JPPIPA 11(6) (2025)

Jurnal Penelitian Pendidikan IPA

http://jppipa.unram.ac.id/index.php/jppipa/index

The Effectiveness of the Probalusan Model on Improving Knowledge and Process Skills in Science Learning for Junior High Schools in Jayapura City

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Received: February 16, 2025
Revised: May 15, 2025
Accepted: June 25, 2025
Published: June 30, 2025

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DOI: 10.29303/jppipa.v11i6.11348

Abstract: This study aims to determine the effectiveness of the Probalusan model in improving science process knowledge and skills in science learning at SMP Negeri 3 Jayapura City. This study used a quasi-experimental Nonequivalent Control Group design with a purposive sampling technique, where the schools studied were SMP Negeri 1 and SMP Negeri 3 Jayapura City. Data collection techniques included tests and observation sheets. Data analysis was carried out descriptively qualitatively, using independent sample-test, MANOVA test, N-Gain, and effect-size test. The results of the study showed that: the Probalusan model can improve science process knowledge and skills in science learning at SMP Negeri 3 Jayapura City. The results of the difference test showed a significant difference between the scores of students taught using the Probalusan Science learning model and the scores of students taught using the conventional model. The scores of science process knowledge and skills of students taught using the Probalusan Science model were higher than the scores of participants taught using the conventional model. The effectiveness of the Probalusan Science learning model is categorized as high based on the N-Gain and effect-size values.

Keywords: Knowledge; Learning model; Probalusan science; Process skills

Introduction

The problems faced by the world of education in improving the quality of education, especially in developing the potential of students, one of which is the problem of the learning process. An ideal learning process is needed to develop the potential of students. Science learning through the application of constructivist theory encourages students to find their own knowledge and experience (Do et al., 2023; Kwan & Wong, 2015). This is intended so that educators do not only try to improve students' cognitive abilities, but also process skills, creativity, scientific attitudes and the application of science in everyday life (Kartika et al., 2019). The purpose of science learning according to (Bramastia & Rahayu, 2023) is to develop mastery of science knowledge (terminology, concepts, principles, laws, theories) and process skills. The learning process that occurs in the classroom so far has been more focused on the acquisition of cognitive abilities (Jamil et al., 2023). The 2013 curriculum and the independent curriculum encourage educators to apply innovative learning models such as PBL (Problem Based Learning) and PjBL (Project Based Learning), but in reality many educators have not applied them optimally so that they have an impact on student learning outcomes (Hermayanti & Setyasto, 2025; Hadis & B., 2018).

Based on the results of problem identification, it can be seen that there are many problems that can be researched and developed to improve the quality of the learning process and the quality of science learning outcomes in junior high schools in Jayapura City (Tanta et al., 2023; Nurbaya et al., 2024). Student learning outcomes in the aspects of knowledge or cognitive and

How to Cite:
Rehiara, R. E. (2025). The Effectiveness of the Probalusan Model on Improving Knowledge and Process Skills in Science Learning for Junior High Schools in Jayapura City. *Jurnal Penelitian Pendidikan IPA*, *11*(6), 306–313. https://doi.org/10.29303/jppipa.v11i6.11348

science process skills are greatly influenced by the learning model applied by educators in the classroom. The Probalusan learning model or a blend of Problem Based Learning (PBL) and Susan Loucks-Horsley (SLH) learning models is one of the innovative learning models that can improve student learning outcomes. The SLH learning model has 5 domains (knowledge, process skills, creativity, attitude and application), but in this study it is limited to the domains of knowledge and process skills (Makkonen et al., 2023; Kim et al., 2021). Process skills in science learning are called science process skills (KPS) (Jalil et al., 2018; Sriwarthini et al., 2024).

