



ANALYSIS OF ELEMENTARY SCHOOL STUDENTS' REFLECTIVE THINKING ABILITIES WITH THE APPLICATION OF THE DIFFERENTIATION PBL MODEL IN THE SUBJECT OF SOCIAL SCIENCES

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Article History

Received : 03/07/2025

Revised : 28/08/2025

Accepted : 06/09/2025

Keywords:

Reflective thinking,
Differentiated PBL,
Social science learning,
Elementary school
students, Mixed method.

Abstract. Reflective thinking is an essential component in fostering critical awareness and problem-solving skills that are particularly needed in Social Science subjects. However, observations indicate that fourth-grade students still exhibit low levels of reflective thinking due to ineffective teaching methods and the lack of alignment between instructional delivery and students' abilities. This study aims to analyze the reflective thinking abilities of elementary school students through the implementation of a Differentiated Problem-Based Learning (PBL) model in Social Science learning. This study employs a mixed-method approach, with data collected through tests and questionnaires to measure students' reflective thinking skills before and after the implementation of the differentiated PBL model. The findings show a significant improvement in students' reflective thinking skills, where the model encouraged active participation, collaborative learning, and deep reflection in problem-solving processes. This study emphasizes the importance of integrating innovative learning models such as differentiated PBL to enhance students' reflective thinking abilities and to promote meaningful Social Science learning at the elementary school level.

How to Cite: Satianingsih, R., Rosmiati, R., Sugiono, S., & Hermita, N. (2025). ANALYSIS OF ELEMENTARY SCHOOL STUDENTS' REFLECTIVE THINKING ABILITIES WITH THE APPLICATION OF THE DIFFERENTIATION PBL MODEL IN THE SUBJECT OF SOCIAL SCIENCES. *Prima Magistra: Jurnal Ilmiah Kependidikan*, 6(4), 705-719. <https://doi.org/10.37478/jpm.v6i4.6554>

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Publisher:

Program Studi PGSD Universitas Flores. Jln. Samratulangi,
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INTRODUCTION

Education is an important aspect in the globalization era where education is expected to develop young people to achieve an innovative, skillful and creative nation (Marsinta Arsani, 2020; Nugroho et al., 2021). Reflective thinking is crucial in developing creative students as students maximize their thinking skills to solve problems in their daily life (Rosmiati, et al., 2020^a, 2020^b). In addition, reflective thinking is very important for students to evaluate themselves so that they become accustomed to thinking deeply. Based on the observation results, the reflective thinking ability of several fourth-grade students was still low during the learning process, especially in the Social Studies subject. Students were found to have inadequate reflective thinking skills to solve the problems given (Satianingsih et al., 2021; Prastyo et al., 2024; Rosmiati et al., 2024; Rosmiati, et al., 2020^a; 2020^b). The lack of reflective thinking skills is also due to limited interaction and thinking skills. In social studies lessons, the teacher is observed to play a more active role than the students. The grade 4 students' scores in Social Studies subject are as shown in Table 1.

Table 1. Grade 4 Social Studies Subject Scores

No	Mark	Value Interval		Amount Learners
		≤ 75	≥ 75	
1.	4-A	8	15	23
2.	4-C	6	20	26

The low score below minimum mastery criteria or Kriteria Ketuntasan Minimal (KKM) of 75 indicate low student interest on the subject leading to low understanding of the subject

thus limiting the (Rosmiati, et al., 2020^a, 2020^b). To solve this challenge, the teacher needs to understand the students' needs to be able to customize the teaching method and strategy. It is stated that reflective thinking skill is important for both teachers and students, but the existing evidence show that reflective thinking skills have not been an important attention, as the teacher assesses only the final answer from students and not the process of getting the answers (Rosmiati, et al., 2020^a, 2020^b). This assessment lowers students' reflective thinking skill in concurrent with the previous studies stating that reflective thinking skills is a process of connecting previous knowledge with current studied content in analyzing problem, exploration on formulate problems, integrating, choosing the best solution and reflecting on the learning process and results (Rosmiati et al., 2024; Satianingsih et al., 2024). Participant educate minorities in Indonesia face inequality significant education. Samsul Hadi et al. (2024) shows number separated schools in the area with population minority reached 12%, more tall compared to the national average of 6%. A study by Becker & Luthar (2002) and Morsy & Rothstein (2015) highlighted that discrimination in schools no only influence performance academics, but also mental health, which is deep term long can make things worse gap social (see Table 2).

