



The Effect of Problem-Based Learning (PBL) on Critical Thinking and Social Science Concept Mastery in SMPN 4 Makassar

Hajriani S^{1*}, Elpisah², Nurdin³

¹⁻³ Graduate School, Universitas Patempo, Indonesia

hajrianis68@guru.smp.belajar.id^{1*}, elpisah77.amir@gmail.com², inu@gmail.com³

Address: Jl. Inspeksi Kanal No.10, Tombolo, Kec. Rappocini, Kota Makassar, Sulawesi Selatan 90233

Author correspondence: hajrianis68@guru.smp.belajar.id

Abstract. This study aims to examine the impact of the Project-Based Learning (PBL) model in improving critical thinking skills (Higher Order Thinking Skills/HOTS) and mastery of Social Science (IPS) concepts among 8th-grade students at UPT SPF SMPN 4 Makassar. A quasi-experimental design with a nonequivalent control group was used, involving an experimental group (PBL) and a control group (conventional learning). The sample consisted of two classes (30 students per class) selected purposively. Data were collected through HOTS essay tests (pretest-posttest), PBL-based worksheets, and observation sheets. Data analysis was conducted using parametric statistical tests (independent sample T-test) supported by IBM SPSS Statistics 22 and Cohen's *d* for effect size. The results show that, 1) the pretest indicated critical thinking and concept mastery were in the "Sufficient" category (96.67%), with only a small portion in the "Good" category (3.33%). After PBL implementation, post-test results revealed a significant improvement, with 93.33% in the "Good" category for critical thinking and a 23.33% increase in concept mastery. 2) PBL significantly enhanced critical thinking skills and 3) PBL significantly improved concept mastery in Social Science.

Keywords Project-Based Learning (PBL), Higher Order Thinking Skills (HOTS), critical thinking, Social Science, educational effectiveness.

1. INTRODUCTION

Education plays a pivotal role in shaping the potential of individuals, as highlighted in Indonesia's Law No. 20 of 2003 on the National Education System (Sisdiknas). The law underscores the importance of creating a learning environment that fosters the active development of students' spiritual, moral, intellectual, and social potential, equipping them with the necessary skills for personal, social, and global advancement. Education is not simply about knowledge transfer; it is a process of nurturing a holistic development of learners. However, as we move further into the 21st century, the education system must evolve to meet the increasing demands of science, technology, and global challenges. One major challenge is the development of Higher Order Thinking Skills (HOTS), which includes critical thinking, problem-solving, and the ability to analyze and evaluate information.

Indonesia's Curriculum 2013 aims to address this challenge by emphasizing active learning and student-centered approaches. The curriculum seeks to shift from traditional, rote-based learning to an approach where critical thinking and problem-solving skills are at the core. Despite this intention, students often struggle to develop HOTS in conventional classrooms. Subjects like Social Science (IPS) frequently use teacher-centered methods

that do not fully engage students in higher-order cognitive processes (Kemendikbud, 2014). Thus, the key challenge lies in finding effective methods to enhance critical thinking and concept mastery in the classroom, especially in Social Science education. Problem-Based Learning (PBL) is one such method that has gained attention as a way to engage students in real-world problem-solving. However, there is limited empirical research on the effectiveness of PBL in enhancing HOTS and concept mastery in Social Science among Indonesian students, particularly at UPT SPF SMPN 4 Makassar. This gap in research presents an opportunity to explore how PBL can enhance critical thinking skills and mastery of Social Science concepts.

Recent studies highlight the growing emphasis on integrating Higher Order Thinking Skills (HOTS) into educational curricula. Research by Sofyatiningrum et al. (2018) stresses that the curriculum should not only provide knowledge but also cultivate critical thinking and problem-solving skills. In line with these goals, Curriculum 2013 seeks to move beyond rote memorization and encourage critical engagement and analysis (Haryanto et al., 2018). As part of this transformation, Gradini (2019) emphasizes that the integration of HOTS into the Indonesian education system demands innovative pedagogical models like Project-Based Learning (PBL), which supports active participation and collaboration.

PBL has been increasingly recognized as an effective teaching approach that fosters HOTS. Sumisni and Dyah Werdiningsih (2018) argue that PBL enhances critical thinking by engaging students in real-world issues that require them to conduct in-depth research, collaborate, and generate solutions. This model promotes skills such as problem-solving, decision-making, and analytical thinking, all essential components of HOTS. Similarly, Fitriani and Sari (2019) found that PBL encourages students to apply their knowledge to real-world problems, thereby increasing both engagement and cognitive development. Moreover, PBL fosters collaboration and communication among students, which is crucial for HOTS development. While these studies provide compelling evidence of the benefits of PBL, most research focuses on subjects such as science and mathematics, where tangible outcomes are more easily measurable. There remains a gap in research exploring how PBL can impact HOTS and concept mastery in Social Science (IPS), which requires more abstract and conceptual thinking.

