



## Science Literacy-Based Student Worksheets to Improve Critical Thinking Skills on Acid-Base Materials

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### Abstract

The goal of this study was to find out the eligibility of science literacy-based student worksheets to improve learners critical thinking skills on acid-base materials. The eligibility of the developed science literacy-based student worksheets viewed from validity, practicality, and effectiveness. This type of study uses Research and Development (R&D) with a 4D research model. This study model consists of the define, design, and limited to develop stages. The validity of science literacy-based student worksheets based on content criteria obtained a percentage of 37.50% (valid) with mode 3 and 62.50% (very valid) with mode 4. On the construction criteria, obtain a percentage of 15.15% (valid) in mode 3 and 84.85% (very valid) in mode 4. The practicality of the student worksheet was viewed from the responses and observations of learner activities, which earned a percentage of 97.10% and 90% with very practical criteria. The effectiveness of the student worksheet received highly effective criteria viewed from the N-gain score of science literacy of 0.75 (high), and critical thinking skills obtained a N-gain score of 0.71 (high). This is corroborated by the Wilcoxon statistical test of science literacy and critical thinking skills, which revealed a disparity between learners' capability for science literacy and critical thinking skills prior to and following the use of science literacy-based student worksheets, with a sig. (2-tailed) of 0.000. The Spearman correlation test resulted in a correlation coefficient of 0.754, indicating a significant association between science literacy and critical thinking skills, with a classical completeness of 89%. So, based on this research, science literacy-based student worksheets are declared eligible to improve learners thinking skills.

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## INTRODUCTION

Chemistry is a family of sciences that encompasses the natural sciences, with similar products, processes, and scientific attitudes (Sari & Maharani, 2020). Chemistry is a science based on experimentation, so chemistry learning in schools is often associated with practical activities. Practical activities are easier to understand when associated with real situations in everyday life (Yasa, 2018). Chemistry and humans are interrelated, both in everyday life, industry, and even in chemistry learning (Mitarlis et al., 2018). Chemicals that are closely related to everyday life are basic acidic substances. Chemical learning on base-acid matter can be done by connecting between the concepts mastered with the phenomena being studied. On the acid-base matter, there is a relationship between the existing theory and what has been proven through an experiment, so the student is required to think critically when associating concepts based on experimental results (Respati, 2023).

Critical thinking skills of learners can be applied while conducting discussion and analysis of evidence, data evaluation, and drawing conclusions (Indah & Hatimah, 2020). In the results of pre-research on February 21, 2023, at one of the high schools in Surabaya, the results of learners critical thinking skills on each indicator were still relatively low, namely 57% interpretation, 49% analysis, 47% evaluation, and 58% inference.

Critical thinking skills are a clear and purposeful process for helping learners develop mental processes such as the ability to think about assumptions, ask pertinent questions, draw implications, and think about and debate issues (Fisher, 2011). Critical thinking, according to psychologist Robert Stenberg, is the mental processes, representations, and strategies that individuals use for making decisions, solving problems, and learning new concepts (Shaw, 2014). Critical thinking skills are born from reading habits, reading analysis, and learning activities that lead to the process of giving explanations (Azrai et al., 2020).

Research by Septiani et al. (2019) revealed that student literacy skills are closely related to reading skills that foster the ability to understand information critically, analytically, and reflectively. In the 21st century, one must have high literacy skills, one of which is science literacy (Rahayu, 2017). The ability to engage with scientific expertise and think critically about science is known as science literacy (Shamos, 1995; Korpan et al., 1997 dalam Windyariani, 2019). According to the American Association for the Advancement of Science, science literacy is the use of a learner's habits of thought and knowledge of science, technology, and mathematics to consider and make decisions about ideas and events that occur in daily life (King, 2002). When the literacy skills of the student are high, then the critical thinking skills are also high, and vice versa (Rahayuni, 2016). The positive relationship between the two skills in this study is related to the indicators of critical thinking skills and the science literacy domain. Indicators of critical thinking in this research include interpretation, analysis, evaluation, inference, and explanation (Facione, 2011). In science literacy, there are three domains: context, knowledge, and competence (OECD, 2019).

