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Assessment for Learning (AfL)-based Student Worksheets: Improving Critical Thinking Skills in Basic Chemistry Learning

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ABSTRACT

Purpose – This study aims to describe AfL-based student worksheets as a means of improving students' critical thinking skills in Basic Chemistry learning.

Methodology – This pre-experimental study employs a one-group pre-test post-test design. The data obtained were analyzed using a mean difference test and an N-gain score. Students' critical thinking skills are considered to have improved if there is a significant difference between the pre-test and post-test scores, and at least 55% of students in a class achieve a medium and/or high criterion of N-gain score.

Findings – The mean difference test revealed a significant difference in the pre-test and post-test scores of students' critical thinking skills. The N-gain score measurement showed that the percentage of N-gain score in the medium and high criteria was higher than 55%. This implies that implementing AfL-based student worksheets can enhance students' critical thinking skills in Basic Chemistry Learning.

Contribution – The research results reinforced previous findings that AfL implementation can improve students' critical thinking skills, especially in chemistry learning. In addition, feedback on the implementation of AfL can help students identify their strengths and weaknesses in learning, which they can use to improve their learning.

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INTRODUCTION

According to Facione, critical thinking skills comprise six indicators: interpretation, analysis, evaluation, inference, explanation, and self-regulation (Facione, 2020). Critical thinking is a mental process that evaluates and analyzes information obtained from observations, experiences, or through communication media (Jannah & Wardono, 2025).

Based on the results of field observations, the low learning outcomes of the Basic Chemistry Learning are also due to students not knowing the advantages and disadvantages of learning, what kind of learning strategies are suitable for their learning progress, and the lack of feedback from the teacher regarding the material and learning strategies applied by students in the Basic Chemistry Learning. The study results of Fadillah et al. (2022) showed that 57.5% of 30 students in a senior high school in Gresik, Indonesia, had low critical thinking skills. According to Achmad & Utami (2023), the critical thinking skills of today's students, which were developed in elementary school, require further development.

One solution is the implementation of AfL-based student worksheets. AfL is a procedure where learners use assessment evidence to change their learning strategies (Plessis, 2021). In AfL, particularly, feedback is crucial (Fitriyah et al., 2022). AfL needs feedback to help and guide students in enhancing their learning (Deeley, 2018). In the context of teaching writing, teachers strive to provide feedback that demonstrates quality (Zhang & Hyland, 2018).

Numerous studies have demonstrated that AfL can enhance students' critical thinking skills. AfL through written feedback applied to Plantae learning can help develop students' critical thinking skills (Nurdini et al., 2020). An AfL-oriented student worksheet can increase students' critical thinking in Acid-Base Titrations (Ramadhani & Muchlis, 2023). The research results also showed that, after using the AfL instrument in project-based physics learning, students' critical thinking skills improved (Oktaviyanti & Viyanti, 2025). The implementation of AfL has proven effective in enhancing students' critical thinking skills related to hydrocarbon materials (Al Halwi & Muchlis, 2025).

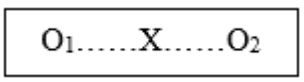
One of the AfL implementation strategies reported Kulasegaram & Rangachari (2018), namely the five main strategies in the implementation of AfL are 1) helps students finding learning objectives, 2) identifies what is needed to go further in relation these learning objectives, 3) prepare students to transfer knowledge and skills in new situation, 4) provide the possibility for students to gain deeper understanding of the material being studied, and 5) provide opportunities for students to characterize their learning. According to some researchers, the steps of AfL include 1) Clarifying learning objectives and learning success criteria, 2) Engineering effective classroom discussions and assigning assignments that provide evidence of understanding to students, 3) Activating students as learning resources for each other and providing feedback that moves students in a better direction, 4) Activating students as owners of their own learning and provide feedback for the sustainability of students' learning in the future (Amanina & Muchlis, 2023; Pratama & Muchlis, 2023; Ramadhani & Muchlis, 2023; Sudarsono & Muchlis, 2023).