Table 2. Study Comparison

Researchers	Focus Study	Key Findings	Identified Gaps
Becker & Luthar (2002) and Morsy & Rothstein (2015)	Discrimination in Schools	Impact on mental health and motivation Study	There is a lack of studies in the Southeast Asian context
Statti & Torres (2020)	Minority Education	Correlation poverty and access education limited	Minimal solutions based digital technology
Samsul Hadi et al. (2024)	Literacy Numeracy Student Minority	The low literacy numeracy in 3T areas	Need innovation learning PBL -based

As one of the higher order thinking skills, reflective thinking skills are evidenced to be improved during the learning process where students are trained to develop their ability and habit through formal education activities, for example elementary students can individually and responsibly solve problems (Sudiono et al., 2025; Sari & Juniarso, 2025). Studies have evidenced that there are stages of reflective thinking skills. This stages include the curiosity shown by the students, problem-solving ideas based on knowledge that has been acquired, observation on the sequence of the solution, revising and modifying inaccurate answers, and providing quality summary (Munafisah et al., 2023; Sari & Juniarso, 2025).

One of learning models that is evidenced to develop and improve reflective thinking skills os *Problem Based Learning* (PBL). The initial phase of PBL focuses on orienting students to the problem. This stage begins with the teachers clearly explain the learning objectives, to provide clarity of the purpose and expected outcomes. Subsequently, the teachers outline the necessary materials or basic knowledge required to engage with the task to ensure students are well equipped to proceed. A key component of this orientation is the teachers' role in motivating students, encouraging them to take an actively participate in solving the problem. Following this introduction, the PBL progresses to a stage where students are organized for the learning process. Here, the teacher facilitates by helping learners define the scope of their inquiry and structure their approach. This support is crucial in guiding the students as they organize the tasks and responsibilities related to investigating and accurately addressing the selected problem. Then, teachers guide individual and group investigations with the objective for students to gather appropriate information and do experiment to get explanation and solution to the problems (Agnes Verya Dianasari et al., 2025; Munafisah et al., 2023; Octavia et al., 2024; Permatasari & Satianingsih, 2025). After the process and presentation of the results, teachers facilitate students to prepare reports. The reports can be in the form of written report, video, or other types and formats. The final stage in PBL is for teachers to guide and support



students in reflecting on the learning process that have been conducted (Dinata et al., 2020; Fajrina et al., 2020; Nurannisa et al., 2025).

Effective learning needs to be designed using appropriate models and approaches suitable for the students' level of growth and development. This ensures that the learning is beneficial and can deliver educational value. Numerous models and approaches can be utilized within the Curriculum Merdeka. Including in these models is the PBL model which is a model that presents a problem to stimulate students to learn. In classes that implement this learning, students work in teams to solve real-world problems (Handayani et al., 2022; Mariani et al., 2025; Rahayu et al., 2024; Satriawan et al., 2020^a; Satriawan et al., 2020^b; Syahputra et al., 2020; Wahyuni KH & Satianingsih, 2024). Learning with PBL model challenges students to learn and master how to study and work in groups to identify solutions to real-world problems. The problems given are used to engage students' sense of curiosity about the intended learning. Problems are given to students before they learn the concept or material related to the problem that must be solved (Agnes Varya Dianasari et al., 2025; Permatasari & Satianingsih, 2025; Lailiyah et al., 2025; Wahyuni KH & Satianingsih, 2024).

Empirical studies have examined and evidenced that differentiated instructions are beneficial for students due to the ability to accommodate students' learning style (Ermawati et al., 2023; Moscoso et al., 2022; Wittek & Habib, 2013; Xu et al., 2024). This approach aligns with several key educational objectives, as outlined in the following statements: 1) To support all students in the learning process with the objective to provide necessary scaffolding and varied approaches to ensure every student can access and engage with the curriculum. 2) To increase student motivation and improve learning outcomes which foster greater intrinsic motivation leading to academic achievement that accurately reflect students' mastery of the material. 3) To improve a harmonious relationship between teachers and students, creating a supportive classroom environment that further energizes students and encourages a positive disposition toward learning. 4) To cultivate independency and appreciate diversity. This practice helps students develop the skills and habits of managing their own educational journey. 5) To enhance teacher satisfaction and professional growth from the success in implementing differentiation which presents a constructive challenge for teachers.

This matter supported by several study that *the Problem Based Learning* model or learning based problem can effectiveness and influence to learning students in class. Eskris (2021) state that *the Problem Based Learning* model more influential rather than the *Discovery Learning* model in increase think critical participant educate fifth grade elementary school. In his research state that skills think critical can improved through *Problem Based Learning* in social studies lessons at SDN Paseban 05 Pagi. This can used as an alternative to learning models for increase think critical. Stated that use of learning models *Problem Based Learning* more effective for increase ability think reflective student compared to those using the expository model.