The Organization for Economic Co-operation and Development (OECD) regularly reviews PISA (Programme for International Student Assessment) every three years. According to the 2018 PISA survey, the science literacy skills of Indonesian learners are low, with a mean score of 396 below the PISA mean score of 500 and ranking 72 out of 77 countries (OECD, 2019). Science literacy and the critical thinking capability of learners can be enhanced by using teaching materials in the format of student worksheets. Worksheets for students play a significant part in assisting the learning process so that they may better understand the subject being taught, particularly the experimental material, so they need media guidelines to guide the course of the practicum (Muna & Rusmini, 2021). Student worksheets contain a set of learning activities to maximize students' understanding by giving them a scientific problem and steps to solve it (Ulandari & Mitarlis, 2021). According to the research problems, it is necessary to test the eligibility of science literacy-based student worksheets to enhance learners critical thinking skills on acid-base material. Student worksheet qualifications are based on validity, practicality, and effectiveness (Nieveen et al., 2010).

## **METHOD**

This study method uses Research and Development (R&D) with the 4D development research model developed by Thiagarajan et al. (1974), namely Define, Design, Develop, and Disseminate. This research is limited to only three stages, namely Develop. The research plan for developing this science literacy-based student worksheet was carried out only until the limited trial. Below is a chart of research procedures for developing science literacy-based student worksheets.

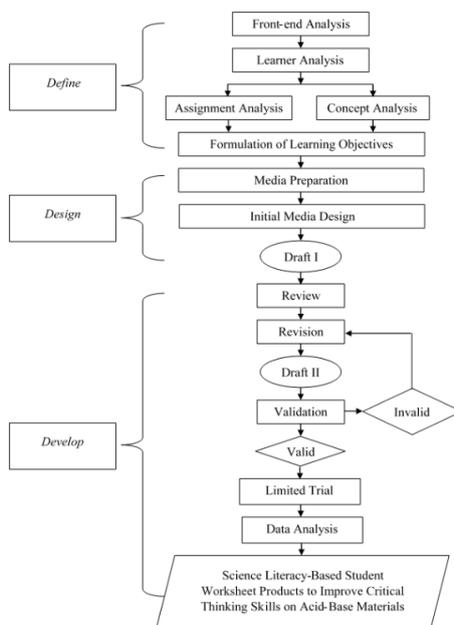


Figure 1. Chart of Research Procedures for Developing Science Literacy-Based Student Worksheets (Adaptation of Ibrahim, 2014).

This study used a trial design with a one-group pretest-posttest design (Creswell & Creswell, 2018).

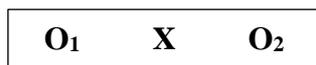


Figure 2. Trial of the One-Group Pretest-Posttest Design

Identifying:

X : Treatment of the application of science literacy-based student worksheets to enhance critical thinking skills

O<sub>1</sub> : Pretest

O<sub>2</sub> : Posttest

Data collection methods include questionnaires, observations, and tests. The questionnaire method in this study was analyzed using validation data analysis and learner response questionnaires. The validation results aim to find the validity of the developed science literacy-based student worksheets. Validation is carried out by three validators who are material and media experts. The assessment is based on the modification of the Likert scale presented in Table 1.

Table 1. Modification of the Likert Score

Scale Value	Criteria
4	Very valid
3	Valid
2	Moderately valid
1	Less valid
0	Invalid

(Riduwan, 2015).

Validation result data of ordinary data can be analyzed using modes on each aspect under the condition that the aspect evaluated by the validator has a score mode  $\geq 3$ .

The response questionnaire method aims to know the practicality of science literacy-based learner worksheets. The results of the learner's responses were obtained after conducting a limited test and evaluated using the following Guttman calculation scale.

Table 2. The Guttman Scale

Question	Positive Question Score	Negative Question Score
Yes	1	0
No	0	1

(Riduwan & Sunarto, 2017).