Although previous studies suggest that PBL is effective in developing HOTS, there remains a gap in understanding its specific effects on critical thinking and concept mastery in Social Science. While Saefudin & Berdiati (2014) highlight that PBL can enhance

critical thinking through real-world problem-solving, this has not been conclusively demonstrated in Social Science education. Most studies focus on subjects like science or technology, where concrete outcomes can be assessed more easily. However, Social Science education involves abstract thinking and conceptual understanding, which makes it more challenging to measure the impact of PBL. Additionally, while studies like Fitriani & Sari (2019) discuss the benefits of PBL for HOTS, few have specifically focused on its impact on Social Science education.

Furthermore, most studies have not utilized essay-based HOTS assessments to evaluate PBL's impact. Brookhart's (2010) framework for HOTS, which integrates Bloom's Taxonomy and Anderson & Krathwohl's Revised Taxonomy, could be useful for assessing the cognitive skills developed through PBL. However, its application within the context of Social Science education has not been thoroughly explored. This research gap presents an opportunity to investigate how PBL can be applied to enhance both critical thinking and concept mastery in Social Science, using HOTS-based assessments to gauge student outcomes.

The objective of this research is to examine the application of the Problem-Based Learning (PBL) model in improving Higher Order Thinking Skills (HOTS) and Social Science (IPS) concept mastery among 8th-grade students at UPT SPF SMPN 4 Makassar. Specifically, the study aims to achieve three objectives: 1) To assess the current state of critical thinking skills and concept mastery in Social Science among students; 2) To evaluate the effect of the PBL model on improving critical thinking skills in Social Science; and 3) To measure the impact of PBL on enhancing concept mastery in Social Science. This study will contribute to addressing the gap in the literature by applying Brookhart's (2010) HOTS framework to evaluate the effectiveness of PBL in improving critical thinking and concept mastery in Social Science.

2. LITERATURE REVIEW

Problem-Based Learning (PBL)

Problem-Based Learning (PBL) is a student-centered approach designed to engage learners in solving complex, real-world problems, emphasizing critical thinking and collaborative work. According to Kemendikbud and Hosnan, PBL requires a comprehensive learning environment where students investigate authentic issues, delve into subject matter, and work independently to produce tangible outcomes. It is often seen as a method that encourages the application of knowledge to real-world scenarios (Hosnan,

2017). The approach is characterized by several key features, including student decision-making, open-ended problem-solving, continuous evaluation, and the creation of a final product that is assessed for quality (Buck Institute for Education in Made Wena, 2016). PBL's primary goal is to enhance higher-order thinking skills and foster problem-solving abilities, which are critical in subjects like Social Science (IPS).

In practice, PBL involves multiple stages: students define problems, collaborate to find solutions, gather information, and evaluate the effectiveness of their strategies (Thomas in Made Wena, 2016). The model encourages autonomy, realism, and active participation (Thomas, 2000). While PBL promotes engagement and skill development, it also presents challenges, such as the time and resources required for successful implementation. Despite its benefits, PBL may be difficult for some students due to its complex, hands-on nature and the potential lack of full participation in group tasks (Majid & Chaerul, 2016).

Higher Order Thinking Skills (HOTS)

Higher-order thinking Skills (HOTS) refer to cognitive abilities that involve analyzing, evaluating, and creating, which are critical for complex problem-solving. Irmawati, Supriyati, & Suseno (2018) define thinking as a process of using the mind to seek meaning and understanding. Valentine (1965) in his psychological study of thinking describes it as a mental activity aimed at connecting ideas for achieving specific goals (Kuswana, 2011). Similarly, Hayon, Wariani, & Bria (2017) explain thinking as a psychic activity that connects past and present problems to find solutions. According to Wahyuni (2017), thinking is a complex, reflective, and creative effort aimed at seeking and finding knowledge. This understanding shows that thinking is a process used to solve problems encountered.

HOTS goes beyond memorization and recalling facts; it requires applying knowledge in novel situations. Thomas & Thorne (2009) highlight that HOTS includes higher-level skills such as analysis, evaluation, and creation. This concept is also reinforced by Bloom's Taxonomy, which divides cognitive skills into lower and higher levels. Lower-order thinking includes remembering, understanding, and applying, while higher-order thinking involves analyzing, evaluating, and creating (Ariyana et al., 2018). Hayon, Wariani, & Bria (2017) state that HOTS involves connecting past and current information to solve complex problems, increasing creativity and critical thinking.