Science process skills are physical and mental skills possessed by scientists to acquire and develop knowledge. KPS emphasizes the development of investigation skills in the form of scientific method skills (Sa'adah et al., 2023; Br Sitepu et al., 2021). Science learning is structured with reference to basic science process skills and integrated science process skills (Nuraini & Muliawan, 2020; Melesse et al., 2025) stated that basic science process skills include observation, measuring, collecting data, concluding, predicting, classifying, communicating and making models; integrated science process skills include data interpretation, making graphs, formulating hypotheses, controlling variables, defining variables operationally and conducting experiments (Wazni & Fatmawati, 2022). KPS indicators in this study consist of: observing, classifying, measuring, communicating and concluding. This study aims to determine the effectiveness of the Probalusan model in improving knowledge and science process skills in science learning in junior high schools in Jayapura City.

Method

This study used a quasi-experimental design of Nonequivalent Control Group Design (Borg & Gall, 2007: 416; Sugiyono, 2015: 506-607), conducted for two months. The subjects of this study were 30 students of class VIII B SMP Negeri 1 Jayapura (KK) and 30 students of class VIII B SMP Negeri 3 Jayapura (KE). The Probalusan IPA learning model in its application uses five syntaxes, namely; orientation/invitation; organizing students to learn, guide, explore-discovery-creation; presenting explanations-solutions; taking action, developing and presenting work results; and analyzing-evaluating the problem-solving process. Before data analysis, validity, practicality and effectiveness tests of the Probalusan IPA model learning tools were carried out. The data analysis technique used a difference test and an N-Gain test. Before the difference test, a normality and homogeneity test of the pretest and posttest data was carried out.

The normality test aims to obtain empirical data whose samples come from a regular population using the One-Sample Kolmogorov-Smirnov Test (Jiménez-Gamero, 2024). Data is said to be normally distributed if the significance level is greater than 0.025. The homogeneity test of data variance between groups aims to obtain homogeneous empirical data. This test uses Levene's Test of Equality of Error Variance. Data is said to be homogeneous if the significance level is greater than 0.05. The difference test was carried out using SPSS version 25.00. Determination of the effectiveness of learning devices is seen from the results of the difference test and the increase in posttest scores is calculated through the N-Gain test based on equation 1.

Result and Discussion

Data Analysis to See the Effectiveness Using Different Test Analysis and N-Gain Test

Validity Test

The validity test includes testing the assessment instrument of the Probalusan IPA learning model, and supporting devices consisting of: learning devices; assessment instruments; and educator assessment, student responses and learning implementation. The level of content validity is seen from the validity coefficient of (Cheung et al., 2024), with a value of Vcount> Vtable = 0.92 so that all instruments are declared valid.

Table 1. Results of the Validity Test of the Probalusan IPA Learning Model Instrument

Device	Average V_{count}	Table	Information
Syllabus	0.94	0.92	Valid
RPP	0.93	0.92	Valid
LKPD	0.98	0.92	Valid
Assessment instrument	0.96	0.92	Valid
Model	0.95	0.92	Valid
Implementation	0.97	0.92	Valid
Educator Assessment	0.93	0.92	Valid

Furthermore, the test of student responses used a questionnaire to measure the level of student responsiveness to the Probalusan IPA model seen from the learning aspect, content aspect and language aspect. The assessment of student responses obtained results of 92.33% with a very good category (Akbar, 2013). The results of the syllabus validation showed that the Probalusan IPA model syllabus was declared suitable for use in junior high school science learning according to the criteria for the syllabus coverage aspect and language use. The results of the RPP validation showed that the RPP was suitable for use in junior high school science learning according to the criteria for the RPP coverage aspect, competency achievement indicators,

learning objectives, content and learning activities, assessment, language use, time, and closing. The results of the LKPD validation were declared suitable for use in junior high school science learning according to the criteria for the LKPD characteristics aspect, content, format, assessment, language use and time. Analysis of the results of the educator assessment, student responses and the implementation of learning are presented in Table 2.