The formula for calculating the percentage of elevation response in students is as follows.

$$Response (\%) = \frac{Total\ score\ obtained}{Score\ criteria} \times 100\%$$

The method of observation of student activity aims to find out the activity of the student during a limited trial using the developed science literacy-based student worksheets. The results of student observations conducted as one of the supporting data in determining the practicality of science literacy-based learner worksheets. The observation results of the activity of the student are obtained from the observation of the observer during the course of learning. The observation sheet of the student activity is processed into the percentage of student activity (P), which can be calculated using the formula below.

$$P (\%) = \frac{\sum Emerging\ student\ activities}{\sum Activity\ overall} \times 100\%$$

The percentage results from the calculation of the response questionnaire and learner activities are interpreted into criteria in Table 4 below.

Table 3. Interpretation of Student Response and Activity Criteria

Percentage (%)	Criteria
81 – 100	Very practical
61 – 80	Practical
41 – 60	Moderately practical
21 – 40	Less practical
0 -20	Impractical

(Riduwan, 2015).

According to these criteria, science literacy-based learner worksheets to enhance critical thinking skills on acid-base material can be declared practical if the percentage of student responses and activities  $\geq 61\%$  (Riduwan, 2015).

The test method was used to specify the effectiveness of the science literacy-based learner worksheets. Effectiveness was derived from students' pretest-posttest data, namely the science literacy test, critical thinking skills test, and cognitive test. The data acquired were then analyzed using the n-gain score, Wilcoxon test, Spearman correlation test, and analysis of the completeness of learning outcomes. The n-gain score analysis was carried out to calculate the amount of upgrade in science literacy and critical thinking skills.

$$N - gain (g) = \frac{Posttest\ value - Pretest\ value}{Max\ value\ (100) - Pretest\ value}$$

(Hake, 1998).

The results of the calculation are then interpreted based on the criteria in Table 4 below.

Table 4. Interpretation of the N-Gain Score

Index Gain	Criteria
$(g) \geq 0,7$	High
$0,7 > (g) \geq 0,3$	Medium
$(g) < 0,3$	Low

(Hake, 1998).

Based on these criteria, the student worksheet is declared effective if the N-gain score retrieved is  $\geq 0.3$ . This shows an improvement in learners science literacy and critical thinking skills.

The normality test is carried out to ascertain whether the data is normally distributed before conducting statistical analysis. With a sample size of less than 50, the Shapiro-Wilk method was used in this study to conduct the normality test. It can be inferred that the sample data is normally distributed at the 5% significance level (Razali & Wah, 2011).

Hypothesis:

$H_0$  : Normally distributed data

$H_1$  : Data distribution is abnormal

With the following test criteria.

$H_0$  received if the value sig. (2-tailed)  $\geq \alpha$  ( $\alpha = 0,05$ )

$H_0$  is refused if the value sig. (2-tailed)  $< \alpha$  ( $\alpha = 0,05$ )

The Wilcoxon test was carried out due to the data distribution was abnormal. The purpose of the Wilcoxon test is to compare learners critical thinking and science literacy capabilities before and after using science literacy-based student worksheets developed for study.

Hypothesis:

$H_0$  :  $\mu_1 = \mu_2$  (The capability of science literacy and critical thinking skills of learners prior to and following being given the treatment showed no significant difference).

$H_1$  :  $\mu_1 \neq \mu_2$  (The capability of science literacy and critical thinking skills of learners prior to and following being given the treatment shows a significant difference).

With the following test criteria.

$H_0$  received if the value sig. (2-tailed)  $\geq \alpha$  ( $\alpha = 0,05$ )

$H_0$  is refused if the value sig. (2-tailed)  $< \alpha$  ( $\alpha = 0,05$ )

The correlation test aims to find out if there is no connection between scientific literacy and critical thinking skills. Spearman's correlation test was carried out because the normality test was not met.

Hypothesis:

$H_0$  : Science literacy has no significant positive relationship to critical thinking skills.