To guide students in implementing AfL, the AfL steps are presented in a student worksheet. In addition, the low level of students' critical thinking skills demands effort to improve them. Therefore, this study aims to describe assessment for learning (AfL)-based student worksheets as a means of improving students' critical thinking skills in Basic Chemistry learning. The study also describes feedback from teachers and peers on how to improve students' critical thinking skills in Basic Chemistry learning.

METHODOLOGY

Research Design

This study employs a pre-experimental research design using a one-group pre-test-post-test approach. The advantage of this design is that it enables researchers to compare pre-test and post-test scores on the exact measurements and subjects (Nardi, 2018). This design illustrates the relationship between variable X (treatment) and variable O (measurement), which is presented in the following schema:



With the informations are O_1 is test of critical thinking skills before the implementation of AfL-based student worksheets in Basic Chemistry Learning (Pre-test), X is implementation of AfL-based student

worksheets in Basic Chemistry Learning, and O_2 is test of critical thinking skills after the implementation of AfL-based student worksheets in Basic Chemistry Learning (Post-test).

Participant

Technique uses the test method. Pre-tests and post-tests are administered to students before and after the implementation of AfL-based student worksheets in Basic Chemistry Learning. Researchers also observe students' answers in the student worksheet to understand the students' activities during the implementation of AfL.

Instrument

The research instruments are developed ourselves. The instrument used in this study was a critical thinking skill test on Basic Chemistry material, which includes Stoichiometry, the periodic system of Elements, and Chemical Bonding sub-materials. Each sub material consists of 10 multiple-choice questions. Each ten multiple-choice questions consists of two questions related to analysis, explanation, interpretation, inference, and evaluation. Before using the instrument, its validation and reliability are determined first.

Data Analysis

The analysis technique used for the data is a paired sample t-test, provided that the data are typically distributed. A normality test is carried out as a prerequisite to ensure that the data used is normally distributed. Data is considered normally distributed if the p-value is greater than 0.05. The score data of the Periodic System of Element sub-material is normally distributed, so it will be analyzed using a paired sample t-test. Score data for Stoichiometry and Chemical Bonding are not normally distributed; therefore, the analysis will proceed with the Wilcoxon test. Hypothesis testing was conducted to determine whether there were significant differences in students' critical skills before and after the implementation of AfL-based student worksheets in Basic Chemistry learning. The mean students' critical thinking skills score before and after the implementation of AfL-based student worksheet in Basic Chemistry learning showed a significant difference if Sig value (Asymp. Sig) <0.05.

Although there was a significant difference before and after implementation, to ensure an improvement in students' critical thinking skills in Basic Chemistry learning, a N-gain score was calculated. Students' critical thinking skills are considered to have improved if at least 55% of students in a class achieve a medium and/or high criterion of N-gain score. The N-gain score formula is as follows:

$$N - gain\ score = \frac{posttest\ score - pretest\ score}{maximum\ score - pretest\ score} x\ 100 \qquad \text{(Hake, 1998)}$$

The result of N-gain score are interpreted as shown at Table 1.

Table 1. Interpretation of N-gain Score

N-gain score	Criteria
$g \geq 0.7$	High
$0.7 > g \geq 0.3$	Medium
$g < 0{,}3$	Low

(Hake, 1998)

FINDINGS

The study is conducted in six meetings. The duration of each meeting is 150 minutes. A pre-test of critical thinking skills on Stoichiometry sub-material, steps 1 of AfL (clarifying learning objectives and learning success criteria), and steps 2 of AfL (engineering effective classroom discussions and assigning assignments that provide evidence of understanding to students) are conducted at the first meeting. Steps 3 of AfL, activating students as learning resources for each other and providing feedback that moves students in a better

direction, post-test of critical thinking skills on Stoichiometry sub material, check the answer of post-test of critical thinking skills on Stoichiometry sub material, and steps 4 of AfL, activating students as owners of their own learning and provide feedback for the sustainability of students' learning in the future, are carried out at the second meeting. Learning activities at the third and fourth meetings are the same as those at the first and second meetings, but they are related to the Periodic System of Elements sub-material. Learning activities at the fifth and sixth meetings are the same as those at the first and second meetings, but they are related to the Chemical Bonding sub-material.

