

Problem Based Learning and Fifth Grade Students Mathematical Critical Thinking Ability

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Article Info	Abstract
Article history: Received: Revised: Accepted: Available online: Keywords: Problem Based Learning; Critical Thinking; Mathematics Education; Elementary School; Pre-Experimental Study	<i>This study examined changes in fifth-grade students mathematical critical thinking after problem-based learning. A quantitative pre-experimental one-group pretest-test design involved 28 students at SDN 2 Jembatan Kembar Timur, West Lombok. Students completed a ten-item test before and after a mathematics lesson organized around problem identification, investigation, collaborative solution development, presentation, and evaluation. The mean score increased from 46.79 (SD = 9.05) to 72.86 (SD = 11.50), producing a mean gain of 26.07 points. A paired-samples t test showed a significant difference, $t(27) = 10.49$, $p < .001$, with a 95% confidence interval for the gain of 20.97 to 31.17. The standardized paired effect was large ($d_z = 1.98$). A Wilcoxon signed-rank sensitivity analysis also indicated improvement ($W = 0$, $p < .001$). The results suggest that problem-based learning can support mathematical critical thinking when students actively analyze contextual problems and justify solutions. Because the study lacked a comparison group and used one school, causal interpretation remains limited.</i>
Kata kunci: Problem-Based Learning; Berpikir Kritis; Pendidikan Matematika; Sekolah Dasar; Pra-Eksperimen	Abstrak Penelitian ini menguji perubahan kemampuan berpikir kritis matematika siswa kelas V setelah penerapan problem based learning. Desain kuantitatif pra-eksperimen one-group pretest-posttest melibatkan 28 siswa SDN 2 Jembatan Kembar Timur, Lombok Barat. Siswa mengerjakan tes sepuluh butir sebelum dan sesudah pembelajaran matematika yang mencakup identifikasi masalah, penyelidikan, penyusunan solusi kolaboratif, presentasi, dan evaluasi. Nilai rata-rata meningkat dari 46,79 (SD = 9,05) menjadi 72,86 (SD = 11,50), dengan kenaikan rata-rata 26,07 poin. Uji t berpasangan menunjukkan perbedaan signifikan, $t(27) = 10,49$, $p < 0,001$, dengan interval kepercayaan 95% sebesar 20,97 sampai 31,17. Efek berpasangan tergolong besar ($d_z = 1,98$). Analisis sensitivitas Wilcoxon juga menunjukkan peningkatan ($W = 0$; $p < 0,001$). Hasil mendukung penggunaan pembelajaran berbasis masalah untuk melatih analisis dan penalaran matematika. Namun, ketiadaan kelompok pembandingan dan cakupan satu sekolah membatasi kesimpulan kausal.

INTRODUCTION

Mathematics education in elementary school is expected to develop more than computational accuracy. Students need to interpret information, recognize relationships, formulate strategies, evaluate procedures, and communicate reasons for an answer. These abilities are closely connected to critical thinking

because mathematical problems frequently require students to decide which information is relevant and whether a proposed solution is reasonable.

Critical thinking is especially important when learners encounter unfamiliar or contextual problems. A student may remember a formula but remain unable to explain why it applies, compare alternative procedures, or detect an error. Such limitations become visible when tasks depart from examples previously demonstrated by the teacher. Classroom instruction therefore needs to provide repeated opportunities for students to investigate, question, justify, and revise their thinking.

International assessments have repeatedly emphasized reasoning and problem solving as central dimensions of mathematical literacy (OECD, 2019). These demands are consistent with Indonesian curriculum expectations that students connect concepts with real situations and communicate mathematical ideas. At the classroom level, however, instruction may still be dominated by explanation, examples, and routine exercises. This pattern can make students dependent on procedures supplied by the teacher.

Preliminary information from SDN 2 Jembatan Kembar Timur indicated that some fifth-grade students found mathematics difficult and showed limited participation during conventional lessons. Several students could perform familiar calculations but experienced difficulty interpreting problems, identifying known and unknown information, and drawing logical conclusions. The situation suggested a need for a learning model that made problems the starting point of instruction rather than an activity added after explanation.

Problem based learning is an instructional model in which students learn through engagement with meaningful problems. The teacher presents a problem, organizes inquiry, supports investigation, facilitates the development and presentation of solutions, and guides reflection. Students are expected to activate prior knowledge, identify what they need to know, seek relevant information, test ideas, and explain conclusions (Nata, 2013; Syamsidah & Suryani, 2018).