$H_1$  : Science literacy has a significant positive relationship with critical thinking skills.

With the following test criteria.

$H_0$  received if the value sig. (2-tailed)  $\geq \alpha$  ( $\alpha = 0,05$ )

$H_0$  is refused if the value sig. (2-tailed)  $< \alpha$  ( $\alpha = 0,05$ )

Table 5. Level of Relationship

Value	Criteria
0,00 - 0,19	Very low corelation
0,20 – 0,39	Low corelation
0,40 – 0,59	Medium corelation
0,60 -0,79	Strong corelation
0,80 – 1,00	Very strong corelation

(Sugiyono, 2017).

Based on these criteria, student worksheets are declared effective if  $H_0$  is accepted in the correlation test results, meaning that scientific literacy has a significant positive relationship to critical thinking skills.

The study intensity of individual learners can be calculated using the formula:

$$\text{Individual learning mastery} = \frac{\text{Jumlah skor yang dicapai peserta didik}}{\text{skor maksimum}} \times 100$$

Individual learning strength is achieved when the total student score is equal to or greater than the minimum learning strength value set by the school, which is  $\geq 75$ .

The intensity of classical learners can be calculated using the formula:

$$\text{Classical learning mastery} = \frac{\text{number of students completed}}{\text{Total number of students}} \times 100\%$$

The classical learning intensity set by the school is achieved when  $\geq 80\%$  of pupils reach it.

## RESULTS AND DISCUSSION

This developmental research discusses the eligibility of student worksheets based on science literacy. Here is the 4D phase description that will be discussed until the developpe stage.

### Define

The level defines the conditions and needs for learning. In this phase, there are five steps: front-end analysis, learner analysis, assignment analysis, concept analysis, and formulation of learning objectives.

The front-end analysis is intended to discover and raise fundamental problems when conducting chemistry learning. On the front end, curriculum analysis and early observations of chemistry learning are carried out. The 2013 curriculum is the one that is still being used in Class XI. The results of the observation are attributed to the fact that critical thinking skills are still lacking and do not meet classical tenacity. As a result of the teacher's interview, it was found that students still had difficulty distinguishing between acids and bases and writing their ionization reactions. In addition, the media used in chemistry learning still uses student worksheets that contain only materials and issues that are not associated with scientific phenomena in daily life that support the skills of science literacy and critical thinking of learners.

Learner analysis was intended to understand the characteristics of learners who are in accord with the scheme of the developed learner worksheet. This analysis consists of analyzing the learners' academic capability, age, and cognitive development. Characteristics that grade XI students can have at this stage include the capability for abstract thought, logical reasoning,

and drawing inferences from data (Nursalim et al., 2019). At this stage, learners can also sharpen their science literacy and critical thinking skills.

The assignment analysis is retrieved to decide the suitability of the assignment in the student worksheets that supports the achievement of the competence of the learners on acid-base materials by paying attention to KI, KD, IPK, and materials in the curriculum 2013, as well as adjusting to the domain of science literacy and critical thinking skills indicators.

Concept analysis was intended to identify the concepts that will be applied to learners and are tailored to their abilities and skills. The basic concepts to be used are base acid materials in KD 3.10 and KD 4.10. The results of assignment analysis and concept analysis are used to formulate learning goals that are tailored using operational words.

## Design

The design stage is aimed at designing and preparing learning devices according to the data collected at the defining stage. The design stages include material preparation, format selection, and making initial designs. The preparation of the material is carried out after analyzing the basic competence of the acid-base material to be achieved. The stages of preparation of the material include the search for phenomena of acid base that are tailored to the parts of the student worksheet developed.

The stage of selection of the student worksheet format consists of the preparation of the cover or title, instructions for the use of student worksheets, the competence to be achieved, supporting information, and tasks to be done by the students. The initial plan for developing student work sheets was to design student worksheets. The step in designing the student work sheet refers to terms of content, presentation, graphics, and language so that the student worksheet is developed appropriately and appropriately used by the student participants. In this study, we developed three student worksheets that cover the theory of base acid, base acid indicators, and base acid strength.