Instruments Validity and Reliability

The pre-test and post-test of students' critical thinking skills are the same in terms of quantity and type. The number of pre-test questions is 10 for each of the following topics: Stoichiometry, Periodic System of Elements, and Chemical Bonding. The validator carries out validation. The validator is comprised of three experts in chemistry education. Validators are three lecturers. The results of instrument validation are shown in Table 2.

Table 2. Validation score and category of students' critical thinking skills pre-test

No	Sub materials	Validation Component					
		Content		Construct		Language	
		Score	Category	Score	Category	Score	Category
1	Stoichiometry	4 or 5	Valid	4 or 5	Valid	4 or 5	Valid
2	Periodic System of Element	4 or 5	Valid	4 or 5	Valid	4 or 5	Valid
3	Chemical Bonding	4 or 5	Valid	4 or 5	Valid	4 or 5	Valid

Based on Table 2, all of the students' critical thinking skills pre-test scores were 4 or 5. It means the instrument research is a valid category. Meanwhile, instrument reliability is determined by determining Cronbach's Alpha. The results of the reliability test are shown in Table 3. Table 3 showed that all Cronbach's alpha values are higher than 0.600. It means that the pre-test of students' critical thinking skills is reliable. The 0.60-0.80 range of Cronbach's alpha values is considered moderate but acceptable (Daud, 2018).

Table 3. Alpha Cronbach values and judgment of students' critical thinking skills pre-test

No	Sub materials	Cronbach's Alpha	
		Value	Judgment
1	Stoichiometry	0.691	reliable
2	Periodic System of Element	0.650	reliable
3	Chemical Bonding	0.610	reliable

The Normality of Students' Critical Thinking Skills Data

The normality test results for the students' critical thinking skills data are shown in Table 4. Based on Table 4, the data on students' critical thinking skills in the Stoichiometry and Chemical Bonding sub-material are not normally distributed. Meanwhile, the data on students' critical thinking skills in the Periodic System of Elements is usually distributed.

Table 4. The normality test result and judgment of students' critical thinking skills pre-test

No	Sub material	Normality test			
		Pre- test		Post-test	
		Sig. value	Judgment	Sig. value	Judgment
1	Stoichiometry	0.002	data is not normally distributed	0.279	data is normally distributed
2	Periodic System of Element	0.026	data is normally distributed	0.059	data is normally distributed
3	Chemical Bonding	0.378	data is normally distributed	0.002	data is not normally distributed

Test of the Mean Difference in Students' Critical Thinking Skills Data

The data on students' critical thinking skills in the Stoichiometry and Chemical Bonding sub-material are generally not distributed, so they are analyzed using the Wilcoxon test. Meanwhile, the data on students' critical thinking skills in the Periodic System of Elements is usually distributed, so it is analyzed using a paired sample t-test.

The results of the Wilcoxon test or Paired sample t-test showed a significant difference in students' critical thinking skills in Basic Chemistry learning before and after the implementation of an Afl-based student worksheet, as shown in Table 5. This difference is positive, as the result of the N-gain score measurement showed an improvement in students' critical thinking skills across low, medium, and high criteria.

Table 5. The result of mean difference test of students' critical thinking skills and judgment

No	Sub material	Wilcoxon signed test		Paired sample t-test	
		Asymp. Sig. (2-tailed)		Sig. (2-tailed)	
		value	Judgment	value	Judgment
1	Stoichiometry	0.003	There is a significant difference		
2	Periodic System of Element			0.000	There is a significant difference
3	Chemical Bonding	0.000	There is a significant difference		

The Result of the N-gain Score

Based on Table 5, there is a significant difference in students' critical thinking skills in Basic Chemistry learning before and after the implementation of an Afl-based student worksheet. This difference is positive, as evidenced by the N-gain score, which showed improvement in students' critical thinking skills across low, medium, and high criteria. The sum of high and medium criteria in the N-gain score is 57.1%, 67.9%, and 89.3% for Stoichiometry, Periodic System of Elements, and Chemical Bonding, respectively. Students' critical thinking skills are reported to have improved because the sum of high and medium criteria in the N-gain score exceeds 55%. The improvement in N-gain score for students' critical thinking skills is recapitulated in Figure 1. The results of the N-gain score are completely shown in Table 6.