The model is theoretically relevant to critical thinking because it places students in situations that require interpretation, analysis, inference, explanation, and self-regulation. Discussion exposes students to different strategies and obliges them to defend their reasoning. Teacher questions can move attention from merely obtaining an answer to examining assumptions, representations, evidence, and the efficiency of a procedure.

Previous studies have reported positive relationships between problem based learning and critical thinking, conceptual understanding, problem solving, and mathematics achievement (Farisi et al., 2017). Nevertheless, effects are not automatic. Students may divide tasks without meaningful interaction, rely on one high-achieving peer, or focus on finishing a worksheet. Outcomes depend on problem quality, teacher scaffolding, classroom norms, assessment, and students experience with collaborative inquiry.

This study investigated whether fifth-grade students mathematical critical thinking scores changed after problem-based learning at SDN 2 Jembatan Kembar Timur. It used a one-group pretest-post test design with 28 students. The study contributes evidence from an elementary mathematics classroom while

recognizing that improvement in a single group cannot by itself establish that the learning model was the sole cause

Problem Based Learning in Elementary Mathematics

Problem-based learning begins with a complex but accessible problem that cannot be solved by copying a single example. The problem should connect with the learning objective, contain sufficient information for investigation, and invite more than one representation or path. In elementary mathematics, contextual situations involving measurement, geometry, money, distance, data, or volume can serve this function when their language and numerical demands are appropriate for students.

A common sequence includes orienting students to the problem, organizing learning, guiding individual or group inquiry, developing and presenting work, and analyzing the process. These phases are iterative rather than strictly linear. Students may return to the problem statement after discovering missing information, revise a representation after discussion, or test a second strategy before deciding which explanation is strongest (Sani, 2014; Trianto, 2013).

The teacher's role changes from primary source of procedures to designer and facilitator of inquiry. This does not mean withdrawing guidance. Elementary students often need prompts that clarify a term, focus attention on quantities, connect diagrams with symbols, or encourage verification. Productive scaffolding supports the next step without removing the intellectual work from students.

Collaboration is valuable when it makes reasoning public. Students can compare interpretations, question calculations, and combine partial insights. To avoid passive participation, the teacher can assign rotating roles such as reader, recorder, checker, and presenter; ask every member to prepare an explanation; and use individual follow-up questions. These structures help ensure that group work becomes a setting for thinking rather than task division.

Reflection completes the learning cycle. Students should examine what information was useful, why a strategy worked, where errors occurred, and how the solution relates to the underlying concept. Reflection enables knowledge developed in one context to become more transferable. It also helps students monitor their own understanding, which is an important element of critical thinking.

Mathematical Critical Thinking

Critical thinking involves purposeful and self-regulated judgment. Facione (2013) describes core processes that include interpretation, analysis, evaluation, inference, explanation, and self-regulation. In mathematics, these processes appear when students translate a situation into mathematical form, identify relationships, choose and assess a strategy, infer a conclusion, and communicate the logic that connects evidence with the answer.

Interpretation requires understanding the meaning of words, diagrams, symbols, and quantities. Analysis involves identifying relevant information and relationships. Evaluation includes checking whether a claim, procedure, or result is supported. Inference allows students to derive consequences or predict results.

Explanation requires communicating steps and reasons, while self-regulation involves reviewing one's own work and correcting mistakes.

Critical thinking should not be confused with task difficulty alone. A long calculation may be demanding but require little judgment if the procedure is fully specified. Conversely, a problem with simple numbers can require strong reasoning when students must decide what is known, choose a representation, compare approaches, or justify why an answer is plausible. Assessment therefore needs items that reveal reasoning rather than only final numerical responses.

For fifth-grade learners, observable indicators include stating the problem in their own words, distinguishing known and unknown information, constructing a diagram or model, proposing a strategy, performing calculations accurately, checking the result, and drawing a conclusion linked to the context. Written tests can capture some indicators, but classroom observation and student explanations provide additional evidence about the process.

Problem based learning may strengthen these indicators by creating repeated cycles of uncertainty and resolution. A meaningful problem motivates students to search for structure. Group interaction makes assumptions visible, and presentation requires students to organize an explanation. Feedback and reflection encourage evaluation and correction. The expected result is not only a higher score but a more deliberate approach to mathematical situations.

