pISSN 2685-0761
eISSN 2685-0850

JURNAL INOVASI PEMBELAJARAN KIMIA
(Journal of Innovation in Chemistry Education)
https://jurnal.unimed.ac.id/2012/index.php/jipk
email: Jinovpkim@unimed.ac.id

Recieved : 30 April 2025
Revised : 10 May 2025
Accepted : 30 June 2025
Publish : 8 July 2025
Page : 82 – 97

Influence of Ethnopedagogical Materials and Problem Based Learning on Students Learning Interest and Critical Thinking

Ramlan Silaban[1]*, Grace Octavia Hutasoit[2], Tita Linyan Pardede[3], Ida Duma Riris[4], Marham Sitorus[5], Rabiah Afifah Daulay[6], Rafida Almira Samosir[7] and Irving Josafat Alexander[8]

[1,2,3,4,5,6,7]*Chemistry Education Study Program, Universitas Negeri Medan, Medan*

[8]*Department of Natural Science, University of HKBP Nommensen, Medan*

**Email: drrsilabanmsi@yahoo.co.id*

Abstract: *The cultural wealth of Indonesia has great potential in chemistry education, but it has not been optimally utilized. Materials such as reaction rates can be contextualized through traditional processes, such as the fermentation of tuak. The lack of relevant teaching materials impacts students' low interest and critical thinking skills. Therefore, an innovation in the form of ethnopedagogy-based Student Worksheets with a Problem Based Learning model is needed to create meaningful learning. This study uses a quantitative approach with a quasi-experimental method. The instruments used consist of 5 essay questions to measure critical thinking skills and a questionnaire containing 20 statements to measure learning interest. A hypothesis test was conducted using a one-tailed Independent Sample T-Test. The results show that the average learning interest of students in the experiment class is higher compared to the control class, namely 90.25 and 85.625, respectively. Meanwhile, the average posttest score for students' critical thinking ability in the experimental class reached 92.25 higher than the control class, which scored 83.5. This shows that the use of Student Worksheet based on ethnopedagogy and Problem Based Learning has an influence on students' learning interest and critical thinking.*

Keywords: *materials teaching; ethnopedagogy; problem-based learning; students learning interest; critical thinking skills*

INTRODUCTION

Indonesia, as the largest archipelagic country in the world, has a wealth of culture and local wisdom that has not yet been widely utilized in chemistry education. The impact of globalization has caused the erosion of local cultural values, making it necessary to integrate culture into education to preserve them. Etnochemistry-based chemistry learning allows students to understand chemical concepts contextually by relating the material to the surrounding environment and culture (Asna et al., 2024; Lestari et al., 2021).

An example of its application can be seen in the Batak Simalungun and Batak Toba cultures through the tradition of making *tuak*, which can be linked to the reaction rate material in the high school chemistry curriculum (Aisyah et al., 2019).

The reaction rate taught in the 11th grade includes theoretical concepts such as order and reaction constant, as well as practical applications like the fermentation of *tuak* by microorganisms. This process involves factors such as temperature, concentration, enzymes, and additives like raru. However, an interview with a chemistry teacher at SMA YP HKBP 1 Pematang Siantar showed that the learning is still conventional, not culture-based, and only focuses on textbooks. This has resulted in low interest in learning, student engagement, and critical thinking skills.

To address this issue, innovative teaching materials such as Student Worksheets are needed, designed contextually and based on ethnopedagogy, which is an educational approach that highlights local cultural values as learning sources (Wardani et al., 2024).

In the context of chemistry, ethnopedagogy is applied through ethnochemistry, which links chemical concepts with traditional knowledge (Lalang et al., 2023).

Additionally, the application of the PBL model in Student Worksheet can train students to actively explore, investigate, and solve problems, thereby enhancing their critical thinking skills and understanding of chemical concepts (Silaban et al., 2021).

Several relevant studies have shown the effectiveness of ethnoscience-based PBL in increasing student interest and engagement (Lulu et al., 2024), as well as Student Worksheet-assisted PBL in developing critical thinking skills (Muzakki et al., 2023). Other research shows that PBL worksheets based on local wisdom effectively support contextual chemistry learning (Suryati et al., 2024). However, these studies have not fully integrated the variables of learning interest and critical thinking ability simultaneously in the context of reaction rate material.

Based on that exposition, the author is interested in examining the influence of ethnopedagogy-based reaction rate teaching materials and Problem Based Learning on students' learning interest and critical thinking skills.

LITERATURE REVIEW

Teaching Materials

Yuberti, (2014) defines teaching materials as a collection of instructional resources that are methodically and aesthetically created to support the development of skills or sub-competencies. To effectively support the learning process, teaching materials are arranged in accordance with instructional principles and include content, methods, limitations, and evaluations.

Teaching materials refers to both software and hardware that can be used to deliver learning content from the source to learners (either individuals or groups). It serves to stimulate learners' thoughts, feelings, attention, and interest in such a way that the learning process, whether inside or outside the classroom, becomes more effective (Tambunan et al., 2021).

Student Worksheet

Lubis et al., (2023) claim that Student Worksheet serves as a tool that includes the steps for learning tasks that students need to complete. Additionally, according to Efendi et al., (2021), Student Worksheet is a sheet of paper that includes resources, summaries, and instructions for completing learning tasks that relate to the Basic Competencies that need to be attained.

Rosmana et al., (2024) state that for Student Worksheets to be as effective as possible, they should have the following essential components: a title, learning objectives, time allocation, tools and materials, a brief introduction, work steps, tasks to be completed, and activity result reports. These elements are arranged in a methodical way to help students comprehend the subject matter, complete learning tasks, and produce products or reports as a way to hold themselves accountable for their learning outcomes.

A few features set Student Worksheets apart from other types of instructional resources. Triyani et al., (2023) list the following qualities of a student worksheet: it is not overly long, it is tailored to a particular educational level, it includes practice questions, summaries, and brief explanations of the major subjects, and it is used directly by students to aid in their learning.

Student Worksheet is a type of teaching material that contains task sheets which must be completed by each student. Generally, LKPD includes instructions and steps for completing the tasks. The function of using LKPD for teachers is to facilitate the learning process (Zakiyah et al., 2021).

Rachmadyanti et al., (2023) state that for effective use, the preparation of Student Worksheet must address three main requirements, which are as follows:

1. Didactic requirements. The Student Worksheet must support an effective learning process, be oriented towards student learning activities, and consider individual ability differences.
2. Constructive requirements. The use of language in the Student Worksheet must be communicative, simple, appropriate to the students' level of thinking, and follow the General Guidelines for Indonesian Spelling to avoid misunderstandings in interpreting the content.
3. Technical requirements. Student Worksheets need to have an attractive visual design, the use of illustrations and layouts that support content clarity, and capture students' attention from the start to motivate them to learn more.