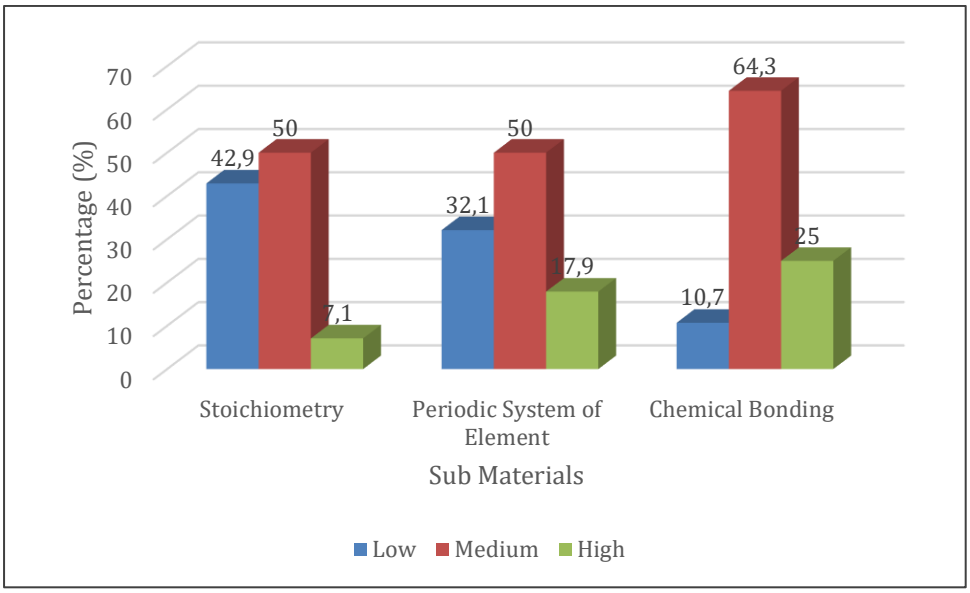


Figure 1. Improvement recapitulation of N-gain score in students' critical thinking skills

Table 6. Score and criteria of students' critical thinking skills and N-Gain score on Stoichiometry, Periodic System of Element, and Chemical Bonding sub materials

No.	Name	Sub material											
		Stoichiometry				Periodic System of Element,				Chemical Bonds			
		Pre test	Post test	N-Gain	Criteria	Pre test	Post test	N-Gain	Criteria	Pre test	Post test	N-Gain	Criteria
1	JWB	30	50	0,3	medium	50	30	-0,4	low	30	70	0,6	medium
2	SK	30	20	-0,1	low	40	70	0,5	medium	50	40	-0,2	low
3	SWM	10	10	0,0	low	20	40	0,3	medium	50	80	0,6	medium
4	CAA	50	20	-0,6	low	20	50	0,4	medium	50	60	0,2	low
5	DFAN	20	60	0,5	medium	30	80	0,7	high	50	80	0,6	medium
6	LPA	30	60	0,4	medium	70	80	0,3	medium	60	80	0,5	medium
7	STR	20	70	0,6	medium	40	80	0,7	high	60	70	0,3	medium
8	GSD	20	50	0,4	medium	20	40	0,3	medium	60	80	0,5	medium
9	CPY	80	90	0,5	medium	50	80	0,6	medium	80	90	0,5	medium
10	SANP	30	60	0,4	medium	40	30	-0,2	low	40	60	0,3	medium
11	ERW	20	70	0,6	medium	70	70	0,0	low	50	90	0,8	High
12	APJS	20	10	-0,1	low	40	40	0,0	low	20	70	0,6	medium
13	NAP	60	40	-0,5	low	10	70	0,7	high	20	80	0,8	High
14	MZP	40	40	0,0	low	20	40	0,3	medium	10	30	0,2	Low
15	NNAS	40	60	0,3	medium	20	60	0,5	medium	40	90	0,8	High
16	AZ	30	30	0,0	low	20	70	0,6	medium	30	90	0,9	High
17	FMR	30	20	-0,1	low	50	50	0,0	low	40	60	0,3	medium
18	UB	30	50	0,3	low	30	70	0,6	medium	10	70	0,7	High
19	RNA	10	40	0,3	low	20	50	0,4	medium	30	80	0,7	High
20	IAI	20	20	0,0	low	10	70	0,7	high	50	80	0,6	medium
21	ALZ	80	80	0,0	low	60	80	0,5	medium	60	70	0,3	medium
22	DM	10	30	0,2	low	10	30	0,2	low	30	60	0,4	medium
23	APS	20	60	0,5	low	50	50	0,0	low	40	90	0,8	High
24	AAS	40	80	0,7	high	40	60	0,3	medium	50	80	0,6	medium
25	CAP	20	30	0,1	low	20	60	0,5	medium	40	70	0,5	medium
26	EFR	60	90	0,8	high	30	90	0,9	high	20	70	0,6	medium
27	YSPN	70	70	0,0	low	70	70	0,0	low	70	80	0,3	medium
28	SSW	40	50	0,2	low	50	50	0,0	low	60	70	0,3	medium