Table 2. Results of Educator Assessment, Student Responses and Learning Implementation in the Main Field Trial

	Average Score	Percentage (%)	Category
Educator Assessment	3.73	93.13	Very Good
Student Response	3.65	91.25	Very Good
Implementation	3.67	91.83	Very Good

The study was conducted on 30 students of class VIII B SMPN 3 Kota Jayapura (KE), using the Probalusan IPA model learning device and class VIII B SMPN 1 Kota Jayapura (KK), without using the Probalusan IPA model learning device. The study was conducted for 10 teaching hours in 3 meetings. The data produced included the achievement of learning implementation, teacher assessment, student responses and pretest-posttest scores. The test of differences in the increase in knowledge and process skills scores between KK and KE can be seen to determine the implementation of the Probalusan IPA learning model. Empirical validity for testing knowledge and process skills instruments: The results of the test of the question item instrument to measure student knowledge in junior high school science learning using the Probalusan IPA model based on the modern approach (Item Response Theory) using the Quest application with the INFT MNSQ value in the range of ≥ 0.5 - ≤ 1.5.

These results indicate that the question item instrument is in accordance with the Rasch model or is good for measuring aspects of knowledge (Hamdu et al., 2020). The results of the Reliability of estimate test on the question instrument based on the IRT analysis with Quest were obtained at 0.84 with a very high category (Affandy et al., 2021) or in the range of 0.80 - 1.00. The level of difficulty of the question instrument is shown by THRSHL (thresholds) in the very easy category of 5.26%, easy category 23.68%, moderate category 63.16%, and difficult 7.89%; Test of the process skills observation sheet instrument of 30 students through 15 statements. The INFT MNSQ value is in the range of ≥ 0.5 - ≤ 1.5. Thus, the science process skills observation sheet instrument is in accordance with the Rasch Model or is good for measuring science process skills. Furthermore, based on the Reliability of estimate value of 0.68 or the level of reliability of the process skills instrument in the high category.

Practicality Test

The practicality of the learning device is known from the analysis of the results of the educator's assessment, student responses and the results of observations of the implementation of learning. The analysis of the implementation of learning is presented in Table 3.

Table 3. Results of Educator Assessment, Student Responses and Learning Implementation.

	Average Score	Percentage (%)	Category
Educator Assessment	3.83	95.63	Very Good
Student Response	3.69	92.33	Very Good
Implementation	3.72	93	Very Good

The results of this analysis mean that the learning device of the Probalusan IPA model based on the assessment of educators, student responses and the implementation of learning has met practical requirements. The results of the practicality analysis also show an increase.

Effectiveness Test

The effectiveness test of the Probalusan IPA model learning device can be seen from the results of the N-gain test and the difference test. Data analysis using N-Gain was carried out to see the increase in student knowledge between the control class and the experimental class (application of the Probalusan IPA model). The results of the N-Gain calculation are obtained in Table 4.

Table 4. Results of N-Gain Analysis of the Control Class and Experimental Class of the Probalusan IPA Model

	Average N-Gain Score	Category
Control Class	0.49	Medium
Experimental Class	0.82	High

Based on these results, it can be seen that the N-Gain in KK is in the medium category, while the N-Gain in KE is in the high category. This proves that the increase in knowledge in KE who was given the treatment of using the IPA Probalusan model learning device was higher than KK. The N-Gain at each meeting in KE tended to increase from meeting I to meeting IV presented in Table 5.

Table 5. Results of the Average N-Gain Score of the Control Class and the Experimental Class of the IPA Probalusan Model

School Name		Average N-Gain at Meeting No				
		I	II	III	IV	Average
SMPN 1 Jayapura	Control	0.52	0.43	0.59	0.41	0.49
SMPN 3 Jayapura	Experiment	0.78	0.80	0.83	0.87	0.82

After the N-Gain test, it was continued with a pretest and posttest difference test preceded by a normality and homogeneity prerequisite test. The results of the pretest normality test on KK and KE using the One-Sample Kolmogorov-Smirnov Test using the SPSS version 25.00 application are presented in Table 6.