Etnopedagogy

Etnopedagogy comes from two words, namely "ethno" which means a group or community that has a culture, and "pedagogy" which means the process of education. Therefore, ethnopedagogy can be defined as an approach that takes local culture into account in the learning process (Hidayat et al., 2023). According to Alwasilah, (2020), ethnopedagogy views local wisdom as a source of innovation and skills that can be empowered for the welfare of the community. Local wisdom is knowledge that is produced, preserved, applied, and passed down within a community (Muzakkir, 2021).

According to Fatmi & Fauzan, (2022), etnopedagogical-based education sees local wisdom as a source of innovation that may be used in social activities and the management of natural resources, among other areas of life.

Based on various opinions, it can be concluded that ethnopedagogy is an educational approach that integrates local culture into the teaching and learning process. This approach aims to preserve local wisdom and make it a source of innovation and skills for the younger generation. This concept views culture as an important element that not only needs to be preserved but also utilized to enrich the educational process, thereby producing superior, creative, and dignified human resources. Ethnopedagogy creates contextual and relevant learning, connecting academic knowledge with local cultural values. This encourages students to understand, manage, and pass on local wisdom for the welfare of the community.

Ethnochemistry

The terms "ethnic" (referring to culture) and "chemistry" (referring to the study of the composition, properties, and interactions of elements or substances) are the seeds of ethnochemistry. Thus, ethnochemistry can be understood as an approach that deepens the understanding of chemistry through the prism of culture (Amora et al., 2024).

Teachers must find local knowledge that is pertinent to the topic being studied before introducing ethnochemistry-based learning. This is crucial to ensure that learning is consistent with the current curriculum and that the lesson's content remains unchanged. Analogy, representation, perception, visualization, and interpretation are some of the ways that local knowledge and chemical content align. Students can become more engaged in their education and make connections between new material and what they already know by using analogy-based teaching, which connects classroom instruction to real-world experiences (Sutrisno et al., 2020).

Learning Interest

Interest is a psychological drive that makes someone attracted to or want to do something, which generates enthusiasm in carrying out that activity. In the context of education, learning interest refers to the attention, interest, and desire of students to engage in the learning process. This interest in learning is marked by enthusiasm, active participation, and engagement in learning activities (Kurniasari et al., 2021). According to Mahdalena, (2022), interest in learning can develop over time. Students who were initially not interested in a subject can develop an interest as their knowledge of the material increases. This shows that interest in learning can grow due to a continuous learning process. Zebua & Harefa, (2022) state that learning interest is a driving force within individuals that motivates them to continue learning so they can acquire knowledge, skills, and experience. In addition, interest also becomes an important factor that influences changes in students' behavior during the learning process. Thus, learning interest can be defined as an internal drive that arises within the individual, allowing them to engage in the learning process without any coercion. This interest functions as a driving force that encourages positive behavioral changes, which in turn impacts the improvement of knowledge and skills acquired by students.

Learning interest is influenced by internal and external factors.

1. Internal Factors (Inside the Student)
   The physical aspect includes a healthy physical condition, which supports the interest in learning. Physical disorders such as vision or hearing problems can reduce interest. Psychological aspects include attention, motivation, and the desire to achieve goals or aspirations, which play a significant role in stimulating interest in learning.
2. External Factors (Outside the Student)
   The family plays an important role through parental support, a comfortable home environment, and the parents' level of education, which influences the interest in learning. Schools also influence through varied teaching methods, the use of engaging learning media, and good relationships between students and teachers. The community environment, especially peers, can influence learning interest; positive influences can enhance motivation, while negative influences can disrupt learning concentration.

Overall, the interest in learning is influenced by the physical and psychological conditions of the students, as well as external factors such as family support, the quality of education at school, and the social environment around the students.

According to Safari, the indicators of students' learning interest consist of four main indicators as cited by Putri et al., (2022):
1. Feeling of happiness.
2. Student interest.
3. Student attention.
4. Student engagement

Critical Thinking Skills

Critical thinking skills are essential abilities needed to face life's challenges. This ability includes the capacity to identify, analyze, and formulate a problem in depth, as well as to distinguish between facts and opinions. Critical thinkers do not accept information at face value without clear evidence and always think with logical reasoning (Nasriati et al., 2023).

Critical thinking skills are one manifestation of higher order thinking abilities. Critical thinking can be defined as a person's attempt to check the truth of information using evidence, logic and ordinary awareness. Critical thinking is not only an element of ability (cognitive), but also must pay attention to attitudes towards critical thinking. Critical thinking is reflective thinking that makes sense and focuses on the process of making decisions about what to do or what to believe (Pulungan & Simamora, 2024).

Critical thinking is a critical assessment of the truth of phenomena or facts. And also everyone has the potential to think critically which can be developed optimally in achieving a better life. Critical thinking is logical and reflective thinking that focuses on deciding what to believe or do (Ramadhana & Sutiani, 2023)

The goal of critical thinking is to evaluate ideas or thoughts reflectively and rationally based on accountable evidence. This ability encourages students to test various opinions, make appropriate decisions, distinguish between true and false information, and eliminate irrelevant matters. Thus, students can filter information, draw conclusions based on facts, and construct logical reasons to support their opinions (Cahyani et al., 2021; Wihartanti et al., 2019).

According to Ennis (in Susanto, 2014), indicators of critical thinking encompass five main aspects that demonstrate students' ability to think logically, analytically, and evaluatively, namely:

1. Providing simple explanations.
2. Building basic skills.
3. Concluding.
4. Providing further explanation.
5. Arranging strategies and tactics.

Moreover, according to Arief (in Susanto, 2014), critical thinking ability is also characterized by skills:

1. Analyzing. Breaking down information into important parts.
2. Synthesizing. Combining information into new ideas.
3. Solving problems. Recognizing, understanding, and finding solutions to problems.
4. Conclude. Drawing conclusions from the available information.
5. Evaluating. Evaluating information based on accountable criteria.

Learning Model

A representation of ideas, beliefs, or actual occurrences that is methodically created to be used in the learning process is called a learning model. Curriculum creation, material design, and directing teaching and learning activities in the classroom are all done using this paradigm as a guidance (Mirdad, 2020).