RESEARCH METHODS

The study applied a quantitative pre-experimental method with a one-group pretest-post test design. One intact fifth-grade class completed an assessment before the intervention, participated in problem-based learning, and completed a post test. The design can identify change over time within the group, but it does not control maturation, testing effects, concurrent events, or ordinary instruction. Accordingly, the findings are described as an improvement associated with the intervention rather than definitive causal proof.

The research was conducted at SDN 2 Jembatan Kembar Timur, Gerung District, West Lombok Regency, West Nusa Tenggara, from 27 to 29 May 2024. The population consisted of the students in the selected fifth-grade class. Because the population was fewer than 100 students, total sampling was used, resulting in 28 participants.

The independent variable was problem-based learning, and the outcome was mathematical critical thinking. The lesson addressed fifth-grade mathematics through contextual problem solving. The classroom teacher observed implementation. The intervention included problem orientation, organization of students, inquiry, solution development, presentation, and reflection.

The source study initially tested 15 items with 20 students at SDN 3 Beleka. Ten items exceeded the reported product-moment correlation criterion of $r = .444$ and were retained, while five items were excluded. The final pretest and posttest therefore consisted of ten items. The source also reported a split-half procedure; however, its stated reliability coefficient and interpretation were inconsistent. The present article reports on the available validity process but treats reliability as a limitation that requires stronger documentation in future studies.

Data collection combined tests, teacher observation, and documentation. The test measured student's ability to understand problems, use mathematical ideas, select procedures, and reach conclusions. The observation instrument contained five areas: lesson preparation, apperception, implementation of problem based learning, response to students, and lesson closure. The teacher implementation score was 14 and was categorized as good in the source study.

Descriptive analysis included the mean, standard deviation, minimum, maximum, median, and score frequencies. A paired-samples t test compared pretest and posttest scores. The original output reported a mean difference of 26.071, SD of the difference of 13.149, $t = 10.492$, $df = 27$, and $p < .001$. Because the score distributions and gain scores were not normally distributed in recalculation, a Wilcoxon signed-rank test was added as a sensitivity analysis using the reported individual scores. Effect size was expressed as paired Cohen d_z , calculated by dividing the mean gain by the standard deviation of gain scores

Research Design and Learning Procedure

Table 1

One Group Pretest Posttest Procedure

Stage	Student Activity	Teacher Support	Evidence
Pretest	Completed ten mathematics items individually.	Explained directions and maintained consistent conditions.	Baseline critical thinking score.
Problem orientation	Read and restated a contextual mathematics problem.	Connected the problem with prior knowledge and clarified the objective.	Problem interpretation and initial questions.
Investigation	Identified information, selected representations, and tested strategies in groups.	Used prompts without directly supplying the solution.	Notes, calculations, diagrams, and group discussion.
Presentation	Presented a solution and responded to questions.	Compared strategies and highlighted mathematical relationships.	Reasoned explanation and peer feedback.
Reflection	Checked results and summarized the concept.	Guided evaluation of errors and alternative procedures.	Revised conclusions and lesson summary.
Posttest	Completed the final assessment individually.	Administered the test under comparable conditions.	Post-intervention critical thinking score.

RESULT AND DISCUSSION

Instrument and Implementation Evidence

The item trial involved 15 questions. Ten were reported as valid according to the criterion r calculated greater than r table (.444), and five were excluded. Item 6 had the strongest reported correlation (.830), while other retained items included coefficients of .449, .594, .765, .669, .484, .652, .732, .594, and .483. This process reduced the final assessment to ten items.

Observation of the lesson produced a total implementation score of 14, categorized as good. Preparation and readiness received the highest score of four. Implementation of the problem-based learning phases and lesson closure received scores of three, while apperception and responses to students received scores of two. The observation indicates that the central model was implemented, although teacher questioning and responses remained areas for improvement.