DISCUSSION

AfL-Based Student Worksheet: Improving Students' Critical Thinking Skills in Stoichiometry Sub-Material of Basic Chemistry Learning

The Wilcoxon test has shown a significant difference between the pre-test and post-test scores of students' critical thinking skills. There was a 57.1% increase in the number of high- and medium-criterion N-gain scores. This percentage is higher than 55%. This indicates an improvement in students' critical thinking skills on the Stoichiometry sub-material in Basic Chemistry learning through the implementation of AfL-based student worksheets.

A student named SK was one of the students who obtained an N-gain score in the low criteria. In step 2 of AfL, namely "engineering effective classroom discussions and assigning assignments that provide evidence of understanding to students". There are five practice questions on the student worksheet. The five practices question encompasses the analysis, explanatory, inferential, interpretive, and evaluative components of critical thinking skills. Based on his student worksheet observation, one practice question of the Stoichiometry sub-material was answered correctly, and four practice questions of Stoichiometry were answered incorrectly. One of the activities in the discussion is peer assessment (Safitri, 2024; Safitri et al., 2024, 2025). A student named SK did not have a productive discussion, so he struggles to carry out peer assessment effectively. A previous study has demonstrated that peer assessment enhances students' performance in group discussions, involving interpersonal skills, teamwork, and problem-solving (Handayani et al., 2019). Well-conducted peer discussion can also increase the number of correct answers (Egelandsdal & Krumsvik, 2017).

Student SK also did not complete step 3, namely "activating students as learning resources for each other and providing feedback that moves students in a better direction." Based on his student worksheet observation, the feedback column is empty, indicating that he did not record the correct answer. Whereas AfL, through written feedback, can help develop students' critical thinking skills (Nurdini et al., 2020).

A student named EFR is one of the students who achieved a high N-gain score in the Stoichiometry sub-material. Based on her student worksheet observation, she completed all AfL steps effectively. She discussed the steps well in AfL. She answered the practice question correctly, regarding stoichiometry sub-material. Group discussions help students understand and promote outcomes (Jones, 2024). She also pays attention to feedback from lecturers and peers in steps 3 of AfL. Implementation of AfL related to concept check and provide feedback to monitor concept understanding of all students (Westbroek, et. al., 2020).

AfL-Based Student Worksheet: Improving Students' Critical Thinking Skills in The Periodic System of Elements, A Sub-Material of Basic Chemistry Learning

A student named UB is one of the students who achieved an N-gain score improvement in critical thinking skills at the medium criteria level in the Periodic System of Elements sub-material. At the same time, she achieved a N-gain score in the low criteria for the Stoichiometry sub-material.

Based on her student worksheet observation, she wrote that her learning strategy for the Stoichiometry sub-material was to study it in a short time before the course. As a result, some key concepts are missed. Based on the weakness of this strategy, she sought a suitable alternative to enhance her learning.