Mirdad, (2020) asserts that learning models possess the following traits:

1. Based on professional conceptions of education and learning.
2. Having clear learning objectives.
3. Acting as a manual for enhancing the educational process.
4. Components include the social system, support system, response principles, and learning processes (syntax).
5. Generates both direct (learning results) and indirect (long-term) implications.
6. As a foundation for learning design.

Problem Based Learning

Through the solution of actual, contextual issues, students are put at the center of learning activities in the Problem Based Learning (PBL) approach. The primary goal of PBL is to foster critical thinking, problem-solving, teamwork, and the ability to learn on one's own. When the approach implemented, pupils are given a problem to solve as the first step in the learning process. Through an exploratory learning process, this motivates kids to actively seek knowledge, evaluate evidence, and make judgments. Students actively construct knowledge via engagement with issues and the environment, in addition to passively absorbing information. Because the information studied is closely related to the students' real-life experiences, PBL therefore gives the learning process greater significance (Sembiring & Sutiani, 2022).

The problem-based learning (PBL) learning paradigm consists of a number of educational exercises that place an emphasis on the process of approaching problems from a scientific perspective. Through PBL, students actively think about or interpret problems, search for and process data, propose answers, and finally draw a conclusion rather than passively listening, taking notes, and memorizing the content (Panggabean et al., 2023).

The following are the phases of the Problem Based Learning model as described by Arends (in Al-tabani, 2014): (1) Giving pupils an introduction to an issue; (2) Setting up research projects for students; (3) Participating in group or individual research; (4) Creating the work and presenting it; (5) Examination and assessment of the process of solving problems.

According to Masrinah et al., (2019), the Problem Based Learning (PBL) model has advantages and disadvantages that need to be considered in its application in the classroom. The main advantage of PBL lies in its close connection to real-life situations outside of school. This model encourages students to develop critical, analytical, creative, and comprehensive thinking skills through a systematic problem-solving process. Conversely, PBL also has several weaknesses. One of them is the difficulty that students often experience in identifying and formulating problems that match their level of ability. Additionally, the learning process with this model takes longer compared to conventional methods. Students are required to actively seek information, analyze data, formulate hypotheses, and find solutions. Therefore, the role of the teacher as a facilitator is very important in guiding students.

METHODS

This research was conducted at SMA YP HKBP 1 Pematang Siantar located at Jalan Gereja No. 26, Siantar Selatan District, Pematang Siantar City, North Sumatra Province. The research was conducted from October to April, the second semester of the 2024/2025 Academic Year. The type of research used is quantitative research with a quasi-experimental method. The population in this study consists of all 11^{th} grade students at SMA YP HKBP 1 Pematang Siantar. The class sample in this study was randomly selected using a lottery, and the student sample was selected using a saturated sampling technique.

The data collection techniques used consist of subjective tests and questionnaires. Subjective tests were chosen because they are effective in measuring students' critical thinking abilities in depth through essay answers that reflect individual thought processes. The test was administered in the form of a pretest and posttest to the experimental class and the control class. Meanwhile, a questionnaire was used to measure students' learning interest, as this method is capable of systematically and efficiently gathering data on students' responses to ethnopedagogy-based and Problem Based Learning. The test instrument in this study was developed and selected through four main stages before being deemed suitable for assessing students' critical thinking skills. After going through the stages of grid preparation, item formulation, and validation by expert validators, the instrument was then tested based on four main characteristics, namely:

1. Validity Test

   Using the Product Moment formula supported by Microsoft Excel software. With degrees of freedom (df = N-2) at $\alpha = 0.05$, the validity coefficient, rxy, is compared to the r_{table} Product Moment values using the following criteria: If $r_{cal} > r_{table}$, the test item is deemed valid (Silitonga, 2014).

2. Difficulty Level TestThe Item Difficulty Index (P) can be calculated with the help of Microsoft Excel software. The higher the value of P, the easier the item, conversely, the lower the value of P, the harder the item. A test item is categorized as good if the difficulty index (P) falls within a moderate range, meaning it is neither too easy nor too difficult, thus motivating students to think and strive to their fullest (Silitonga, 2014).
3. Difference Power Test

   If a test item's discrimination index (D) falls between +0.20 and +1.00, it is considered to have strong discriminating power. With the help of Microsoft Excel software, the following formula can be used to determine the item's discriminating power:

$$D = \frac{\bar{X}\text{ Upper} - \bar{X}\text{ Lower}}{\text{Maximal score}}$$ (Lestari et al., 2023)

4. Reliability Test

The K-R 20 formula is used, and the value of Cronbach's Alpha can be calculated using the following equation with the help of Microsoft Excel software:

$$r_{11} = \left(\frac{K}{K-1}\right)\left(\frac{S^2 - \sum P^2}{S^2}\right)$$

The instrument is declared reliable if $r_{count} > r_{table}$ at a significance level of 0.05 (Silitonga, 2014).

The questionnaire used in this study consists of 20 statements designed to measure students' learning interest. Before the questionnaire was used, it was validated by expert validators competent in their field to ensure the reliability and relevance of each statement. The questionnaire instrument was constructed using a Likert scale, where the variable of learning interest was broken down into indicators of learning interest, which were then used as the basis for formulating the statement items. This questionnaire includes positive and negative statements in four assessment categories. The score for each item ranges from 1 to 4. Here are the guidelines.

Table 1. Scoring Guidelines for the Learning Interest Questionnaire

Positive Statement		Negative Statement	
Respond	Score	Respond	Score
Strongly agree	4	Strongly agree	1
Agree	3	Agree	2
Slighly Disagree	2	Slighly Disagree	3
Disagree	1	Disagree	4

(Khasanah & Nugraheni, 2022).

The analysis of the data in this research involves three testing stages, namely:

1. Normality Test
Using the Liliefors test with the aid of Microsoft Excel with α = 0.05. If the $t_{count} < t_{table}$, it is concluded that the data is normally distributed (Yahya et al., 2024).
2. Homogeneity Test
The homogeneity test for two treatment groups can be conducted using the Fisher test (F-test) and the data were processed using Microsoft Excel software, using the formula:

$$F_{count} = \frac{Largest\ varians}{Smallest\ varians}$$

Then the F_{count} is compared with the F_{table} (0.05). If $F_{count} < F_{table}(\alpha)$ (db= (n1 – 1)(n2 – 1)), it can be stated that the groups are homogeneous at the 5% significance level (Sitompul & Ardansyah, 2022).
3. Hypothesis Test
Using the right-tailed Independent Sample T-Test and the data were processed using Microsoft Excel software.