Table 2

Summary of Instrument Screening and Lesson Observation

Component	Available Evidence	Result	Interpretation
Item trial	15 questions tested with 20 students; r table = .444.	10 items retained; 5 excluded.	Final assessment used the items meeting the reported criterion.
Split-half reliability	Odd-even calculation reported in the thesis.	Coefficient and written interpretation were inconsistent.	Reliability requires re-estimation before broader use.
Preparation	Observation score.	4	Strong readiness for the lesson.
Apperception	Observation score.	2	Opening connection could be strengthened.
PBL implementation	Observation score.	3	Core phases were implemented.
Response to students	Observation score.	2	More probing and feedback were needed.
Lesson closure	Observation score.	3	The lesson ended with an adequate summary.
Total implementation	Five observation components.	14, good category	Treatment was delivered with generally good fidelity.

Pretest and Posttest Performance

The 28 students had a pretest mean of 46.79 ($SD = 9.05$), a median of 45, and scores ranging from 30 to 70. The posttest mean was 72.86 ($SD = 11.50$), the median was 75, and scores ranged from 50 to 90. The mean gain was 26.07 points ($SD = 13.15$), with gains ranging from 0 to 50. Twenty-seven students improved and one student had the same score on both occasions.

Table 3

Descriptive Statistics for Pretest Posttest and Gain Scores

Measure	N	Minimum	Maximum	Median	Mean	SD
Pretest	28	30	70	45.00	46.79	9.05
Posttest	28	50	90	75.00	72.86	11.50
Gain	28	0	50	30.00	26.07	13.15

The distribution shifted upward substantially. Thirteen students scored 40 on the pretest and nine scored 50, whereas eleven students scored 80 on the posttest. The lowest posttest score of 50 was 20 points above the lowest pretest score. Three students reached 90. The concentration of posttest scores at 70 and 80 indicates that improvement occurred across much of the class rather than only among a few high-performing students

Table 4

Frequency Distribution of Student Scores

Score	Pretest Frequency	Posttest Frequency
30	1	0
40	13	0
50	9	3
60	4	3
70	1	8
80	0	11
90	0	3

Paired Comparison and Sensitivity Analysis

The paired-samples analysis found an average increase of 26.071 points. The 95% confidence interval ranged from 20.973 to 31.170, and the paired *t* statistic was 10.492 with 27 degrees of freedom. The probability was below .001. The paired standardized effect size was $d_z = 1.98$, indicating a large change relative to the variability of individual gain scores.

The source thesis presented a Kolmogorov-Smirnov significance value of .000 while describing the data as normal. Under the conventional criterion, *p* below .05 indicates departure from normality, not normality. Recalculation from the reported scores also indicated non-normal pretest, posttest, and gain distributions. Therefore, the paired *t* result was checked with a Wilcoxon signed-rank test. The nonparametric test produced $W = 0$ and $p < .001$, leading to the same conclusion that posttest scores were higher.

The original homogeneity output reported Levene significance of .251. Homogeneity is generally relevant when comparing independent groups, whereas a one-group paired analysis focuses on the distribution of within-student differences. The sensitivity analysis is therefore more informative for addressing the non-normal gain distribution in this design.

Table 5
Summary of Statistical Results

Analysis	Statistic	p Value	Interpretation
Mean paired gain	26.071 points	-	Average posttest improvement.
95% confidence interval	20.973 to 31.170	-	Plausible range for the mean gain.
Paired samples t test	$t(27) = 10.492$	$< .001$	Posttest scores were significantly higher.
Paired effect size	Cohen $d_z = 1.98$	-	Large standardized within-group change.
Wilcoxon sensitivity test	$W = 0$	$< .001$	Nonparametric analysis confirmed improvement.
Teacher observation	14 points	-	Implementation categorized as good.

DISCUSSION

The results show a substantial increase in mathematical critical thinking scores after problem-based learning. The class mean rose by 26.07 points, 27 of 28 students improved, and both parametric and nonparametric tests indicated that the change was unlikely to be explained by random score fluctuation alone. The large, paired effect describes the magnitude of change within this group.

Problem orientation may have contributed by giving students a reason to use mathematical concepts. Instead of beginning with a formula, students first encountered a situation that required interpretation. They had to determine what the problem asked, identify relevant quantities, and consider how those quantities were related. These activities correspond with interpretation and analysis, two central components of critical thinking.

The investigation phase encouraged students to externalize their reasoning through calculations, diagrams, verbal explanations, and group discussion. Representations can reduce abstraction by showing relationships among quantities. When students compared strategies, they also encountered the possibility that an initial approach could be incomplete or inefficient. This creates an authentic need for evaluation rather than a teacher-imposed instruction to check work.