The student was helped to find a suitable strategy by following step 4 of AfL, namely "activating students as owners of their own learning and providing feedback for the sustainability of students' learning in the future". AfL is a procedure where learners use assessment evidence to change their learning strategies (Plessis, 2021). In step 4 of AfL, the teacher also provides feedback that helps to identify the students' strengths and weaknesses. In AfL, particularly, feedback is crucial (Fitriyah et al., 2022). AfL needs feedback to help and guide students in enhancing their learning (Deeley, 2018). Therefore, she wrote that she allocated time for learning, noted key concepts, and learned about the Periodic System of Elements through video-related content and other learning sources. The impact of this change in strategy enabled her to achieve an N-gain

score improvement in critical thinking skills at the medium criteria level in the Periodic System of Elements sub-material.

Changes in learning strategies were also made by the majority of students, increasing the number of students who received an N-gain score in the high and medium criteria to 67.9%. This percentage is higher than 55%. The result of the Paired sample t-test has shown a significant difference between the pre-test and post-test scores of students' critical thinking skills. This indicates that students' critical thinking skills improved on the Periodic System of Elements sub-material in Basic Chemistry learning through the implementation of AfL-based student worksheets.

AfL-Based Student Worksheet: Improving Students' Critical Thinking Skills in The Chemical Bonding Sub-Material of Basic Chemistry Learning

A student named AZ is one of the students who achieved a significant improvement in N-gain scores for critical thinking skills in the high criteria category for the Chemical Bonding sub-material. Based on her student worksheet observation, she carried out all steps of Afl well. She wrote the learning target clearly. Goal and success criteria should be explicit; students should not be afraid to make mistakes (Cowe et al., 2018). Providing students with the opportunity to work toward their own goals has been shown to effectively improve their performance (Side & Cuevas, 2020).

Based on her student worksheet observation, AZ also carried out steps 2 and 3 of AfL well. The five practices question on critical thinking skills related to the Chemical Bonding problem is answered correctly. It has been shown that she discussed effectively in the group. This is in accordance with the study results of Handayani et al. (2019), which found that peer assessment enhances students' performance in group discussions and involves interpersonal skills, teamwork, and problem-solving. Teacher feedback in step 3 of AfL also helped students solve practice questions that developed critical thinking skills on Chemical Bonding problems. Feedback in clinical teaching should have a positive effect on students' skills and motivation to learn (Leung et al., 2022).

AZ also wrote in her student worksheet that her learning strategy for the Periodic System of Elements sub-material was to study before and after learning the material. Her learning strategy was unable to achieve her learning target, resulting in a medium N-gain score in the Periodic System Element sub-material learning. Therefore, in the Chemical Bonding sub-material learning, AZ studied the material before and after learning, practiced more problem-solving of Chemical Bonding, and created summaries and concept maps. AfL can be used as a diagnostic tool to provide descriptive feedback that improves learning, identifying students' strengths and weaknesses (Fitriyah et al., 2022). The research results of Volante et al. (2025) suggest that AfL, when applied consistently, can be a powerful tool for improving student achievement and learning outcomes. The impact of this change in strategy enabled her to achieve an N-gain score improvement of critical thinking skills in the Chemical Bonding sub-material

Changes in learning strategies were also made by the majority of students, increasing the number of students who received an N-gain score in the high and medium criteria to 89.3%. This percentage is higher than 55%. The result of the Wilcoxon test showed a significant difference between the pre-test and post-test scores of students' critical thinking skills. This indicates that students' critical thinking skills improved in the Chemical Bonding sub-material of Basic Chemistry learning through the implementation of AfL-based student worksheets.

Based on the discussion above, several things can be summarized as follows. The study has proven that the implementation of AfL-based student worksheets can improve students' critical thinking skills in Basic Chemistry learning. Teacher feedback includes the concept of Basic Chemistry and students' learning strategies. The activities in the AfL-based student worksheets, with feedback from the teacher and peers, enable students to identify their weaknesses and strengths, and choose learning strategies that are suitable for improving their learning.

CONCLUSION

Based on the mean difference test, it was shown that there is a significant difference in students' critical thinking at the pre-test and post-test through the implementation of AfL-based student worksheets on Stoichiometry, the Periodic System of Elements, and Chemical Bonding sub-material of Basic Chemistry learning. The number of N-gain scores in high and medium criteria is 57.1%, 67.9%, and 89.3% for Stoichiometry, the Periodic System of Elements, and Chemical Bonding, respectively. This percentage is higher than 55%. Therefore, it can be concluded that AfL-based student worksheets can improve students' critical thinking skills in Basic Chemistry.