Table 6. Results of the Normality Test for Pretest Data for the Control Class and Experimental Class of the Science Probability Model

		One-Sample Kolmogorov-Smirnov Test	
		Pretest Control	Pretest Experiment
N		12	13
Normal Parameters[a,b]	Mean	33.9583	31.5962
	Std. Deviation	2.62599	2.53216
Most Extreme Differences	Absolute	.142	.168
	Positive	.094	.168
	Negative	-.142	-.111
Test Statistic		.142	.168
Asymp. Sig. (2-tailed)		.200[c,d]	.200[c,d]

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.
d. This is a lower bound of the true significance.

The results of the normality test show that the pretest data of the knowledge aspects of KK and KE are normally distributed with a significance level greater than 0.025. The homogeneity test of the pretest data of the knowledge aspect using Levene Statistic with the SPSS application version 25.00 is presented in Table 7.

Table 7. Results of the Homogeneity Test of the Pretest Data of the Science Probability Model

		Test of Homogeneity of Variances			
		Levene Statistic	df1	df2	Sig.
Pretest	Based on Mean	.213	1	23	.649
KK & KE	Based on Median	.240	1	23	.629
	Based on Median and with adjusted df	.240	1	22.015	.629
	Based on trimmed mean	.219	1	23	.644

The results of the pretest data difference test in the control class and the experimental class showed that the pretest data prerequisite test at SMPN 3 Jayapura was normally distributed and homogeneous, so the pretest value difference test was carried out using a parametric test in the form of an Independent sample test with the results of Asymp. Sig. (2-tailed) = 0.032 so that sig> 0.025. This indicates that there is no significant difference in the pretest value between the control class and the experimental class. Thus, it can be said that before being given the Probalusan model treatment, students at SMPN 3 Jayapura had the same initial abilities in Table 8.

Table 8. Pretest Data Difference Test between Control Class and Experimental Class

		Independent Samples Test					
		Levene's test for equality of variances		t-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Pretest	Equal variances assumed	0.213	0.649	2.289	23	0.032	236.218
KK & KE	Equal variances not assumed			2.286	22.674	0.032	236.218

Furthermore, the posttest difference test is preceded by a prerequisite test for normality and homogeneity. The results of the posttest data normality test for KK and KE are presented in Table 9.

Table 9. Results of the Posttest Data Normality Test for the Knowledge Aspect, and Process Skills of the Science Probability Model

Class	Knowledge		Process Skills	
	Statistics	Sig 2-tailed	Statistics	Sig 2-tailed
Control	0.121	0.200	0.207	0.037
Experiment	0.153	0.200	0.154	0.109

The results of the posttest data normality test for the knowledge and process skills aspects in KK and KE were all normally distributed at a significance level greater than 0.025. The results of the posttest data homogeneity test between the control class and the experimental class are presented in Table 10.

Table 10. Results of the Posttest Data Homogeneity Test for the Knowledge and Process Skills Aspects of the Science Probability Model

	Resource	Levene Statistic	df1	df2	Sig.
Knowledge	Based on Mean	.000	1	23.000	.983
KK and KE	Based on Median	.004	1	23.000	.953
	Based on Median and with adjusted df	.004	1	22.918	.953
	Based on trimmed mean	.000	1	23.000	.985
Process Skills	Based on Mean	.130	1	23.000	.722
KK and KE	Based on Median	.015	1	23.000	.903
	Based on Median and with adjusted df	.015	1	21.600	.903
	Based on trimmed mean	.119	1	23.000	.733

The results of the homogeneity test of the posttest data on the knowledge and process skills aspects of the IPA Probalusan model in KK and KE are homogeneous. Because the prerequisite test of the posttest data (knowledge and process skills) is normally distributed and homogeneous, the difference test uses MANOVA analysis in Table 11.