RESEARCH METHODS

This research employs a mixed-methods design. This study design is utilized to analyze the research problem specifically concerning the "Analysis of Reflective Thinking Skills of Grade 4 Elementary School Students Through the Implementation of a Differentiated Problem-Based Learning Model in Social Studies Subjects. The study applied differentiated PBL to examine the effectiveness of differentiation towards learning outcomes. Learning styles represent the way students process, learn, and store information. Designing instructions by considering students' learning style has been evidenced to increase not only students' motivation and interest but also their academic achievement (Ishartono et al., 2021; Malvigie et al., 2023; Priya et al., 2020). Students learning style consist of three styles which are visual, auditory and kinesthetic or a combination of the styles as follows (Ishartono et al., 2021; Malvigie et al., 2023; Priya et al., 2020):

- a. Visual. Students with this learning style depend mostly on their vision in acquiring information during learning



- b. Auditory. Students with auditory learning style mainly have sensitive auditory and learn best by listening
- c. Kinesthetic. Students having kinesthetic learning style tend to learn best in instructional design involving movement, including touching or working on an object

The data was analyzed using descriptive statistic to count the number of students in specific learning styles. The reflective thinking skills data was analyzed based on the results from the Experiment Class 1 and Experiment Class 2. A normality test was used to examine the normal distribution of data from experiment class 1 and experiment class 2. This is a critical step to verify the assumptions underlying many parametric statistical procedures (Ghasemi & Zahediasl, 2012). The data normality test conducted in this research used descriptive statistics, namely skewness and kurtosis which is a valid and practical approach for assessing normality when the kurtosis value is between -2 and 2 and the skewness value is between -1 to 1, then the data distribution is considered normal (Colussi & Enami, 2019; Schuller et al., 2013).

The examination whether the second data group originates from a sample with the same variance, homogeneity test was conducted. Testing for homogeneity of variance is a fundamental assumption for the valid comparison of group means. The homogeneity test is done after the normality test and uses the Two-Sample F-Test for Variances as F-test is a statistical method designed to compare the variances of two independent samples (Bhattacharyya & Alisherov, 2009). The basis for making the homogeneity test decision is as follows: If the value significance > 0.05 then the data is homogeneous. If the value significance < 0.05 then the data is not homogeneous. This use of a (alpha) of 0.05 is the conventional threshold for failing to reject or rejecting the null hypothesis of equal variances (Venkatesan et al., 2016).

Hypothesis testing was conducted after the normality test and the homogeneity test. This research applied hypothesis testing using t-test and *N-Gain test*. The t-test was used to obtain the information on the level of influence of the differentiated PBL model to reflective thinking skills in Social Studies subject for Grade 4 which refers to parametric statistics that is independent sample t-test. The hypothesis with the t-test were as follows:

1. If significance (2-tailed) > 0.05 it leads to H_1 to be rejected and H_0 to be accepted so there is statistically no significant difference between the differentiated PBL model to support reflective thinking skills in Social Studies subject in Grade 4.
2. If significance (2-tailed) < 0.05 it would mean that H_1 is accepted and H_0 is rejected, thus there is significant difference of the differentiated PBL model to support reflective thinking skills in Social Studies subject in Grade 4.

N-Gain Test used to see improvement in reflective thinking skills in Social Studies students of grade 4 from individual and group tests. The *N-Gain value* can calculate using the following equation.

$$N-Gain = \frac{\text{Posttest-Pretest}}{\text{Ideal Score-Pretest}}$$

Category N-Gain score: If N-Gain < 0.30 then the category is low. If $0.3 \leq N-Gain \leq 0.70$ then category medium. If N-Gain > 0.70 then the category is high.

In addition to tests and questionnaires, this study also utilized observation data to assess the quality of learning implementation and the development of students' reflective thinking skills. Observations were conducted over three sessions: before the intervention, during the implementation of the differentiated PBL, and after the intervention. The observation instrument included indicators such as student engagement, variation in teaching strategies, and the application of reflective thinking skills. Observation data were analyzed descriptively to support the quantitative findings.

RESULTS AND DISCUSSION

The research was conducted at SD Hang Tuah 10 Juanda. The sample used in the study were 49 students from Experiment Class 1 with 23 students and Experiment Class 2 with 26 students. The following is results analysis of data:



A. Analysis on students' learning style

Following pie chart style image Study student Class 4A of Hang Tuah 10 Juanda Elementary School (Figure 1).



Figure 1. Learning Styles Student Experiment Class 1

The Figure 1 display distribution style Study student Experiment Class 1 SD Hang Tuah 10 Juanda. There is three group style dominant learning, namely: A total of 26% of students (6 students) have a **visual** learning style, which is more effective through observation and visualization, while 57% of students (13 students) prefer the **auditory** learning style, which is more effective through listening and verbal explanations, and 17% of students (4 students) have a **kinesthetic** learning style, which is more effective through physical activities and hands-on practice. This data show that majority student Experiment Class 1 has style Study auditory, so it is an effective learning strategy can focused on methods verbal explanation and discussion. While that, it is necessary adjustment of learning strategies for fulfil need student with style different learning. And teachers need to use method varied learning for ensure equality learning. Following pie chart style image Study student Experiment Class 2 of Hang Tuah 10 Juanda Elementary School.