Figure 3. (a) Science Literacy-Based Student Worksheet 1: Acid-Base Theory (b) Science Literacy-Based Student Worksheet 2: Acid-Base Indicator (c) Science Literacy-Based Student Worksheet 3: Acid-Base Power and pH

The initial plan at this stage includes three important parts: the preliminary, the content, and the closing, which will later be used as draft I.

## Develop

The development stage seeks to develop and produce science literacy-based worksheet products for learners to enhance their capacity for critical thought when studying acid-base material. This phase consists of two stages: an expert assessment and a limited test. Expert assessment consists of evaluation and validation. The survey aims to obtain advice or comments from experts to be used as the basis for the material for the review. According to

the results of the expert review, draft I was revised to produce draft II. Students' work sheets that have undergone the excavation process were subsequently validated before a limited test was carried out.

### Validity

Validation aims to obtain expert assessment used as the basis for the revision material when there are errors in the preliminary design of the developed learner worksheet. The validation aspect assessed is the validity of content and construction. Here is a review by three validators.

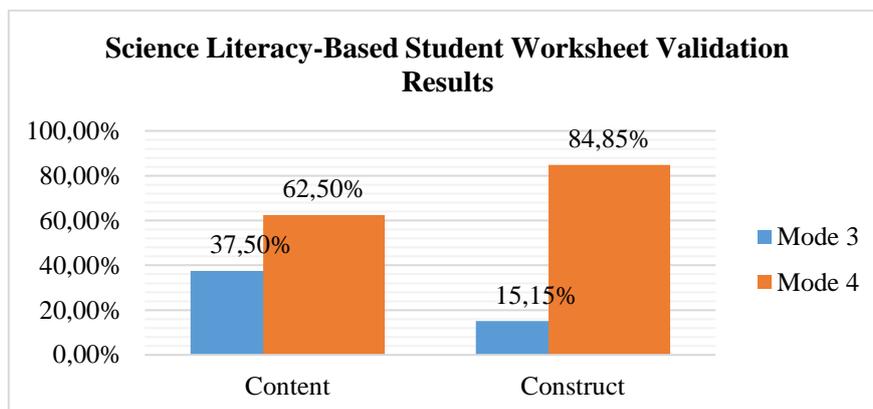


Figure 4. Graph of Science Literacy-Based Student Worksheet Validation Results

Based on the chart above, the content criteria obtained 37.50% with mode 3 and 62.50% with mode 4. On the construction criteria obtained, 15.15% in mode 3 and 84.85% in mode 4. Overall, it can be inferred that the science literacy-based student worksheet get modes 3 (valid) and 4 (very valid).

Once the science literacy-based student worksheets were declared valid, the next stage was a limited trial. The limited trial stage is intended to assess the practicality and effectiveness of using the developed science literacy-based student worksheets.

### Practically

The practicality of the science literacy-based student worksheets developed is reviewed according to the results of the learner response questionnaire and the results of learner activity observations. Below are the results of learners responses to the developed science literacy-based student worksheets. According to data analysis, the average response percentage for practicality was 97.10% with very practical criteria. In line with a study by (Hidayah & Kuntjoro, 2022), the operation of e-LKPD-based science literacy to train critical thinking skills helps learners gain an average in a highly practical category.

Observation of students activities aims to know the activities of learners during the limited test run using science literacy-based student worksheets. The observation activities are carried out with the help of the observer, who is an observer of the activities of the students. Below is a table of results of observations of student activity during a limited trial of student worksheets based on science literacy developed.