Table 11. Difference Test of Posttest Data (Knowledge and Process Skills) between the Control Class and the Experimental Class

							Multivariate Tests[a]
Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.999	1073.941[b]	3.000	4.000	.000	.999
	Wilks' Lambda	.001	1073.941[b]	3.000	4.000	.000	.999
	Hotelling's Trace	805.456	1073.941[b]	3.000	4.000	.000	.999
	Roy's Largest Root	805.456	1073.941[b]	3.000	4.000	.000	.999
KK - KE	Pillai's Trace	.979	62.886[b]	3.000	4.000	.001	.979
	Wilks' Lambda	.021	62.886[b]	3.000	4.000	.001	.979
	Hotelling's Trace	47.165	62.886[b]	3.000	4.000	.001	.979
	Roy's Largest Root	47.165	62.886[b]	3.000	4.000	.001	.979

a. Design: Intercept + Control Class & Experimental Class
b. Exact statistic

The results of the posttest data difference test on KK and KE showed a significance level smaller than α = 0.05, meaning that the Probalusan IPA model has a significant effect on the knowledge and process skills of students. Thus, it can be said that the development of the Probalusan IPA learning device is very effective in improving the knowledge and process skills of class VIII IPA junior high school students. Research on improving knowledge and process skills in science learning through the Probalusan IPA model learning device is in line with previous research (Rophi et al., 2024; Monsang et al., 2021). The implementation of PBL in learning directs students to solve problems, improve learning abilities and science process skills (Wang, 2021; Khoirulloh et al., 2024). The results of the study on the effect of PBL on learning show that PBL improves students' learning achievement in science (Akınoğlu & Tandoğan, 2007; Munawaroh & Setyani, 2020).

The results of problem-based learning research on student achievement show that PBL improves learning, problem-solving and critical thinking skills (Zhang & Ma, 2023; Yulia & Salirawati, 2023), teamwork and the ability to apply knowledge in new situations (Khoa & Huynh, 2024), improves science process skills and student learning motivation (Yu, 2024). PBL improves problem-solving skills, students' attitudes towards science, positive views of the learning environment and develops a sense of togetherness in the classroom

(Almulla, 2020; Markula & Aksela, 2022). The SLH learning model in its application can improve the quality of constructivist-based learning and help students achieve the science domain competency standards in the 2013 Curriculum, namely the domains of attitudes, skills and knowledge. Learning devices based on the SLH model in the learning process are superior in improving science process skills (Irianti & Nurcahyo, 2016), improving attitudes towards science, science process skills and mastery of science material (De Jong et al., 2023; Darling-Hammond et al., 2020).

The subjects in this study were able to solve problems, put forward explanations and solutions (Smith et al., 2022). The application of the SLH learning model can improve learning outcomes (Yusuf et al., 2024), science process skills (Liliawati et al., 2016). The development of the Probalusan IPA learning model has also been shown to be able to improve knowledge and science process skills in science learning at SMP Negeri 3 Jayapura City with an N-Gain value of 0.82 in the high category. In addition, there is a significant difference between classes that use the Probalusan IPA model learning device and classes that do not use it. Thus, it is concluded that the Probalusan IPA model science learning device has been proven to be able to improve students' knowledge and process skills in science.

Conclusion

Based on the results of the analysis, it can be concluded as follows that the learning device meets the effective criteria based on the N-gain value of 0.82 and the MANOVA test results show a significance level of less than 0.05, meaning that there is a significant difference between classes that use the Probalusan IPA model learning device and those that do not use it. The conclusion of this study is that the Probalusan model is effective in improving the knowledge and skills of junior high school students' science processes.

Acknowledgments
Thanks to all parties who have supported the implementation of this research. I hope this research can be useful.

Author Contributions
Conceptualization; methodology; validation; formal analysis; investigation; resources; data curation: writing—original; draft preparation; writing—review and editing: visualization: E. R. R. All authors have read and agreed to the published version of the manuscript.

Funding
Researchers independently funded this research.

Conflicts of Interest
The authors declare no conflict of interest.

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