The T-Test with a significance level (α) = 0.05 is conducted by comparing the t_{count} with the t_{table}. H_a is accepted if $t_{count} > t_{table}$. The value of t_{table} can be obtained from the t_{table} or by using programs like Microsoft Excel (Japlani et al., 2020).

RESULTS AND DISCUSSION

RESULT

Analysis of Research Instrument Data

The essay test instrument, consisting of 10 questions, was then validated by a Chemistry lecturer from FMIPA UNIMED to ensure its quality and suitability. After validation, the instrument was tested on 19 12th grade students at SMA YP HKBP 1 Pematang Siantar to analyze validity, difficulty level, discrimination power, and reliability, in order to select 5 questions with optimal quality.

Test the validity of the test instrument. From the 10 questions that were tested, 6 questions were declared valid based on the criteria $r_{count} > r_{table}$.

Test the difficulty index of the test instrument. Based on the analysis results, all questions are classified in the moderate category, indicating that the questions have a balanced level of difficulty.

Test instrument discrimination test. From the analysis results, 6 questions fall into the good category, 2 questions into the sufficient category, and 2 questions into the weak category.

Test reliability. The calculation results show that the $r_{count} > r_{table}$ (0.802 > 0.455), so this test instrument is considered reliable. Based on the classification, this test falls into the high reliability category.

Research Data Analysis

1. Normality Test

Obtained $L_{table} = 0.19$.

Table 2. Normality Test Result

Class	Data	L_{count}
Experiment	Pretest	0,146
	Posttest	0,112
Control	Pretest	0,144
	Posttest	0,179
Experiment	Learning	0,148
Control	Interest	0,163

Based on the results with the help of Microsoft Excel software, it can be concluded that all the data are normaly distributed.

2. Homogeneity Test

Obtained $F_{table} = 2.124$.

Table 3. Homogeneity Test Result

Class Data	F_{count}
Pretest Critical Thinking Skills	1,596
Posttest Critical Thinking Skills	2,092
Learning Interest	1,977

Based on the results with the help of Microsoft Excel software, it can be concluded that all the data are homogeneously distributed.

3. Hypothesis Test

After conducting normality and homogeneity tests, the next step is to perform hypothesis testing using the one-tailed right Independent Sample T-Test with the help of Microsoft Excel.

a. First Hypothesis Test

Here are the data calculations for the learning interest of the experimental class and the control class.

Table 4. Data Result of Learning Interest Calculation in Experiment and Control Classes

Data Source	Average	Standard Deviation	Varians
Experiment	90.25	4.472	20
Control	85.625	3.18	10.115

Obtained t_{count} = 3,769 and t_{table} = 1,686. Because $t_{count} > t_{table}$, H_0 is rejected and H_a is accepted. It can be said that there is a significant influence on students' learning interest through the use of ethnopedagogy-based reaction rate teaching materials and PBL compared to conventional learning.

b. Second Hypothesis Test

Here are the data calculations for the critical thinking skills of the experimental class and the control class.

Table 5. Data Result of Critical Thinking Skills Calculation in Experiment dan Control Classes

Data Source	Average	Standard Deviation	Varians
Experiment	92.25	5.73	32.829
Control	83.5	8.288	68.684

Obtained t_{count} = 3.887 and t_{table} = 1.686. Because $t_{count} > t_{table}$, H_0 is rejected and H_a is accepted. This shows that there is a significant influence on students' critical thinking skills through the use of ethnopedagogy-based teaching materials and PBL compared to conventional learning.

DISCUSSION

The research was conducted at SMA YP HKBP 1 Pematang Siantar involving all 11th grade students as the population. Two classes were selected through a simple lottery: XI-1 as the experimental class and XI-3 as the control class. The experimental class received treatment through Problem Based Learning (PBL) and ethnopedagogical LKPD on reaction rate material related to Batak culture (the fermentation process of *tuak*), while the control class used the Chemistry Package Book with simple practicals. To measure students' interest in learning and critical thinking skills, a questionnaire (non-test) and essay questions (test) were used. The initial test instrument consisted of 10 questions validated by expert lecturers, tested on 19 twelfth-grade students, and then analyzed for validity, difficulty level, discrimination power, and reliability. The five best questions were selected to represent each critical thinking indicator.

Analysis of the Influence of Teaching Materials on Critical Thinking Skills

Before the learning process, both classes were given a pretest to measure their initial understanding and to serve as a basis for grouping students during the experiment. The pretest results showed low scores (experimental class: 62 and control: 60), indicating the need for structured learning. During the learning process, the experimental class showed high enthusiasm and active engagement, while the control class showed lower participation. Practical constraints occurred in both classes, but they did not diminish the enthusiasm for learning, especially in the experimental class, which found the learning more meaningful.

After the lesson, the posttest results showed a significant impact from the treatment given. The experimental class obtained an average of 92.25 while the control class scored 83.5. The following is a graph comparing critical thinking ability scores between the experimental class and the control class, adjusted according to critical thinking indicators.

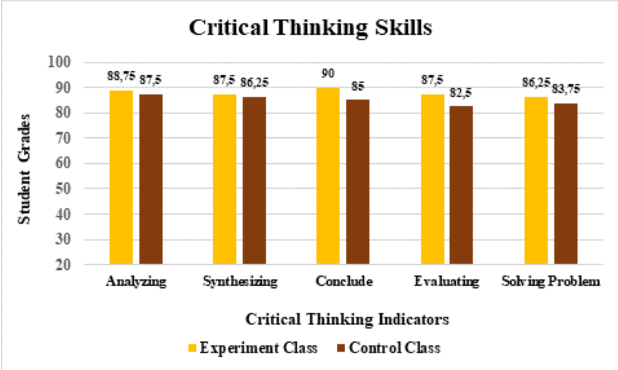

Figure 1. Graph of the Comparison of Posttest Scores on Students' Critical Thinking Skills in the Experimen and Control Classes

Based on the presented graph, it is evident that the experimental class shows higher scores compared to the control class on all indicators of critical thinking ability. On the analyzing indicator, the experimental class scored 88.75 while the control class scored 87.5, indicating that the ethnopedagogical approach is more effective in helping students identify and analyze information. On the synthesis indicator, the experimental class scored 87.5 while the control class scored 86.25 indicating that the PBL approach encourages students to integrate information into new understanding more effectively. A slightly noticeable difference occurred in the concluding indicator, where the experimental class achieved 90 while the control class scored 85, indicating that contextual learning linking the material with local wisdom can enhance students' ability to draw logical and data-based conclusions. On the evaluating indicator, the experimental class recorded a score of 86.25 while the control class scored 82.5, indicating that the ethnopedagogy-based Student Worksheets are effective in training students to critically assess the quality of arguments or processes. Lastly, on the problem-solving indicator, the experimental class scored 86.25 while the control class scored 83.75, indicating that problem-based learning is capable of training students to develop creative solutions to real-world problems.