Table 6. Results of Activity Observation

Learning Activities	Percent	Criteria
First	89%	Very practical
Second	90%	Very practical
Third	92%	Very practical
<b>Average</b>	<b>90%</b>	<b>Very practical</b>

The overall observation of the participant's activity increased at each meeting. Overall, a mean percentage of 90% was achieved with very practical criteria. Supported by Irsalina and Dwiningsih (2018) research that learning activities performed by students obtained 98% relevance and were in accordance with the teacher's activity plan. The increase in percentage values at each meeting indicates that students are increasingly active in carrying out relevant activities such as listening to the teacher's explanations, reading the phenomena presented, conducting discussions, solving questions of analysis, evaluation, and explanation, as well as being able to draw a conclusion.

According to the results of the response questionnaire and observation of learners activities, the developed science literacy-based student worksheet can be declared very practical and feasible to use because it obtained a percentage  $\geq 61\%$  (Riduwan, 2015).

### Effective

The effectiveness of learner worksheets is retrieved according to the pretest-posttest results of learners, namely the science literacy ability test, critical thinking ability test, and cognitive test. The science literacy and critical thinking skills tests used descriptive questions, and the cognition test was presented as a series of multiple-choice questions.

Data results from the science literacy and critical thinking skills tests were analyzed with the n-gain score to calculate the improvement of science literacy and critical thinking skills. Here is the n-gain score obtained from 36 students who followed the test.

Table 7. Results of the N-gain score

Test Type	Percentage <i>N-gain Score</i> (%)	Criteria	Mean <i>N-Gain Score</i>
Scientific literacy test	27,28	Medium	0,75
	72,22	High	
Critical thinking skills test	71,43	Medium	0,71
	58,33	High	

According to Table 7, the results of the test of science literacy and critical thinking obtained an overall average in succession of 0.75 and 0.71 with high criteria. The pretest-posttest of science literacy contained a knowledge domain with a mean n-gain score of 0.69 (medium) and a competency domain of 0.92 (high). The pretest-posttest results of critical thinking skills obtained the mean n-gain score of each indicator: interpretation 0.84 (high), analysis 0.57 (medium), evaluation 0.83 (high), inference 0.81 (high), and explanation 0.63 (medium). According to the calculation of the n-gain score, the science literacy-based student worksheet was declared effective because it obtained an n-gain score  $\geq 0.3$  (Hake, 1998). Therefore, this science literacy-based student worksheet is very effective for enhancing students' critical thinking skills because there is an improvement in science literacy and critical thinking skills before and after the test. It is supported by research by Maksun & Rusdiyana (2022) that the use of science literacy student worksheets to practice science literacy capability can use a variety of learning bases that are tailored to the student's characteristics, material, and other supporting facilities, with a mean n-gain score of 0.76–0.88.

Furthermore, the normality test was conducted first before the Wilcoxon test and the Spearman correlation test. Data is said to be normal when the probability, or sig. (2-tailed), is 0,05 (Razali & Wah, 2011). The normality results of students' science literacy pretest and posttest are presented on Table 8 below.

Table 8 present the sig. (2-tailed) pretest-posttest literacy values are obtained in succession 0,018 and 0,003. This shows that both have a sig. (2-tailed)  $< 0.05$ , so it can be inferred that  $H_0$  is refused or the pretest and posttest of science literacy are not normally distributed (Razali & Wah, 2011).

Table 8. Result of Normality Pretest-Posttest Scientific Literacy

Tests of Normality				
Shapiro-Wilk				
	Statistic	Statistic	df	Sig.
Pretest SL	.180	.925	36	.018
Posttest SL	.190	.899	36	.003

a. Lilliefors Significance Correction

The normality results of learners critical thinking skills on the pretest-posttest are presented below.

Table 9. Result of Normality Pretest-Posttest Critical Thinking Skills

Tests of Normality			
Shapiro-Wilk			
	Statistic	df	Sig.
Pretest CTS	.900	36	.003
Posttest CTS	.934	36	.034

a. Lilliefors Significance Correction

According to Table 9, the pretest-posttest critical thinking skills scores were obtained by the students in succession 0,003 and 0,034. This suggests that both have sig. (2-tailed) < 0,05, so it can be inferred that  $H_0$  is refused or pretested and posttested critical thinking skills are not normally distributed (Razali & Wah, 2011). After the pretest-posttest data was found to be not normally distributed, the Wilcoxon test was conducted using SPSS. The Wilcoxon test data from the pretest-posttest scores of learners' science literacy are presented as follows.