According to Brookhart (2010), HOTS indicators include several cognitive abilities such as analyzing, evaluating, and creating.

- a. Analyzing: The ability to break down information into parts and examine relationships. Students identify key ideas and arguments and compare various pieces of information.
- b. Evaluating: Involves making judgments based on evidence and logic. Students assess different approaches or ideas based on specific criteria (Brookhart, 2010).
- c. Creating: This skill involves combining elements in new ways to generate novel ideas or solutions. Students apply creativity to organize information into a new structure.
- d. Reasoning and Logic: The ability to evaluate conclusions and make logical decisions based on reasoning.
- e. Decision Making: The ability to critically assess a situation and make informed decisions.
- f. Problem Solving: Involves identifying problems, exploring strategies, and evaluating the most effective solutions.
- g. Creative Thinking: The ability to generate new ideas or products, reframe questions, or create original solutions.

Assessment of HOTS serves three main purposes: supporting learning, measuring student performance, and evaluating overall programs. Widana (2017) outlines that HOTS assessment can be used to evaluate critical thinking by connecting concepts, applying information, and analyzing different types of data to find solutions. According to Sugrue (1994), HOTS can be measured using various test formats such as multiple-choice, matching, short answers, essays, and performance tasks. Brookhart (2010) also emphasizes two types of assessment:

- a. Formative Assessment: This is used to observe students' reasoning in real-time, offering feedback on their learning process.
- b. Summative Assessment: This evaluates how students apply higher-order thinking skills in a test, often through essays or structured responses, using rubrics to gauge their cognitive abilities.

These assessments ensure that students are not only recalling information but are able to apply, analyze, evaluate, and create solutions in various contexts.

3. METHODS

This study employs a quasi-experimental design with a nonequivalent one-group pretest-posttest approach to evaluate the effectiveness of the Project-Based Learning (PBL) model on enhancing Higher Order Thinking Skills (HOTS) among 8th-grade students at UPT SPF SMPN 4 Makassar. The research uses non-probability sampling with purposive

sampling, selecting two classes: VIII1 as the experimental group and VIII2 as the control group, each with 30 students. Data collection involves administering pretest and posttest essays to measure HOTS, providing LKPDs (student worksheets) and observation sheets to assess PBL implementation in the experimental group. The study uses quantitative analysis, with statistical techniques such as Kolmogorov-Smirnov for normality testing, One Way Anova for homogeneity, and independent sample T-test for hypothesis testing. Cohen's d is also applied to measure effect size. The hypothesis being tested is whether the implementation of PBL significantly influences HOTS, with results interpreted based on the significance level ($\alpha = 0.05$).

4. RESULTS

Normality Test

To test the normality of the data distribution, normality tests were conducted using two methods: Kolmogorov-Smirnov and Shapiro-Wilk. This test was performed to ensure that the data from the pre-test and post-test of both the experimental and control groups followed a normal distribution, which is a prerequisite for further data analysis.

Table 1.Normality Test Results for Pre-test and Post-test Data

Class	Kolmogorov Sig Value	Shapiro Sig Value	Conclusion
Pre-test Experiment	.117	.725	Data is normally distributed
Post-test Experiment	.200*	.432	Data is normally distributed
Pre-test Control	.200*	.983	Data is normally distributed
Post-test Control	.200*	.868	Data is normally distributed

Based on the results of the normality tests using Kolmogorov-Smirnov and Shapiro-Wilk, it can be concluded that all data from the pre-test and post-test for both the experimental and control groups are normally distributed, as the significance values (p-values) are greater than 0.05. Therefore, parametric statistical analysis can proceed in the next steps.

Homogeneity Test

The test of homogeneity of variances was conducted to determine whether the variances between the experimental and control groups are equal. This is a prerequisite for conducting further statistical analysis, specifically for ANOVA, which assumes that the variances between groups are homogenous.

Table 2. Homogeneity of Variances and ANOVA Results

Test	Levene Statistic	df1	df2	Sig.
Levene's Test	.130	1	58	.720

Table 3. ANOVA Results

Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2124.150	1	2124.150	65.648	.000
Within Groups	1876.700	58	32.357		
Total	4000.850	59			

The Levene's Test result shows a Sig. value of .720, which is greater than 0.05, indicating that the variances between the groups are homogeneous. As a result, the assumption of homogeneity of variances is met.