Analysis of the Influence of Teaching Materials on Student Learning Interest

Students' learning interest was measured through a questionnaire containing 20 validated statements, covering four indicators: enjoyment, attention, interest, and active engagement. The average interest in learning score for the experimental class students was 90.25, while the control class scored 85.625. Here is the graph.

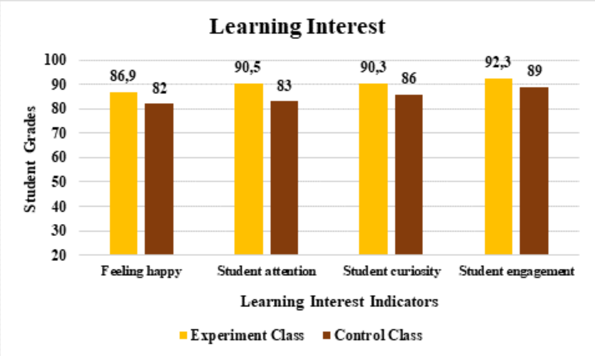

Figure 2. Graph of the Comparison of Posttest Scores on Students' Learning Interest in the Experimen and Control Classes

The learning interest of students in the experimental class appears to be higher compared to the control class across all indicators. In terms of feelings of happiness, the experimental class recorded a score of 86.9, indicating a more positive emotional learning atmosphere compared to the control class, which scored 82. Students' attention was also stronger in the experimental class (90.5) compared to the control class (83), reflecting better focus on learning. On the interest indicator, the experimental class scored 90,3 while the control class scored 86, indicating that topics related to local culture were able to build students' curiosity. Lastly, the engagement indicator showed the highest achievement, namely 92.3 in the experimental class and 89 in the control class, indicating stronger active student participation in the learning process.

The Connection Between Reaction Rate Material and the Cultural Context of *Tuak* Production

Learning chemistry in context makes it easier to comprehend scientific ideas by relating them to real-world situations and regional customs. The Batak Toba community's tradition of fermenting *tuak* serves as an introduction to the idea of reaction rate in this research. Reaction rate principles including temperature, concentration, surface area, and catalysts are reflected in the fermentation of aren sap (*Arenga pinnata*) utilizing typical raru-based yeast. This procedure demonstrates how the organic application of scientific concepts may be reflected in local knowledge. The procedure for drawing sap from the aren tree is shown in **Figure 3** below. This procedure demonstrates how *tuak*'s primary raw material is sourced from the environment:

Figure 3. The Process of Tapping Sap from the Aren Tree

This activity emphasizes the importance of the quality of the raw material (palm sap), which in the context of chemistry relates to the concentration of reactants. The tapping process also reflects traditional skills passed down through generations and the wise utilization of nature by the local community.

The connection of the process of making *tuak* in reaction rate learning builds students' emotional and cognitive engagement. The material becomes more relevant because it is sourced from their own cultural reality, while also instilling the idea that modern science and local values complement each other. The concept of collision theory and reaction dynamics is explained through real-life examples such as: tapping palm sap (reactant concentration), treatment of raru (surface area), and storage at different temperatures (the effect of temperature on fermentation rate).

The surface area of the reactants is an important factor that affects the rate of a chemical reaction. In the fermentation of *tuak*, the raru skin as a fermentation agent contains natural microorganisms, and its physical form affects the efficiency of the process. Observation results show that fermentation occurs more quickly with finely powdered raru skin compared to larger pieces. This is in line with the collision theory, where a larger surface area increases the number of effective collisions between microorganisms and the substrate (sap), thereby accelerating the fermentation reaction. The following data shows the effect of variations in the physical form of raru on the fermentation rate obtained from one of the experimental class groups.

Table 6. The Effect of the Surface Area of Raru Skin on the Alcohol Concentration (%) of Tuak

Raru Size	Fermentation Time (hours)	Alcohol Concentration (%)
Raru powder	12	6,5%
Raru cut of 0,5 cm	16	4,8%
Raru cut of 1 cm	20	3,2%
Raru cut of 1,5 cm	24	1,5%

In raru powder, gas bubbles quickly appear, a strong fermentation aroma, the raru skin is almost gone, finely dissolved in the liquid, the color fades. In the 0,5 cm cut raru, moderate bubbles appear, the fermentation aroma starts to be noticeable, the raru skin partially dissolves, appears crumbled, and the texture begins to soften. At the 1 cm cut of the raru, bubbles appear slowly, with a light fermentation aroma, the raru skin is still partially intact, and the surface is softening. In the 1.5 cm cut raru, there are almost no bubbles, the fermentation process is slow, the raru skin is mostly still hard and intact, with only slight changes.

Data shows that the finer the texture of the raru skin, the shorter the fermentation time and the higher the reaction rate. This confirms that the increase in the surface area of solid substances accelerates the reaction through an increase in the frequency of effective collisions. These findings align with the principles of chemical kinetics and demonstrate that the traditional fermentation practices of the Batak community have empirically applied scientific principles, albeit without a formal theoretical foundation.

Data Processing and Statistical Testing to Determine the Significance of Teaching Materials' Influence

After all the data has been collected, the next step is to conduct statistical assumption testing before proceeding to the hypothesis testing stage using a one-tailed (right) Independent Sample T-Test. The entire data analysis process was carried out with the help of Microsoft Excel software.

To test the normality of the data, the Liliefors test was used. With a significance level of 0.05 and a total of 20 respondents per class, the L_{table} value obtained is 0.19. The calculation results show that all L_{count} are less than 0.19, which means all data are normally distributed. Next, a homogeneity test was conducted using the Fisher test, with the decision criterion $F_{count} < F_{table}$. At a significance level of 0.05 with 20 respondents each in the experimental and control classes, the F_{table} obtained is 2.124. Based on the calculation results, all $F_{count} < F_{table}$, which indicates that the data from both sample classes are homogeneous.

With the fulfillment of both conditions, namely normality and homogeneity, the data are deemed suitable for further testing using a one-tailed (right) Independent Sample T-Test parametric hypothesis test. Based on the calculations, the t_{table} value obtained is 1.686.