Setting one's own goal and success criteria can improve one's performance. The activities in the AfL-based student worksheets, with feedback from the teacher and peer-led students, enable them to identify their weaknesses and strengths, and choose learning strategies suitable for improving their learning.

REFERENCES

Achmad, W.K. S. & Utami, U. (2023). High-Order Questions Improve Students' Critical Thinking Skills In Elementary Schools. *International Journal of Elementary Education*. 7(2). 196-203. https://doi.org/10.23887/ijee.v7i2.61607

Al Halwi, A. & Muchlis. (2025). Improving Students' Critical Thinking Skills on Hydrocarbon Material through Assessment for Learning. *Jurnal Eduscience*. 12(4), 1189-1199. https://doi.org/10.36987/jes.v12i4

Amanina, A. A., & Muchlis. (2023). Development of Assessment for Learning Oriented Electronic Student Student worksheet s to Improve Student Learning Outcomes on Acid-Base Titration Material. *Journal of Mathematics and Mathematics*, *18*(4), 518–524. https://doi.org/https://doi.org/10.29303/jpm.v18i4.5188

Cowie, B., Harrison, C., & Willis, J. (2018). Supporting teacher responsiveness in assessment for learning through disciplined noticing. *The Curriculum Journal*, *29*(4), 464–478. https://doi.org/10.1080/09585176.2018.1481442

Daud, K. A. M., Khidzir, N. Z., Ismail, A. R., & Abdullah, F. A. (2018). Validity and reliability of instrument to measure social media skills among small and medium entrepreneurs at Pengkalan Datu River. *International Journal of Development and Sustainability*, 7(3), 1026-1037. IJDS18013101

Deeley, S. J. (2018). Using technology to facilitate effective assessment for learning and feedback in higher education. *Assessment and Evaluation in Higher Education*, 43(3), 439-448. doi:10.1080/02602938.2017.1356906

Egelandsdal, K., & Krumsvik, R. J. (2017). Peer discussions and response technology: Short interventions, considerable gains, *Nordic Journal of Digital Literacy,12 (1-2)*, 19–30. https://doi.org/10.18261/issn.1891-943x-2017-01-02-03

Facione, P. A. (2020). Critical Thinking: What It Is and Why It Counts. In *Insight assessment*. Measured Reasons and The California Academic Press.

Fadillah, R. N., Jatmiko, B. & Widodo, W. (2022). Critical Thinking Profile of Senior High School Students in terms of Argumentation-Based Learning. *Studies in Learning and Teaching*. 3(3), 149-162. https://doi.org/10.46627/silet

Fitriyah, I., Bastomi, Y., Khotimah, K., & Gozali, I. (2022). Implementation of Assessment for Learning in Online EFL Writing Class: A Case of Novice Undergraduate Teachers. *LEARN Journal: Language Education and Acquisition Research Network*, *15*(2), 129–159. so04.tci-thaijo.org/index.php/LEARN/article/view/259925

Handayani, R. D., Genisa, M. U., & Triyanto. (2019). Empowering Physics Students' Performance in a Group Discussion Through two Types of Peer Assessment. *International Journal of Instruction*. 12(1). 655-668.

Jannah, M. F., & Wardono, M. S. (2025). The Effect of the Think Pair Share (TPS) Learning Model on the Critical Thinking Ability of Grade IV Students of SDN Ngaban. *Journal of Elementary School Education*, *12*(2). https://doi.org/https://doi.org/10.19184/jipsd.v12i2.53747

Kulasegaram, K.M & Rangachari, P.K. (2018). Best Practices Beyond "formative": assessments to enrich student learning. *Adv Physiol Educ* 42: 5–14, 2018.