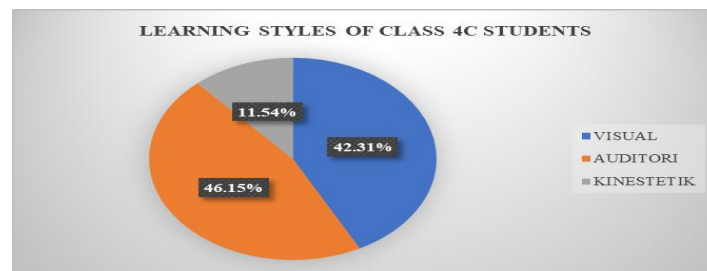


Figure 2. Learning Styles Student Experiment Class 2

The Figure 2 display distribution style Study student Experiment Class 2 at SD Hang Tuah 10 Juanda. There is three group style dominant learning , namely : A total of 42% of students (11 students) have a **visual** learning style, which is more effective through observation and visualization; 46% of students (12 students) prefer the **auditory** learning style, which is more effective through listening and verbal explanations; and 12% of students (3 students) have a **kinesthetic** learning style, which is more effective through physical activities and hands-on practice. In both experiment classes we concluded that most of the students in Experiment Class 1 has auditory learning style (57%), whereas Experiment Class 2 has a balanced auditory and visual learning style (46% and 42%). Students in both Experiment Class 1 and Experiment Class 2 have a relatively low percentage in kinesthetic learning style (17% and 12%). Therefore, the effective learning strategies in Experiment Class 1 is verbal and discussion methods, whereas Experiment Class 2 requires a varied approach. Consequently, teachers need to develop learning strategies based on auditory, visual and kinesthetic learning styles to support various learning styles.

B. Worksheet Analysis

The worksheet analysis include: (1) Clarity in the worksheet results, (2) Discussion activity, and (3) Quality of the presentation. These criteria comprehensively assessed students' ability . and assists teachers in developing effective and varied learning strategies Teachers can adapt the instructional design in teaching to increase students' motivation and achievement. The

following diagram shows the worksheet learning style of Experiment Class 1 and Experiment Class 2. Figure 3 presents students' learning style. In auditory learning style has similar percentage, both the same that is Experiment Class 1 with an average score of 89.86 while Experiment Class 2 with an average score of 89.93. In auditor learning style can seen that Experiment Class 2 more superior from IPS Experiment Class 1 with the average difference in value is 0.07. In visual learning style class the have an average that is almost The same that is Experiment Class 1 with an average score of 87.82 while Experiment Class 2 with an average score of 88.64. In auditor learning style can seen that Experiment Class 2 more superior from IPS Experiment Class 1 with difference average value 0.82. In kinesthetic learning style second class the have very different averages that is Experiment Class 1 with an average score of 91.67 while Experiment Class 2 with an average score of 88.89. In auditor learning style can seen that Experiment Class 1 more superior from IPSda Experiment Class 2 with the average difference in value is 2.78. In the data can seen that Experiment Class 1 more stand out in kinesthetic learning style, style Study This tend like learning that involves movement. While Experiment Class 2 tends to stand out in style auditory and visual learning styles Study.

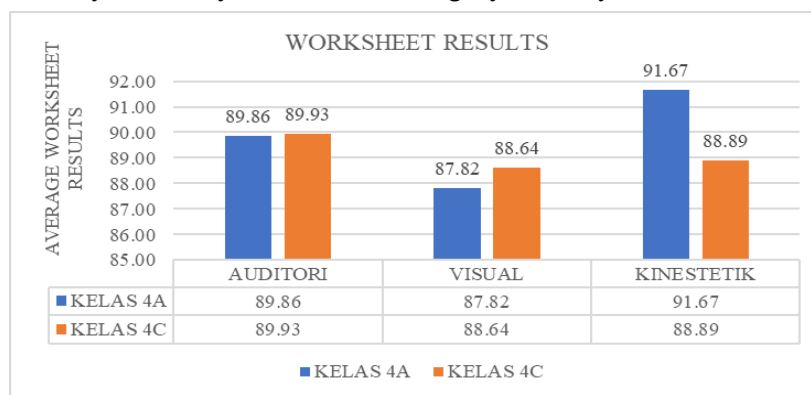


Figure 3. Learning Style

C. Normality Test & Homogeneity Test

The normality test conducted in the study showed normal distribution, which was evidenced in the significance of pretest and posttest from both Experiment Class1 and Experiment Class 2. The Skewness value ranged between -1 to 1 which are theoretically considered as normal and the Kurtosis value range was between -2 to 2. A homogeneity test was conducted in the study to ensure that the research data possessed equivalent variances across each group. The primary purpose of this test was to verify that the data met the assumption of homogeneity of variance required for subsequent statistical analysis. The results of the homogeneity test indicated that the research data demonstrated equal variances, as evidenced by a significance value of 0.15 (>0.05) for the pretest, while the posttest result was 0.02 (>0.05) in Levene's Test. Consequently, the research data can be processed using parametric statistical methods to obtain accurate and reliable results. Furthermore, these results also allow the researchers to compare outcomes between groups in an effective manner.