Hypothesis one aims to test the influence of ethnopedagogical-based reaction rate teaching materials and Problem Based Learning on students' learning interest between the experimental class and the control class. It is known that the average student learning interest in the experimental class is higher than in the control class. From the analysis results, a t_{count} of 3.769 was obtained, which means $t_{count} > t_{table}$ (3.769 > 1.686). Therefore, H_0 is rejected and H_a is accepted, indicating that the use of ethnopedagogy-based reaction rate teaching materials and Problem Based Learning has a significant effect on students' learning interest.

The second hypothesis tests the influence of ethnopedagogy-based reaction rate teaching materials and Problem Based Learning on students' critical thinking skills. The results show that the average critical thinking ability of students in the experimental class is also higher than that of the control class. Through calculations, a t_{count} of 3.887 was obtained, which also meets the criteria of $t_{count} > t_{table}$ (3.887 > 1.686). Thus, H_0 is rejected again and H_a is accepted, indicating that the reaction rate learning materials based on ethnopedagogy and Problem Based Learning significantly influence students' critical thinking skills.

The research results show that the use of ethnopedagogy-based reaction rate teaching materials and the Problem Based Learning (PBL) model has a significant impact on students' learning interest and critical thinking skills. These findings are in line with the research results of Sandi et al., (2024), which show that the Problem Based Learning (PBL) model effectively increases students' interest in learning. Real-world problem-based learning encourages enthusiasm, motivation, active engagement, as well as students' curiosity and perseverance in learning, making PBL deemed relevant to be applied in various learning contexts. These findings are in line with Lulu et al., (2024), who found a significant increase in learning interest among SDK Wolowio students through the ethnoscience-based PBL model. Although it did not use a specific Student Worksheet, the study reinforces the effectiveness of the culture-based approach in building student engagement. The influence of the Problem Based Learning (PBL) model on critical thinking skills is also reinforced by the research of Zahro & Lutfianasari, (2024). Through a t-test with a significance level of 5%, a t-value of 8.071 was obtained, indicating that the implementation of PBL significantly enhances students' critical thinking skills on the topic of salt hydrolysis. These findings affirm the influence of PBL in fostering critical thinking skills. Similar support comes from Muzakki et al., (2023), who show that PBL based on Student Scientific Worksheets enhances critical thinking skills, particularly in the aspects of interpretation and analysis, achieving a completeness of 79.41%.

The advantage of the teaching materials in this study lies in their ability to contextualize the concept of reaction rate through local cultural phenomena, namely the fermentation process of *tuak* in Batak culture. This teaching method reinforces the understanding of scientific concepts while also fostering a sense of pride in the students' cultural identity. The learning experience becomes more concrete, meaningful, and emotional, as evidenced by the increased participation and curiosity of the students during the lessons. The application of ethnopedagogy-based teaching materials effectively transforms the learning atmosphere from passive to active. Students not only understand scientific concepts but also engage in a learning process that integrates local values, thereby developing their affective dimension as well. The posttest results and significant increase in learning interest in the experimental class, compared to the control class, indicate that this approach successfully bridges abstract concepts with students' daily realities.

The combination of ethnopedagogy and the Problem Based Learning (PBL) model has proven to be complementary. Ethnopedagogy presents culturally and emotionally relevant learning, while PBL encourages active engagement in solving real problems that demand critical thinking skills. This combination creates a holistic, cognitively challenging, and contextual learning process. The research results show that students in the experimental class experienced a significant increase in learning interest and critical thinking skills, in line with the 21st-century education goals that emphasize the importance of scientific literacy, cultural literacy, and higher-order thinking skills.

CONCLUTION

Based on the research conducted at SMA YP HKBP 1 Pematang Siantar, it can be concluded that there is a significant influence of ethnopedagogy-based reaction rate teaching materials and Problem Based Learning on students' learning interest. This is indicated by the average student interest in the experimental class being 90.25, while in the control class it was 85.625. It can also be seen from the t_{count} where the t_{count} (3.769) > t_{table} (1.686). There is a significant influence of the ethnopedagogy-based reaction rate teaching materials and Problem Based Learning on students' critical thinking skills. This is evidenced by the posttest results which show an average critical thinking ability of 92.25 in the experimental class, while the control class had an average of 83.5. It can also be seen from the t_{count} where t_{count} (3,887) > t_{table} (1.686). The findings of this study provide a realistic contribution to the development of science education, particularly in the implementation of contextual and culture-based learning. By integrating traditional tuak fermentation into the topic of reaction rate, students were able to understand abstract chemical concepts through familiar cultural practices. Although the scope of the study was limited to one school and one topic, the results indicate that incorporating local wisdom into teaching materials can enhance students' engagement and comprehension. This approach can serve as a reference for educators seeking to apply culturally relevant pedagogy in other science topics, especially in regions rich in local traditions.

REFERENCE

Aisyah S, S., Hasyimuddin, H., & Samsinar, S. (2019). Uji Alkohol Pada Fermentasi Tuak. *Teknosains: Media Informasi Sains Dan Teknologi*, *12*(2), 148–156. https://doi.org/10.24252/teknosains.v12i2.7594

Al-tabani. (2014). *Mendesain Model Pembelajaran Inovatif, Progresif, dan Kontekstual*. Prenadamedia Group.

Alwasilah. (2020). *Etnopedagogi*. PT Kiblat Buku Utama.

Amora, S. Di, Novita, D., & Wiyati, A. (2024). Penerapan Etnokimia Yang Kontekstual Pada Materi Koloid Melalui Model Pembelajaran Problem Based Learning Untuk Melatih Kemampuan Berpikir. *UNESA Journal of Chemical Education*, *13*(1), 9–15.