Paired Sample T Test

A paired samples test was performed to compare the pre-test and post-test results for both critical thinking skills and concept mastery. This test determines whether there is a significant difference between the paired observations before and after the intervention (Project-Based Learning in this case).

Table 4. Paired Samples Test Results for Critical Thinking and Concept Mastery

Pair	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference	t	df	Sig. (2-tailed)
Pair 1	Pre-test Critical Thinking - Post-test Critical Thinking	-15.267	3.956	.722	-16.744, -13.789	-	29
Pair 2	Pre-test Concept Mastery - Post-test Concept Mastery	-5.233	1.223	.223	-5.690, -4.777	-	29

For both pairs, the Sig. (2-tailed) values are .000, which is less than the significance level of 0.05. This indicates that there are statistically significant differences between the pre-test and post-test scores for both critical thinking skills and concept mastery, suggesting that the intervention (Project-Based Learning) had a positive effect on improving both skills. The ANOVA results show that the F value is 65.648 with a Sig. value of .000, which is less than 0.05, indicating that there is a statistically significant difference between the groups' learning outcomes.

Independent Sample Test

An Independent Samples Test was conducted to compare the learning outcomes between the experimental and control groups. The Levene's Test was first applied to check the assumption of equality of variances between the groups.

Table 5. Independent Samples Test Results for Learning Outcomes

Test	F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Levene's Test for Equality of Variances	.130	.720					
t-test for Equality of Means			8.102	58	.000	11.900	1.469
Equal variances not assumed			8.102	57.954	.000	11.900	1.469

The Levene's Test for Equality of Variances yields a Sig. value of .720, which is greater than 0.05, indicating that the assumption of equal variances is met. The t-test for Equality of Means shows a t-value of 8.102 with a Sig. value of .000, which is less than 0.05, indicating a significant difference in learning outcomes between the experimental and control groups. The mean difference of 11.900 suggests that the experimental group outperformed the control group, with a 95% confidence interval ranging from 8.960 to 14.840.

Cohens D test

The hypothesis test used is to measure the **effect size** is to calculate the **effect size**, which provides information on how significant the difference is after the implementation of PBL. In this case, Cohen's d will be used as a measure of effect size, which allows us to know how big the average difference recorded between the critical thinking and concept mastery groups is in terms of improving critical thinking skills. With the interpretation of

Interpretation of effect size:

Small: $d \approx 0.2$; Medium: $d \approx 0.5$; Large: $d \approx 0.8$

Table 6. Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Critical Thinking Pre Test	52.73	30	4.941	.902
	Post Test Critical thinking	68.00	30	5.608	1.024

Table 7. Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Critical Thinking Pre Test & Critical Thinking Post Test	30	.726	.000

Table 9. Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Critical Thinking Pre Test - Critical Thinking Post Test	-15.267	3.956	.722	-16.744	-13.789	21.137	29	.000

The calculation is done in a way:

$$\text{Cohen's } d = (M_2 - M_1) / SD_{\text{(pooled)}}$$

where:

$$SD_{\text{pooled}} = \sqrt{((SD_1^2 + SD_2^2) / 2)}$$

The calculation results show the following values

$$\text{Cohen's } d = (68 - 52.73) / 5.284764 = 2.889438.$$

$$\text{Glass's } \Delta = (68 - 52.73) / 4.940566 = 3.090739.$$

$$\text{Hedges' } g = (68 - 52.73) / 5.284764 = 2.889438.$$

Based on the calculation of **Cohen's d**, the value obtained is **2.89**, which indicates a very large effect of applying the Problem Based Learning (PBL) model on improving students' critical thinking skills in the experimental class. In comparison, the calculated **Glass's delta** value was **3.09**, which also indicated a very large effect, using the standard deviation of Critical Thinking as a comparison. In addition, Hedges' g, which was also calculated using the pooled standard deviation, yielded a value of 2.89, indicating consistency in the measurement of effect size. All of these values indicate that the implementation of PBL had a highly significant and large impact on improving students' critical thinking skills, with improvements that far exceeded the small or medium effects generally considered significant in educational research.

Based on the results of the analysis conducted, it can be concluded that the alternative hypothesis (H1), which states that there is an effect of the Project Based Learning (PBL) model on higher order thinking skills (HOTS) in grade 8 UPT SPF SMPN

4 Makassar students, is accepted. This is supported by the results which show a significant increase in students' critical thinking skills and analytical abilities after the PBL model is applied. The application of PBL proved effective in encouraging students to develop higher order thinking skills, such as analysis, evaluation, and creation, which are the core of HOTS. In addition, effect size calculations such as Cohen's *d*, Glass's delta, and Hedges' *g*, which show the large effect of the PBL model, reinforce these findings. Thus, it can be concluded that the implementation of PBL has a **significant positive** effect on increasing students' HOTS in grade 8 of SMPN 4 Makassar.