D. Hypothesis Test / T-Test

Hypothesis testing was carried out utilizing a t-test to determine whether a significant difference exists between the two groups of Experiment Class 1 and Experiment Class 2, and to test the validity of the research hypothesis. This test employed the t-statistic to measure the difference in the average results of the two experimental groups. The outcome of the t-test indicated whether a significant difference is present between the two groups. The hypothesis test chart is presented as Figure 4. Based on the statistical results presented in Figure 4, the analysis reveals significant findings. The independent samples t-test conducted on the pretest scores yielded a t-statistic of 2.07, which exceeds the critical t-value of 2.02. This, combined with a p-value of 0.00 ($p \leq 0.05$), leads to the rejection of the null hypothesis (H_0). This indicates that a statistically significant difference already existed between the pretest scores of Experiment Class 1 and Experiment Class 2 prior to the intervention. This initial disparity in baseline

knowledge necessitated the use of a differentiated PBL model to ensure a valid comparison of its effects.

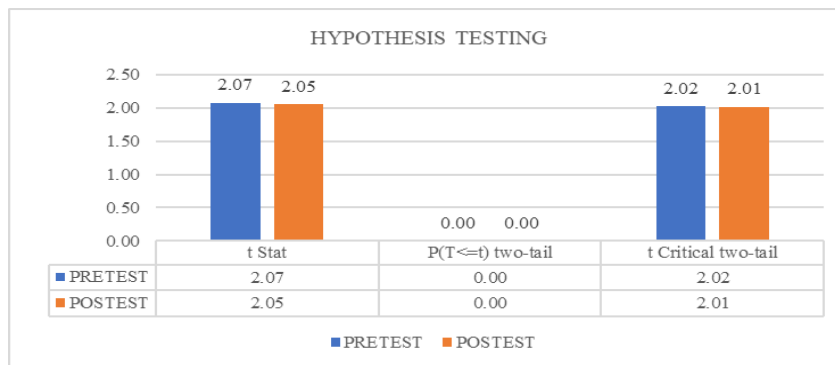


Figure 4. Hypothesis Testing

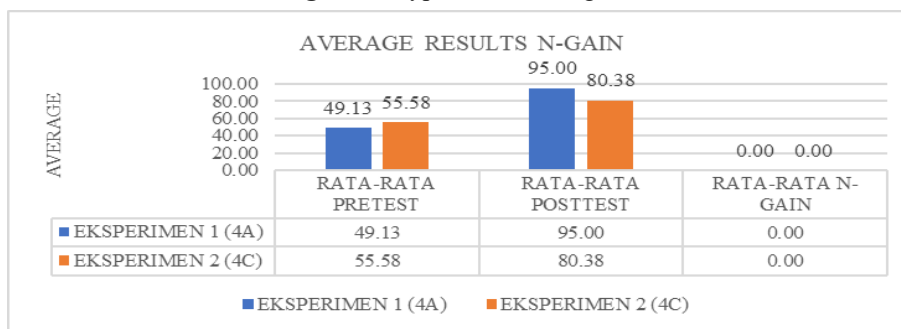


Figure 5. Average N-Gain Results

Following the intervention, the t-test on the posttest scores resulted in a t-statistic of 2.05, which is also greater than the critical t-value of 2.01, and a p-value of 0.00 ($p \leq 0.05$). Therefore, the null hypothesis is again rejected. This confirms that a statistically significant difference persisted between the two classes after the implementation of the differentiated PBL model. Crucially, this significant result on the posttest, when considered alongside the pretest difference, allows for the conclusion that the differentiated PBL model was effective in fostering learning gains within each class. The chart visually supports this, showing a $p < 0.01$ for both comparisons. The consistent rejection of the null hypothesis confirms that the implemented learning strategies had a significant influence on the outcomes. The substantial difference is further evidenced by the t-statistic values being considerably larger than their respective critical t-values. The pretest, administered before the intervention, measured students' initial knowledge. The average pretest scores of 49.13 (Experiment Class 1) and 55.58 (Experiment Class 2) indicate that students had not yet met the expected competency standards and required a deeper understanding of the material. After the learning intervention, the posttest was conducted to measure improvement. The results show a significant increase, with average scores rising to 95.00 in Experiment Class 1 and 80.38 in Experiment Class 2 (see Figure 5). This demonstrates that the applied learning strategies were highly effective in enhancing student understanding. The comparison is further quantified using normalized gain (N-Gain) scores, which were 0.91 in Experiment Class 1 and 0.55 in Experiment Class 2. This improvement confirms that the differentiated PBL model successfully increased student knowledge and comprehension. These findings serve as a valuable reference for improving future learning strategies, highlighting the importance of adapting pedagogical approaches to student needs. Teachers should continue to develop effective and varied learning strategies to enhance student outcomes.

