test with SPSS

software. This analysis aimed to determine if there was an impact from using question prompt scaffolding in student worksheets on the scientific writing abilities of junior high school students in science learning. Prior to this, a Shapiro-Wilk normality test was conducted as a pre-test. The results of this normality test are presented in Table 3.

Table 3. Normality test results

Class	Shapiro-Wilk		
	Statistic	Df	Sig.
VIII-G	0.940	28	0.109
VIII-H	0.982	28	0.898

Based on the results obtained, it shows that the sig. value of class VIII-G is 0.109 and the sig. value of class VIII-H is 0.898. Both classes have a significance value of more than 0.05. This shows that the data obtained from the two classes are normally distributed. With this, data analysis using the *Independent Sample t-test* can be carried out by researchers. The results of the *Independent Sample t-test* can be seen in Table 4.

Table 4. Independent Sample t-test results

Scientific Skill	Writing	Equal variances assumed	Lavene's Test for Equality of Variances		t-test for Equality of Means		
			F	Sig.	T	Df	Sig.(2-tailed)
			1.222	0.274	2.259	54	0.028
		Equal variances not assumed			2.259	50.115	0.028

The results indicate a significance value of p Sig. (2-tailed) at 0.028, which is less than 0.05. Consequently, it can be inferred that the average score of the scientific writing skills test for students in class VIII-G differs from that of students in class VIII-H. This finding highlights a disparity in the average scientific writing skills test scores between the two classes. Therefore, it can be concluded that student worksheets based on question prompt scaffolding have a significant impact on the scientific writing skills of junior high school students in science learning.

The use of student worksheet based on question prompt scaffolding helps students to plan their scientific writing in a more structured way. With guiding questions that direct them to choose a topic, formulate writing objectives, and develop an *outline*, students become more skillful in planning the structure of their writing before writing. *Scaffolding question prompts* effectively stimulate rational and logical reasoning that promotes reflection and improvement of problem-solving skills (Yuriev et al., 2017). With *scaffolding*, students are assisted in answering the problem formulation so that they are able to write conclusions appropriately (Vale et al., 2019). In addition, students are encouraged to formulate cohesive and logical arguments in their writing. Guiding questions help them to organize their ideas sequentially and link each argument with relevant evidence or data. In addition, students are also guided in drawing conclusions that tie all the arguments together.

The findings of this research align with the results of the study conducted by Supeno et al., (2023), where in the experimental class the average score of scientific writing skills was 80.56, then in the control class the

average score of scientific writing skills was 51.27. The results show, it is obtained that the student worksheet based on question prompt scaffolding has an effect on scientific writing skills. Other supporting research is research Mahtari et al., (2020), which revealed that student worksheet based on question prompt scaffolding improves student learning performance and can be used as a gradual tool to encourage students to achieve learning and research goals. Research conducted by Sari et al., (2023), with the conclusion that student worksheet based on *question prompt scaffolding* is effectively used to improve students' scientific writing skills.

The learning process using student worksheet based on *question prompt scaffolding* focuses on achieving indicators of scientific writing skills. Through the guiding questions in the student worksheet, students are encouraged to conduct more focused information gathering and deeper analysis of the material they are writing about. This helps them to present stronger and more detailed arguments in their scientific writing. In the clarification indicator, students create questions and write down their initial knowledge to stimulate explanations in the form of facts. In the generalization indicator, students answer the problem formulation based on the experimental results, analyze the data, and make conclusions from the data that has been obtained. In the observation indicator, students write the observation data in the observation table. In the claim indicator, students describe the observation data in their own language so that it is easy to understand. In the cause/effect indicator, students explain the link between the data that has been obtained and the concept being studied. While in the argumentation indicator, students

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express their arguments regarding the data that has been obtained with the support of theory.

The question prompts scaffolding-based student worksheet directs students' attention to the key points of a problem, guides the problem-solving process, and helps students to build arguments based on evidence (Hsu et al., 2015). Scaffolding question prompts can develop students' ability to build arguments with claims, data, support, justification, and refutation (Ustunel & Tokel, 2018). However, in the research conducted by the researcher, students were not very good at explaining their arguments regarding the observational data supported by relevant theories. This is evidenced by the argumentation indicator which is the indicator with the lowest score. An alternative that can be done is to increase elaborative questions. Nevertheless, students are very good at deciding on the cognitive strategy of the investigation for the problem-solving process and can produce a well-organized practicum report based on the framework of the scientific writing method.

Conclusion

Based on the research, this study concluded that student worksheet based on question prompt scaffolding has a significant effect on scientific writing skills in science learning of junior high school students. Student worksheet based on question prompt scaffolding can be used by teachers as an alternative method to train students' academic writing skills.

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Author Contributions

Conceptualization was done by R.R; methodology by S.S; research instruments by U.N; data retrieval and curation by R.E.F; original draft writing by R.R; review and editing by R.R; visualization by A.I.

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Conflicts of Interest

The authors declare no conflict of interest

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