Table 10. Result of the Wilcoxon Pretest-Posttest of Scientific Literacy

Test Statistics <sup>a</sup>		
Posttest LS - Pretest LS		
Z		
		-5.307 <sup>b</sup>
Asymp. Sig. (2-tailed)		.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

This shows that the sig value (2-tailed) < 0.05 means that  $H_0$  is refused, or it can be said that there is a disparity in the science literacy capability of learners before and after using the developed science literacy-based student worksheet. This indicates the improvement of science literacy skills after learning using the student work sheets based on science literature developed, so that the student work sheets based on scientific literature can be said to be effective for use in the learning of the chemistry of base acid materials. It is in line with Ulya & Rusmini (2022) that the results of the test of science literacy capability show improvement. By actively engaging during the learning process and making learning activities meaningful, the media sheets of students can be exploited as a learning resource to enhance science literacy skills. Next is the Wilcoxon test of the pretest-posttest values of critical thinking skills, presented below.

Table 11. Results of the Wilcoxon Pretest-Posttest of Critical Thinking Skills

Test Statistics <sup>a</sup>		
Posttest KBKi - Pretest KBKi		
Z		
		-5.237 <sup>b</sup>
Asymp. Sig. (2-tailed)		.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

According to table 11, the sig value is obtained. (2-tailed) of 0.000. This shows the sig value. (2-tailed)  $< 0.05$  means that  $H_0$  is refused, or it can be said that there is a disparity in the critical thinking skills of learners before and after using the science literacy-based student worksheet developed. This shows that learners' critical thinking skills are enhanced after studying to use the developed science literacy worksheets. Therefore, the science literacy worksheets can be considered effective for use in learning acid-base chemistry.

After pretest-posttest data are known not to be distributed normally, in addition to Wilcoxon testing, a Spearman correlation test is also performed. The Spearman test results for science literacy and critical thinking skills of learners are presented below.

Table 12. Spearman Correlation of Science Literacy and Critical Thinking Skills in Posttest

Correlations			
		Posttest LS	Posttest KBKi
Spearman's rho	Posttest SL	Correlation Coefficient	1.000
		Sig. (2-tailed)	.754**
		N	36
Posttest CTS	Posttest CTS	Correlation Coefficient	.754**
		Sig. (2-tailed)	1.000
		N	.000
		36	36

According to table 12, the posttest results of critical thinking skills and science literacy each produce a sig (2-tailed) value of 0.000, which indicates that the sig (2-tailed)  $< 0.05$ , meaning that  $H_0$  is refused or science literacy has a significant positive correlation with critical thinking skills. Correlation test results using the Spearman test retrieved a correlation coefficient of 0.754 with strong correlations. In line with study carried out by Azrai et al. (2020), there is a positive correlation between science literacy and critical thinking skills among high school students in East Java.

For the completeness of learning outcomes, the data used are the results of cognitive test scores. Individual student intensity can be achieved when the student's cognitive test score is  $\geq 75$ . In this study, the total number of students who responded was 32, and those who did not respond were 4. There are many different kinds of teachers who do not know what they are doing but who learn from what they do. This is corroborated by the learner response questionnaire results, which show that learners are not motivated to take part in lessons after using science literacy-based student worksheets. The results also showed that learners were not actively engaged in the studying process. Motivation can be a trigger for active learners in the studying process, where studying activeness is one of the factors that affect learning outcomes (Tegeh et al., 2019). Overall, classical learning intensity can be seen from the following graph.