Leung, A., Fine, P.D., Blizard, R., Tonni, I., Ilhan, D., & Louca, C. (2022). Teacher feedback and student learning–The students' perspective. Journal of Dentistry, 125. 1-6. https://doi.org/10.1016/j.jdent.2022.104242

Nardi, P. M. (2018). *Doing Survey Research: A Guide to Quantitative Methods* (3rd ed.). Routledge.

Nurdini, Y., Wulan, A. R., & Diana, S. (2020). Assessment for learning through written feedback to develop 21st-century critical thinking skills on plantae learning. *Journal of Physics: Conference Series*, 1521. https://doi.org/10.1088/1742-6596/1521/4/042019

Oktaviyanti, F. & Viyanti, V. (2025). Implementation of Assessment for Learning Instruments in Project Based Learning to Improve Students' Critical Thinking Skill. *Edu Fisika: Jurnal Pendidikan Fisika*. 10(1), 159-168. https://doi.org/10.59052/edufisika.v10i1.42581.

Plessis, E. (E. C.) du. (2021). Assessing for Learning: Teacher Training in Practice Involving 14 Postgraduate Certificate in Education (PGCE) Students. *International Journal of Learning, Teaching and Educational Research*. 20(11), 346-365. https://doi.org/10.26803/ijlter.20.11.19

Pratama, D. P., & Muchlis. (2023). Student Student worksheet Oriented on Assessment for Learning to Improve Learning Outcome on Acid Base Titration. *Hydrogen: Journal of Chemistry Education*, *11*(4), 485–496. https://doi.org/https://doi.org/10.33394/hjkk.v11i4.8154 h

Ramadhani, N. I., & Muchlis. (2023). Development of Assessment-Oriented LKDP for Learning to Improve Students' Critical Thinking Skills on Acid-Base Titration Materials. *Jurnal Pendidikan Kimia*, *8*(3), 171–185. https://doi.org/10.36709/jpkim.v8i3.32

Safitri, I. (2024). Transformation of Student Science Achievement Through Project-Based Learning (PjBL): A Meta Analysis Study. *Scientiae Educatia: Jurnal Pendidikan Sains*, *13*(2). https://doi.org/DOI: 10.24235/sc.educatia.v13i2.18694

Safitri, I., Andriyanti, E., Ansyari, R., Harahap, R. D., Harahap, R. H., & Istiqlal, M. (2025). Character Education in Indonesia: Do Integrated Islamic Schools Outperform Public Schools? *Journal of Education Culture and Society*, *16*(1), 251–270.

Safitri, I., Lestarani, D., Imtikhanah, R. D. N. W., Akbarini, N. R., Sari, M. W., Fitrah, M., & Hapsan, A. (2024). *Teori Pengukuran dan Evaluasi*. CV. Ruang Tentor.

Sides, A. D. & Cuevas, J. A. (2020). Effect of Goal Setting for Motivation, Self-Efficacy, and Performance in Elementary Mathematics. *International Journal of Instruction*. 13(4), 1-16. https://doi.org/10.29333/iji.2020.1341a

Sudarsono, G. T. A., & Muchlis. (2023). The Feasibility of Assessment-Oriented LKPD for Learning (AfL) to Improve Student Learning Outcomes on Buffer Solution Materials. *Journal of Chemical Education*, *8*(2), 95–108. https://doi.org/https://doi.org/ 10.36709/jpkim.v8i2.27

Volante, L., DeLuca, C., Barnes, N., Birenbaum, M., Kimber, M., Koch, M., Looney, A., Poskitt, J., Smith, K., & Wyatt-Smith, C. (2025). International trends in the implementation of assessment for learning revisited: Implications for policy and practice in a post-COVID world. *Policy Futures in Education*, *23*(1), 224–242. https://doi.org/10.1177/14782103241255855

Westbroek, H. B., Rens, L. V., Berg, E. V. D., & Janssen. F. (2020). A practical approach to assessment for learning and differentiated instruction. *International Journal Of Science Education*. 42(6), 955-976. https://doi.org/10.1080/09500693.2020.1744044

Zhang, Z., & Hyland, K. (2018). Student engagement with teacher and automated feedback on L2 writing. *Assessing Writing*, *36*, 90–102. https://doi.org/https://doi.org/10.1016/j.asw.2018.02.004