Asna, A. Z., Sumarni, W., & Cahyono, E. (2024). Modul Etnokimia Terintegrasi Nilai Islami pada Pembelajaran Berbasis Proyek untuk Melatih Kreativitas. *Jurnal Inovasi Pendidikan Kimia*, *18*(1), 43–49. https://doi.org/10.15294/jipk.v18i1.46707

Cahyani, H. D., Hadiyanti, A. H. D., & Saptoro, A. (2021). Peningkatan Sikap Kedisiplinan dan Kemampuan Berpikir Kritis Siswa dengan Penerapan Model Pembelajaran Problem Based Learning. *Edukatif : Jurnal Ilmu Pendidikan*, *3*(3), 919–927. https://doi.org/10.31004/edukatif.v3i3.472

Fatmi, N., & Fauzan, F. (2022). Kajian Pendekatan Etnopedagogi Dalam Pendidikan Melalui Kearifan Lokal Aceh. *Al-Madaris Jurnal Pendidikan Dan Studi Keislaman*, *3*(2), 31–41. https://doi.org/10.47887/amd.v3i2.98

Hidayat, S., Leksono, S. M., Jamaludin, U., & Shintawati, S. (2023). Ethno Pedagogy Approach in Preparing Science Learning in The Society 5.0 Era. *Jurnal Penelitian Pendidikan IPA*, *9*(7), 309–314. https://doi.org/10.29303/jppipa.v9i7.4154

Japlani, A., Fitriani, F., & Mudawamah, S. (2020). Pengaruh Kualitas Pelayanan, Kepercayaan Terhadap Kepuasan Nasabah Pada Cabang Bmt Fajar Metro Pusat. *Fidusia : Jurnal Keuangan Dan Perbankan*, *3*(1), 67–85. https://doi.org/10.24127/jf.v3i1.469

Khasanah, U., & Nugraheni, E. A. (2022). Analisis Minat Belajar Matematika Siswa Kelas Vll Pada Materi Segiempat Berbantuan Aplikasi Geogebra di SMP Negeri 239 Jakarta. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *6*(1), 181–190. https://doi.org/10.31004/cendekia.v6i1.813

Kurniasari, W., Murtono, M., & Setiawan, D. (2021). Meningkatkan Minat Belajar Siswa Menggunakan Model Blended Learning Berbasis Pada Google Classroom. *Jurnal Educatio FKIP UNMA*, *7*(1), 141–148. https://doi.org/10.31949/educatio.v7i1.891

Lalang, A. C., Christianto, H., Lestarani, D., Parera, L. A. M., & Murni, M. M. (2023). Etnokimia Pada Kain Tenun Songke Asal Desa Kakor Kecamatan Lembor Selatan Kabupaten Manggarai Barat, Nusa Tenggara Timur. *Jurnal Beta Kimia*, *3*(2), 15–28. https://doi.org/10.35508/jbk.v3i2.13602

Lestari, A. S., Fitrianna, A. Y., & Zanthy, L. S. (2023). Analisis Butir Soal Tes Materi Sistem Persamaan Linear Dua Variabel pada Siswa Kelas VIII. *Jurnal Pembelajaran Matematika Inovatif*, *6*(1), 367–376. https://doi.org/10.22460/jpmi.v6i1.12389

Lestari, I. B., Sudarmin, Ellianawati, Wiyanto, & Sumarni, W. (2021). Review Analysis of Video Blogging, Ethnoscience and Social Media Literacy in the Era of the Industrial Revolution 4.0. *Thabiea : Journal of Natural Science Teaching*, *4*(1), 33–49. https://doi.org/10.21043/thabiea.v4i1.9767

Lubis, M. R. S., Khairuna, & Rohani. (2023). Pengembangan Lembar Kerja Peserta Didik (LKPD) Berbasis Kemandirian Belajar bagi Siswa di SMA Cerdas Murni Tembung. *Pekobis : Jurnal Pendidikan, Ekonomi, Dan Bisnis*, *8*(1), 81–94. https://doi.org/10.32493/pekobis.v8i1.p81-94.29819

Lulu, M. M., Dhiu, M. I., Lawe, U. Y., & Koe, M. (2024). Penerapan Model PBL berbasis Etnosains dalam Meningkatkan Minat Belajar IPAS Siswa Kelas V SDK Wolowio. *Jurnal Ilmiah Mandalika Education (MADU)*, *2*(1), 294–299. https://permatamandalika.com/index.php/MADU

Mahdalena, M. (2022). PENGARUH MINAT BELAJAR, DUKUNGAN ORANG TUA DAN LINGKUNGAN BELAJAR TERHADAP PERILAKU BELAJAR SISWA DAN HASIL BELAJAR SISWA PADA MATA PELAJARAN IPA (Studi Faktor Yang Mempengaruhi Prilaku Belajar dan Hasil Belajar Siswa Kelas 4,5 dan 6 Pada SDN Binuang 4 da. *Kindai*, *18*(2), 332–351. https://doi.org/10.35972/kindai.v18i2.803

Masrinah, E. N., Aripin, I., & Gaffar, A. A. (2019). Problem Based Learning Untuk Meningkatkan Keterampilan Berpikir Kritis: Meta Analisis. *FKIP UNMA*, *18*(4), 924–932.

Mirdad, J. (2020). Model-Model Pembelajaran (Empat Rumpun Model Pembelajaran). *(Indonesia Jurnal Sakinah) Jurnal Pendidikan Dan Sosial Islam*, *2*(1), 14–23.

Muzakki, A. R., Prafitasari, A. N., & Wulandari, F. (2023). Peningkatan Keterampilan Berpikir Kritis Siswa Kelas XI MIPA Menggunakan PBL Berbantuan LKPD Saintifik Konsep. *DWIJA CENDEKIA: Jurnal Riset Pedagogik*, *7*(2), 629–640. https://doi.org/10.20961/jdc.v7i2.75270

Muzakkir. (2021). Pendekatan Etnopedagogi Sebagai Media Pelestarian Kearifan Lokal. *Jurnal Hurriah: Jurnal Evaluasi Pendidikan Dan Penelitian*, *2*(2), 28–39.

Panggabean, F. T. M., Silitonga, P. M., Purba, J., Jasmidi, J., & Purba, R. A. (2023). Analysis Student Motivation and Learning Outcomes by Apllying Problem Based Learning and Discovery Learning Models. *Jurnal Inovasi Pembelajaran Kimia (Journal Of Innovation in Chemistry Education)*, *5*(1), 11. https://doi.org/10.24114/jipk.v5i1.42419

Pulungan, E. N., & Simamora, K. F. (2024). Influence of Canva Media Based on Guided Inquiry Model on Students' Critical Thinking Ability and Chemical Literacy. *Jurnal Inovasi Pembelajaran Kimia (Journal Of Innovation in Chemistry Education)*, *6*(1), 100. https://doi.org/10.24114/jipk.v6i1.57379

Putri, F. P., Nugroho, A. A., & Utami, R. E. (2022). Analisis Minat Belajar Matematika Siswa yang Diterapkan pada School from Home (SFH). *Imajiner: Jurnal Matematika Dan Pendidikan Matematika*, *4*(4), 355–362. https://doi.org/10.26877/imajiner.v4i4.10856