E. Data analysis results questionnaire

A questionnaire is an effective research instrument for collecting primary data directly from respondents. In this study, the questionnaire was distributed to 49 respondents from two classes: 23 students from Class 4A (Experiment Class 1) and 26 students from Class 4C

(Experiment Class 2). This method successfully facilitated the collection of accurate and reliable data. The instrument consisted of five questions designed on a scale to measure students' reflective thinking. The results from this questionnaire were subsequently analyzed using descriptive statistics to identify prevailing trends and patterns in the respondents' levels of satisfaction. For this study, the researchers employed a reflective thinking scale questionnaire to understand the participants' responses. The research across both classes yielded indicator data on the reflective thinking attitude scale, with the respective acquisition details as follows (Figure 6).

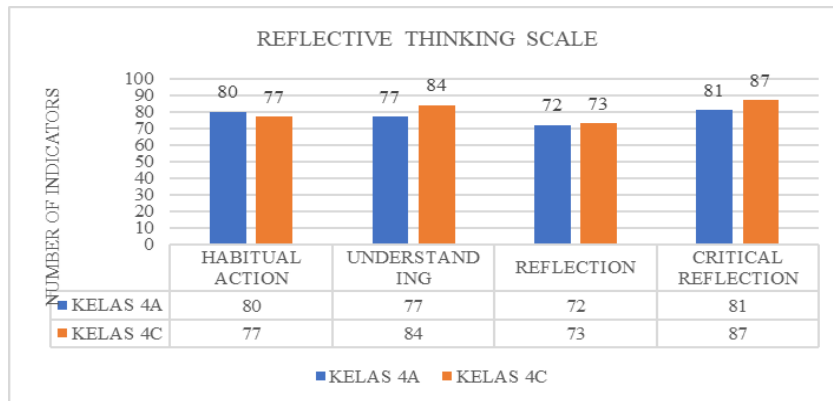


Figure 6. Thinking Scale Reflective Student

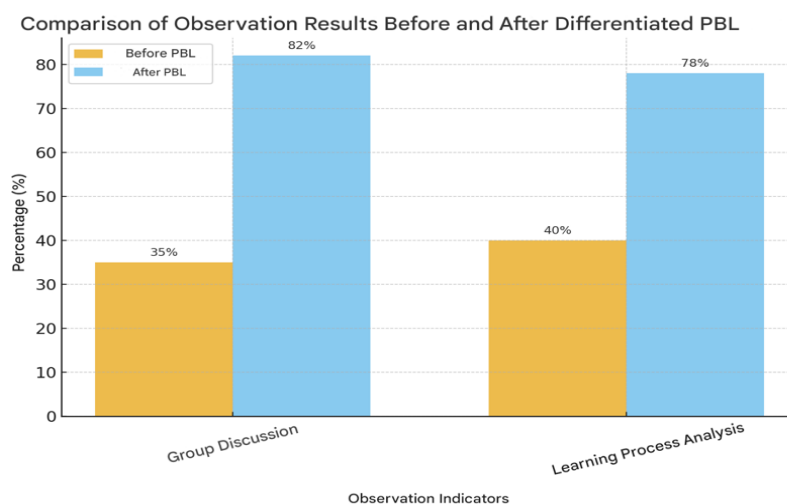


Figure 7. Observation Indicators

The observation results showed that before the intervention, only 35% of students actively participated in group discussions, and 40% demonstrated the ability to analyze the learning process (Figure 7). After the implementation of the differentiated PBL, student engagement increased to 82%, and reflective thinking skills rose to 78%. These findings support the results of the *t-test* and *N-Gain* analysis, which indicate a significant improvement in students' reflective thinking skills.

Observation results show that the teacher uses method varied learning, such as discussion groups, presentations, and activities practical. However, it is still lack of differentiation in teaching, so that several students have trouble understand material. In addition, research it also observes ability think reflective students. Observation results show that part big student Not yet capable practice think reflective with good. They Not yet Can analyze and evaluate the learning process in a way effective. Teachers need to give guidance and support for increase ability think reflective students. For increase quality learning, necessary done repair in several aspects. First, teachers need to increase differentiation in teaching For fulfil need diverse students. Second, it is necessary developed strategies for increase ability think reflective

students, such as give task reflective and discussion group. With Thus, learning can become more effective and meaningful for student (Rosmiati et al., 2024).