Presentation and questioning further strengthened explanation. A solution that is understandable to its author may not be clear to classmates. Preparing to present requires students to organize steps, use mathematical language, and connect the conclusion with the problem. Questions from peers or the teacher can reveal unsupported assumptions and prompt revision. Such exchanges make reasoning an object of classroom attention.

The findings are consistent with research that links problem-based learning with improved critical thinking and learning outcomes (Farisi et al., 2017). They also accord with the theoretical description of PBL as an approach that combines authentic problems, collaborative inquiry, and reflective evaluation (Syamsidah & Suryani, 2018). The present study extends this pattern to fifth-grade mathematics in a West Lombok elementary school.

However, the observed improvement cannot be attributed exclusively to the model. Students completed the same general type of assessment twice, received mathematics instruction during the study, and may have benefited from familiarity with the test. Without a comparison group, the design cannot separate

the contribution of PBL from practice effects, maturation, teacher attention, or other events. The statistically significant change is therefore evidence of improvement during the intervention period, not definitive proof of unique causation.

The score distribution provides additional perspective. Students began with a narrow concentration at 40 and 50. After instruction, most scores clustered at 70 and 80. This pattern suggests broad class movement, but three students remained at 50 and three at 60. These learners may need more explicit scaffolding in reading problems, selecting representations, or monitoring calculations. PBL should be differentiated so that productive struggle does not become unstructured confusion.

Teacher observation supports the plausibility of the learning process. Preparation received a strong score, and the central PBL phase was implemented. Lower scores for apperception and teacher response suggest that the lesson could have made stronger connections with prior knowledge and provided more responsive questioning. These components are important because students need both cognitive challenge and timely support.

The validity screening reduced the assessment from 15 to ten items, but reliability reporting was inconsistent. A measure with uncertain reliability can either conceal or exaggerate change. Future use should include a clear test blueprint, item wording, scoring rubric, item difficulty, discrimination, and a correctly calculated internal consistency coefficient. Open-ended items should be scored by more than one rater when possible.

Despite these limitations, the study offers a practical signal for classroom improvement. The combination of contextual problems, group inquiry, explanation, and reflection corresponds with the abilities that mathematics education intends to develop. The result encourages teachers to move beyond routine exercises while maintaining structured guidance and individual accountability.

Instructional Implications

Effective implementation begins with problem design. Problems should be understandable without being trivial, closely aligned with the target concept, and open enough to require decisions. Unnecessary language should be minimized for elementary students, while diagrams, objects, or tables can be added when they represent the context rather than reveal the procedure.

A short problem-analysis routine can help students begin. They may write what is known, what is asked, possible representations, an initial strategy, and a reason for choosing it. This routine transforms a vague instruction to think critically into observable actions. Over time, prompts can be reduced as students internalize the process.

Teacher questioning should target reasoning. Useful questions include What information supports your plan, is there another representation, How can you verify the result, What assumption are you making, and Why is this answer reasonable in the context. Questions that merely ask whether students understand often provide little diagnostic information.

Group work requires individual accountability. Every student can complete an initial attempt before discussion, record the agreed strategy in personal notes, and answer a random follow-up question. Roles may rotate so that the same student does not always calculate or present. The teacher should observe participation as well as the final group product.

Assessment should reward reasoning. Rubric can allocate points for interpreting the problem, selecting a relevant strategy, carrying out procedures, checking the answer, and explaining the conclusion. This prevents students from receiving full credit for an unsupported answer and recognizes partial conceptual progress even when arithmetic errors occur.

For students who need additional support, the teacher can provide partially complete diagrams, vocabulary cards, worked examples of problem representation, or smaller numerical values. Extension tasks can ask advanced students to develop another strategy, generalize a pattern, or modify the conditions of the problem. Differentiation preserves a common reasoning goal while varying support and complexity.

Limitations and Future Research

The primary limitation is the one-group design. A future quasi-experiment should include a comparison class with similar baseline ability, the same instructional duration, and the same assessment schedule. Random assignment at the class level would provide stronger evidence when feasible. A delayed posttest would show whether the improvement persists.

The sample contained only 28 students from one school, limiting statistical precision and transferability. Replication across urban and rural schools, different achievement levels, and multiple teachers would clarify whether results depend on context. Multilevel analysis may be appropriate when several classes or schools participate.