Rachmadyanti, P., Gunansyah, G., Hariyati, D. P., Istianah, F., & Mulyani, M. (2023). Pelatihan Pembuatan LKPD Interaktif dengan Liveworksheets bagi Guru Sekolah Dasar di Kabupaten Magetan Jawa Timur. *Bubungan Tinggi: Jurnal Pengabdian Masyarakat*, *5*(1), 543–551. https://doi.org/10.20527/btjpm.v5i1.7495

Ramadhana, G. H., & Sutiani, A. (2023). Implementation of Problem Based Learning on Critical Thinking to Increase Learning Outcomes and Student Activities. *Jurnal Inovasi Pembelajaran Kimia (Journal Of Innovation in Chemistry Education)*, *5*(1), 37–43. https://doi.org/10.24114/jipk.v5i1.43757

Rosmana, P. S., Ruswan, A., Lesmana, A. R. D., Andini, I. F., Yuliani, I. P., Ramanda, N., ... &, & Citra, W. R. (2024). Penerapan LKPD Terhadap Efektivitas Pembelajaran Peserta Didik Di Sekolah Dasar. *Jurnal Pendidikan Tambusai*, *8*(1), 3082–3088.

Sandi, N. R., Nisa, S., & Suriani, A. (2024). Penggunaan Model Pembelajaran Problem Based Learning Dalam Meningkatkan Minat Belajar Siswa. *Jurnal Pendidikan Sosial Humaniora*, *3*(2), 294–303. https://doi.org/10.30640/dewantara.v3i2.2654

Sembiring, H. G., & Sutiani, A. (2022). Pengembang modul berbasis Problem Based Learning (PBL) terintegrasi literasi sains pada materi laju reaksi kimia. *Educenter : Jurnal Ilmiah Pendidikan*, *1*(6), 674–682. https://doi.org/10.55904/educenter.v1i6.238

Silaban, R., Tua, F., Panggabean, M., Hutahaean, E., Hutapea, F. M., & Alexander, I. J. (2021). Efektivitas Model Problem Based Learning Bermediakan Lembar Kerja Peserta Didik Terhadap Hasil Belajar Kimia Dan Kemampuan Berpikir Kritis Peserta Didik SMA. *JURNAL ILMU PENDIDIKAN INDONESIA*, *9*(1), 18–26. http://ejournal.uncen.ac.id/index.php/JIPI

Silitonga, P. M. (2014). *Statistik Teori dan Aplikasi dalam Penelitian*. FMIPA UNIMED.

Sitompul, H., & Ardansyah, M. (2022). *Statistika Pendidikan Teori dan Cara Perhitungan*. Perdana Publishing.

Suryati, S., Hatimah, H., Zohri, S. A., & Salim, A. (2024). Review LKPD PBL Berbasis Kearifan Lokal Lombok untuk Mendukung Kurikulum Merdeka pada Materi Koloid. *Jurnal Ilmiah IKIP Mataram*, *11*(1), 10–23. https://e-journal.undikma.ac.id/index.php/jiim/article/view/12531%0Ahttps://e-journal.undikma.ac.id/index.php/jiim/article/viewFile/12531/6116

Susanto, A. (2014). *Teori Belajar dan Pembelajaran di Sekolah Dasar*. Kencana.

Sutrisno, H., Wahyudiati, D., & Louise, I. S. Y. (2020). Ethnochemistry in the Chemistry Curriculum in Higher Education: Exploring Chemistry Learning Resources in Sasak Local Wisdom. *Universal Journal of Educational Research*, *8*(12A), 7833–7842. https://doi.org/10.13189/ujer.2020.082572

Tambunan, C. E., Simanjuntak, N. Z., & Susanti, N. (2021). Pengembangan Website Berbasis Masalah Sebagai Media Pembelajaran untuk Mendukung Pembelajaran Online Pada Materi Laju Reaksi. *Jurnal Inovasi Pembelajaran Kimia (Journal Of Innovation in Chemistry Education)*, *3*(1), 35–45. https://doi.org/10.24114/jipk.v3i1.22845

Triyani, L., Fakhrudin, A., & Lubis, P. H. (2023). Pengembangan LKPD Berbasis Discovery Learning Pada Pembelajaran IPA Kelas IV SD. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, *8*(2), 849–862.

Wardani, R. P., Fitriyah, C. Z., & Rofiq, A. (2024). ETNOPEDAGOGIK SEBAGAI PENDEKATAN DALAM PENDIDIKAN DASAR. *JURNAL PENDIDIKAN EKONOMI: Jurnal Ilmiah Ilmu Pendidikan, Ilmu Ekonomi Dan Ilmu Sosial*, *18*(1), 183–190.

Wihartanti, L. V., Prasetya Wibawa, R., Astuti, R. I., & Pangestu, B. A. (2019). Penggunaan Aplikasi Quizizz Berbasis Smarthphone Dalam Membangunkemampuan Berpikir Kritis Mahasiswa. *Prosiding Seminar Nasional Pendidikan Dan Pembelajaran*, *1*(1), 362–368.

Yahya, A., Aprilianto, R., & Hardovi, B. H. (2024). Pengaruh Latihan Shuttle Run Terhadap Kelincahan Pemain Sepak Bola Ampel Putra. *Sparta*, *6*(2), 55–60. https://doi.org/10.35438/sparta.v6i2.243

Yuberti, Y. (2014). *Pembelajaran dan Pengembangan Bahan Ajar dalam Pendidikan*. Anugrah Utama raharja (AURA).

Zahro, M., & Lutfianasari, U. (2024). Penerapan Model Pembelajaran Problem-Based Learning terhadap Kemampuan Berpikir Kritis dan Aktivitas Belajar Peserta Didik pada Materi Hidrolisis Garam. *Jurnal Inovasi Pendidikan Kimia*, *18*(1), 17–22. https://doi.org/10.15294/jipk.v18i1.45567

Zakiyah, F., Yonata, B., & Korespondensi, A. (2021). Pengembangan LKPD Berorientasi Guided Discovery Learning dengan Internet Assisted Learning untuk Melatihkan Keterampilan Berpikir Kritis. *Jurnal Inovasi Pembelajaran Kimia (Journal Of Innovation in Chemistry Education)*, *3*(1), 46–55. https://jurnal.unimed.ac.id/2012/index.php/jipk

Zebua, E., & Harefa, A. T. (2022). Penerapan Model Pembelajaran Blended Learning Dalam Meningkatkan Minat Belajar Siswa. *Educativo: Jurnal Pendidikan*, *1*(1), 251–262. https://doi.org/10.56248/educativo.v1i1.35