In the research this has do analysis conducted at SD Hang Tuah 10 Juanda through observation data, tests and questionnaires. In addition to the results research, research this implemented with objective for can analyze response think reflective student grade 4 elementary school understand draft change form energy through application of the differentiated PBL model (Dardanili et al., 2025; Dinata et al., 2025; Nikmah & Cintamulya, 2017; Sari et al., 2020). As well as for analyze influence application of differentiated PBL model to ability think reflective students and describe response think reflective student grade 4 elementary school understand draft change form energy after application of the differentiated PBL model. In the discussion study This based on the formulation the problem that has been created, namely "whether application of differentiated PBL model can increase ability think reflective students?" and "how response think reflective student grade 4 elementary school understand draft change form energy through implementation of the differentiated PBL model?". Each answer from formulation problem the will explained based on results research that has been obtained researcher (Nikmah & Cintamulya, 2017; Sari & Juniarso, 2025).

This study employed observational methods to evaluate classroom learning practices prior to the implementation of a differentiated PBL model, drawing on established pedagogical frameworks (Dinata et al., 2020; Fajrina et al., 2020; Moscoso et al., 2022; Sistermans, 2020). The observation was conducted in grade 4 classes at SD Hang Tuah 10 Juanda during social studies lessons. The results indicated that although the teacher implemented varied methods in the teaching and learning process including group discussions, presentations, and practical activities, the instruction lacked differentiated elements. Consequently, some students were found facing difficulties in understanding the material learned. Furthermore, the observation that focused on assessing students' reflective thinking skills, revealed that a significant proportion of the grade 4 students were not yet capable of applying reflective thinking effectively. Students struggled to analyze and evaluate the learning process, indicating a need for targeted guidance and support to develop these higher-order skills. This research was conducted at SD Hang Tuah 10 Juanda, utilizing a mixed-methods approach through the collection of observational data, tests, and questionnaires. The discussion is structured around the following research questions, formulated to guide the inquiry: "Can the application of a differentiated PBL model increase the reflective thinking skills of grade 4 students?". "What are the reflective thinking responses of grade 4 students to the Social Studies after the implementation of the differentiated PBL model?". Each research question will be answered based on the empirical data obtained during the study, with reference to relevant literature. The observation data revealed an increase in student participation and reflective thinking skills following the implementation of the differentiated PBL. These findings are consistent with the *t-test* and *N-Gain* results, which showed a significant enhancement in students' reflective thinking abilities, thereby providing triangulation evidence that strengthens the study's conclusions.

Implementation of the differentiated PBL model has been confirmed to increase reflective thinking skills of grade 4 students in learning Social Studies subject. Students achieved improvement in reflective thinking skills and the results were evidenced on the results from pretest to posttest in both Experiment Class 1 and Experiment Class 2. The worksheet was assigned after the assessment of students' learning style and prior to the lesson therefore the worksheet assigned has applied the suitable differentiated learning style of the students. Pretest and posttest data was taken from both classes with normality test, homogeneity test, hypothesis test (T test) and N-Gain test (Fajrina et al., 2020; Mutlu, 2020; Zulyadaini, 2017). The study examined the assumption of normality for both pretest and posttest data. All skewness (ranging from -0.60 to 0.95) and kurtosis values (ranging from -1.14 to 1.42) fell within the accepted thresholds of approximately ± 1 and ± 2 , respectively. This indicates that the data for both experimental classes adhered to a normal distribution, justifying the use of parametric statistical tests and suggesting the sample was not biased by extreme outliers. A test for homogeneity of variances (Levene's Test) was also conducted. The pretest results showed no significant

difference in variances between the two classes ($*p* = .15$), confirming their equivalent starting points prior to the intervention. However, the posttest results indicated a violation of this assumption ($*p* = .01$), signifying that the intervention had a differential impact on the score distributions within each class. However, despite the heterogeneous posttest variances, a paired samples t-test was employed to evaluate the intervention's effect within each experiment class. The results demonstrated a statistically significant increase in reflective thinking scores from pretest to posttest for both Experimental Class 1 ($*t* = 2.07$, $*p* < .05$) and Experimental Class 2 ($*t* = 2.05$, $*p* < .05$). The null hypothesis was therefore rejected.

The analysis confirms that the differentiated PBL model significantly improved reflective thinking skills within both grade 4 classes. The violation of homogeneity after the intervention did not negate this finding but rather reflected the reality that the treatment effect manifested differently across the groups. This model presents a valid and effective pedagogical strategy for enhancing higher-order cognitive skills in elementary education, particularly in the reflective thinking skills. Empirical studies have been supporting differentiated as an essential pedagogical approach for addressing diverse learner needs. Studies by [Moscoso et al. \(2022\)](#), [Tsingos-Lucas et al. \(2017\)](#), and [Xu et al. \(2024\)](#) emphasize the role of differentiated learning in enabling teachers to tailor and modify instruction to students' abilities, interests, and learning styles. [Thurrodliyah et al. \(2023\)](#) further note that this method guides students to engage with materials in ways best suited with their individual capacities. Further, [Rosmiati et al. \(2020\)](#) affirm that differentiated learning is critical in modern education, moving beyond the outdated "one-size-fits-all" model. By adopting differentiated strategies, teachers are able to create inclusive and responsive teaching and learning that accommodate varied learning profiles. [Rosmiati et al. \(2024\)](#) highlight that this model helps students reach their full potential, boosts motivation, and reduces learning gaps.