Future studies should document the intervention in sufficient detail for replication. Important information includes problem texts, lesson duration, grouping procedures, teacher prompts, student work, and fidelity observations. Video or structured field notes can help identify which PBL phases are enacted strongly, and which are abbreviated.

Measurement also requires improvement. Researchers should validate items against explicit critical-thinking indicators, estimate reliability correctly, and report scoring procedures. Combining tests with interviews, think-aloud protocols, or analysis of written work would reveal how students interpret problems and revise strategies. These process data can explain why scores change.

Comparative research could examine variations such as individual versus collaborative PBL, contextual versus abstract problems, physical manipulatives versus digital representations, and different levels of teacher scaffolding. Such studies would move evidence beyond whether PBL works toward understanding how, for whom, and under what conditions it supports mathematical critical thinking.

CONCLUSION

Fifth-grade students at SDN 2 Jembatan Kembar Timur showed substantial improvement in mathematical critical thinking scores after problem based learning. The mean increased from 46.79 to 72.86, with an average gain of 26.07 points. The paired t test, $t(27) = 10.49$, $p < .001$, and the Wilcoxon sensitivity analysis, $W = 0$, $p < .001$, both supported a difference between pretest and posttest performance. The paired standardized effects were large.

The improvement is educationally consistent with a learning process that requires students to interpret contextual problems, investigate possible strategies, discuss evidence, present solutions, and reflect on results. Teachers can use these phases to make mathematical reasoning visible and assessable. Because the study used one group, one school, a short intervention, and an instrument with incomplete reliability documentation, the results should be interpreted as promising classroom evidence rather than conclusive causal proof. Stronger comparison designs and measurement procedures are needed for confirmation

REFERENCE

- Arikunto, S. (2016). Penelitian tindakan kelas. Aditya Media.
- Akhiruddin, Sujarwo, Atmowardoyo, H., & Nurhikmah. (2019). Belajar dan pembelajaran. CV Cahaya Bintang Cemerlang.
- Arikunto, S. (2019). Prosedur penelitian suatu pendekatan praktik. Rineka Cipta.
- Facione, P. A. (2013). Critical thinking What it is and why it counts. Insight Assessment.
- Farisi, A., Hamid, A., & Melvina. (2017). Pengaruh model pembelajaran problem-based learning terhadap kemampuan berpikir kritis dalam meningkatkan hasil belajar siswa pada suhu dan kalor. Jurnal Ilmiah Mahasiswa, 2(3).
- Fauzi, L. M., Fahrurrozi, Gazali, M., Hayati, N., & Wirentake. (2022). Pembelajaran matematika sekolah integrasi etnomatematika dan higher order thinking skill. Universitas Hamzanwadi Press.
- Hamzah, A., & Muhlizarini. (2014). Perencanaan dan strategi pembelajaran matematika. RajaGrafindo Persada.
- Nata, A. (2013). Perspektif Islam tentang strategi pembelajaran. Prenada Media Group.
- OECD. (2019). PISA 2018 results combined executive summaries. OECD Publishing.
- Sani, R. A. (2014). Pembelajaran saintifik untuk implementasi Kurikulum 2013. Bumi Aksara.
- Sugiyono. (2021). Metode penelitian pendidikan pendekatan kuantitatif kualitatif dan R&D. Alfabeta.
- Sumantri, M. S. (2015). Strategi pembelajaran. RajaGrafindo Persada.
- Sundayana, R. (2015). Statistika penelitian pendidikan. Alfabeta.

- Syamsidah, & Suryani, H. (2018). Model pembelajaran problem-based learning. CV Budi Utama.
- Trianto. (2013). Mendesain model pembelajaran inovatif progresif. Kencana.
- Utaminingsih, C. D. T., & Wasitohadi. (2017). Pengembangan modul pembelajaran matematika dengan menerapkan pendekatan saintifik dalam materi pecahan untuk kelas V SD. E-Journal Mitra Pendidikan, 1(4).
- Yudi Darma et al. (2020). Analisis data statistik sebuah pendekatan praktis pengolahan statistik bermuatan karakter. Graha Ilmu.
- Zakiah, L., & Lestari, I. (2019). Berpikir kritis dalam konteks pembelajaran. Erzatama Karya Abadi