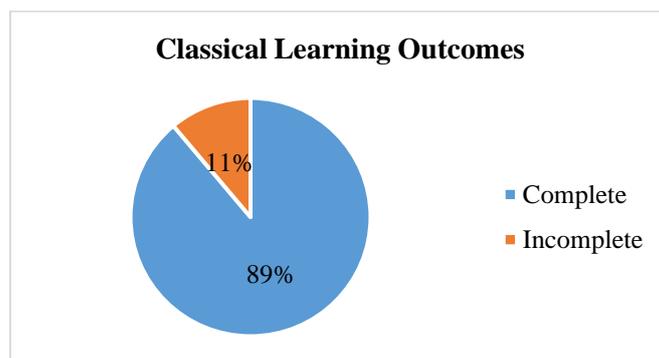


Figure 5. Diagram of Students Classical Completeness Percentage

From the chart above, it can be seen that 11% of students are said to be inaccurate, and 89% of students say they are accurate. It is consistent with the classical learning intensity set by the school that the student participant achieves when the percentage is  $\geq 80\%$ .

In this study, there are previous studies that are relevant to support the latest research. Based on previous research by Zahroh & Yuliani (2021), science literacy-based e-LKPD is said to be feasible for training students' critical thinking skills by obtaining an average percentage of validity of 98.38% (very valid), practicality of 97.65% (very practical), completeness of cognitive learning outcomes of 100% (very good), and learning outcomes of critical thinking skills of 90% (very good). In another study, Sutiani et al. (2021) stated that the inquiry model with science literacy proved effective for developing students' critical thinking skills in chemistry subjects by getting a mean score of 3,60 for the validity of the eligibility of teaching materials for chemistry learning materials and a percentage of the results of learners' critical thinking skills indicators in the range of 72–97% (very good).

Learning resources developed in the inquiry learning model with science literacy have a very significant contribution to making to improving students' learning abilities, which in turn can improve their critical thinking skills and learning outcomes. With previous studies on the eligibility of science literacy-based student worksheets and chemistry teaching materials developed with science literacy being able to enhance learners critical thinking skills, this research is relevant and obtained appropriate results, namely that science literacy-based student worksheets are eligible to use to enhance learners critical thinking skills on acid-base materials by meeting valid, practical, and effective criteria.

## CONCLUSION

According to the results of the research and discussion, it can be inferred that the science literacy-based student worksheet is declared eligible to be used to enhance learners critical thinking skills because it has met the following eligibility criteria.

1. The validity of science literacy-based student worksheets to enhance learners' critical thinking skills on acid-base material in terms of content criteria got a percentage of 37.50% (valid) with mode 3 and 62.50% (very valid) with mode 4. On the construction criteria, a percentage of 15.15% (valid) was obtained with mode 3 and 84.85% (very valid) with mode 4.
2. The practicality of science literacy-based student worksheets to enhance learners critical thinking skills on acid-base materials is declared practical in terms of the mean percentage of student responses of 97.10% and the percentage of student activity implementation of 90%, both receiving very practical criteria.
3. The effectiveness of science literacy-based student worksheets to enhance learners critical thinking skills on acid-base material is declared effective in terms of pretest and posttest scores, namely science literacy tests, critical thinking skills tests, and cognitive tests. Overall, the N-gain score for science literacy was 0.75 (high criteria), and the critical thinking skills test retrieved an N-gain score of 0.71 (high criteria). This is supported by the results of the Wilcoxon statistical test of science literacy and critical thinking skills, which obtained a sig. (2-tailed) of 0.000, which can be interpreted as indicating that there is disparity in the science literacy and critical thinking skills of learners prior to and following the use of science literacy-based student worksheets. Correlation tests show a strong positive relationship between the two skills with a correlation coefficient of 0.754 and classical completeness reaching 89%.

## RECOMMENDATIONS

According to the results of the research, several advices can be made, namely, that the basic acid experiments contained in the student work sheets based on science literacy take a lot of time. Therefore, teachers need to prepare the tools and materials as best as possible so that their implementation time becomes more effective. Second, the domain of scientific knowledge and the analysis indicator on this research are on the medium criteria, so teachers need to teach in detail and clarify the questions on the subject so that learners can easily understand the meaning of the subject and write the answers according to the indicators.

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