Empirical evidence from this study reinforces the efficacy of a differentiated PBL model. N-Gain results show significant improvement in comprehension: pretest averages rose from 49.13 and 55.58 to posttest scores of 95.00 and 80.38 in Experiment Classes 1 and 2, respectively. The N-Gain values of 0.91 (high) and 0.55 (moderate) confirm the strategy's effectiveness. These findings underscore the importance of aligning instruction with student needs. Homogeneity testing and t-tests validated the statistical robustness of the results, and notable improvements in critical thinking were observed post-intervention ([Nugraha, 2018](#)). Educators should therefore continue developing varied, effective strategies to enhance student achievement. This study offers a valuable reference for instructional planning ([Arianto & Hanif, 2024](#); [Khuana et al., 2017](#)), particularly in diverse classrooms where educational equity is a priority. The observation data revealed an increase in student participation and reflective thinking skills following the implementation of the differentiated PBL. These findings are consistent with the *t-test* and *N-Gain* results, which showed a significant enhancement in students' reflective thinking abilities, thereby providing triangulation evidence that strengthens the study's conclusions.

Questionnaire on reflective thinking skills was collected from 49 respondents consisted of 23 students from Experiment Class 1 and 26 from Experiment Class 2. The results showed significant difference between Experiment Class 1 and 2. On the habitual action indicator, Experiment Class 1 (80) showed higher results than Experiment Class 2 (71). However, the Experiment Class 2 has higher Understanding of 84 compared to the other class achieving 77. On the Reflection indicator, both Experiment Class 1 and 2 showed similar results of 72 and 73 respectively. Experiment Class 2 showed higher results in Critical Reflection of 87 compared to Experiment Class 1 (81) ([Rosmiati et al., 2020](#)). To summarize, Experiment Class 2 achieved higher results in understanding and reflective thinking skills, whereas Experiment Class 1 was higher in the habitual aspect. Students with reflective thinking skills tend to require a longer period to formulate responses and to reflect upon the accuracy of their answers. These students are characteristically meticulous and deliberate in responding, which often produce better results. Students having reflective thinking skills typically exhibit a preference for tasks that involve recalling structured information, reading for deep

comprehension, interpreting complex texts, and engaging in methodical problem-solving and decision-making processes. Furthermore, these students often demonstrate a greater capacity for independent learning, showing an enhanced ability to individually define learning objectives and to maintain focus on information relevant to the task. This findings align with previous study which evidenced that students reflective thinking skills have high learning standard (Anggraini, 2024). This findings of this empirical study can be used as reference for improvement instructional strategies in the future. It evidenced the importance to equip students with reflective thinking skills so to prepare them in future professional and personal life. The lack of reflection has the potential to reduce the learning process (Rosmiati et al., 2020^a) due to the ability to think reflectively is a strong foundation in solving various problems. additionally, reflective thinking skills enable students to generate ideas leading to scientific discovery (Rosmiati et al., 2020^b). This study showed the effectiveness of differentiated PBL in increasing reflective thinking skills of the grade 4 student in understanding the change of energy form. Research results show improvement significant in ability think reflective students, marked with ability analyze, evaluate and create solution. Therefore that, the PBL model is differentiated can made into alternative learning strategies for increase quality learning.

CONCLUSIONS AND SUGGESTIONS

Based on the empirical data obtained in this study, the following conclusions can be drawn regarding the reflective thinking skills of Grade 4 students following the implementation of a Differentiated PBL model in Social Studies subject: This experimental study, conducted during social studies subject for Grade 4 students at SD Hang Tuah 10 Juanda, evidenced that the Differentiated PBL model demonstrated a significant positive influence on students' reflective thinking skills. The pretest results set a low baseline for reflective thinking skills, a finding through initial observations which indicated that conventional teaching methods were insufficient for developing these skills. The posttest results, however, revealed a statistically significant improvement, confirming the model's efficacy. Students responded well to the Differentiated PBL model's application in the study. Significant increases in student motivation, attentiveness, and engagement foster conceptual mastery of the Social Studies content. The results of the questionnaire indicated that students were more at ease, engaged, and inspired in a classroom setting that placed an emphasis on peer cooperation and direct engagement with the material. Importantly, the approach effectively promoted the growth of critical thinking, issue appraisal, and critical analysis—all crucial metacognitive abilities. Students improved their ability to evaluate other viewpoints and to express their thoughts clearly during group conversations. The data clearly shows that the Differentiated PBL paradigm is beneficial for developing the qualitative, higher-order cognitive abilities required for sustained academic achievement in addition to increasing quantitative learning results.

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