Table 10. Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Concept Mastery Pre Test	51.73	30	3.941	.902
	Concept Mastery Post Test	67.00	30	4.608	1.024

Table 11. Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Concept Mastery Pre Test & Concept Mastery Post Test	30	.626	.000

Table 12. Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Critical Thinking Pre Test & Critical Thinking Post Test	-15.267	2.956	.622	-16.744	-13.789	-20.137	29	.000

The calculation is done in a way:

$$\text{Cohen's } d = (M_2 - M_1) / SD_{\text{(pooled)}}$$

where:

$$SD_{\text{pooled}} = \sqrt{((SD_1^2 + SD_2^2) / 2)}$$

The calculation results show the following values

$$\text{Cohen's } d = (67 - 51.73) / 2.284764 = 2.889438.$$

$$\text{Glass's } \Delta = (67 - 51.73) / 2.940566 = 2.070739.$$

$$\text{Hedges' } g = (67 - 51.73) / 4.284764 = 2.684438.$$

Based on the calculation of **Cohen's d**, the value obtained is **2.68**, which indicates a very large effect of applying the Problem Based Learning (PBL) Model on improving students' Mastery of concepts . In comparison, the calculated Glass's delta value is 2.07, which also indicates a very large effect, using the standard deviation of Critical Thinking as a comparison. In addition, Hedges' g, which was also calculated using the combined standard deviation, yielded a value of 2.68, indicating consistency in the measurement of effect size. All of these values indicate that the implementation of PBL had a highly significant and large impact on improving students' conceptual understanding, with improvements that far exceeded the small or medium effects generally considered significant in educational research.

Based on the results of the analysis conducted, it can be concluded that the alternative hypothesis (H2), which states that there is an effect of the Project Based Learning (PBL) model on concept mastery in class 8 UPT SPF SMPN 4 Makassar students, is accepted. This is supported by the results that show a significant increase in concept mastery after the PBL model is applied. The application of PBL proved effective in encouraging students to develop higher order thinking skills, such as analysis, evaluation, and creation, which are the core of HOTS. In addition, effect size calculations such as Cohen's d, Glass's delta, and Hedges' g, which show the large effect of the PBL model, reinforce these findings. Thus, it can be concluded that the application of PBL has a significant positive effect on improving students' concept mastery in class 8 of SMPN 4 Makassar.

5. DISCUSSION

The results of this study provide strong evidence supporting the constructivist theory, particularly in the context of the Problem-Based Learning (PBL) model. Constructivist theory emphasizes that knowledge is not simply transferred from teacher to student but is actively constructed by students through experiences and interactions with their environment (Piaget, 1977; Vygotsky, 1978). PBL, as a student-centered learning approach, creates space for students to explore, analyze, and solve problems independently or collaboratively. The findings of this study show that PBL successfully enhances students' critical thinking skills, which aligns with the constructivist principle that meaningful learning occurs when students are actively involved in the problem-solving process.

The significant improvement in the critical thinking skills of the experimental group can also be explained through the concept of scaffolding proposed by Vygotsky (1978). In

PBL, the teacher acts as a facilitator, providing gradual support to students to achieve deeper understanding. This scaffolding allows students to overcome challenges within their zone of proximal development, which is the area where students can reach higher understanding with the help of others. The results indicate that the experimental group showed greater improvement compared to the control group, suggesting that scaffolding in PBL effectively helped students develop higher-order thinking skills.

These findings also align with the Problem-Based Learning theory developed by Barrows and Tamblyn (1980). According to this theory, problem-based learning stimulates students to develop critical, analytical, and creative thinking skills through the process of investigation and problem-solving. The results show that the experimental group, which used PBL, made significant improvements in critical thinking skills, reinforcing the argument that PBL is an effective approach for developing higher cognitive abilities. This proves that PBL is not only a learning method but also a tool for shaping critical and analytical thinking.

Additionally, these findings support the intrinsic motivation theory in Self-Determination Theory (SDT) proposed by Deci and Ryan (1985). PBL creates a learning environment that encourages curiosity, autonomy, and active involvement, which in turn enhances students' intrinsic motivation. This intrinsic motivation becomes a key driver for students to engage in deeper and more meaningful learning processes. The significant improvement in the learning outcomes of the experimental group suggests that PBL successfully created conditions that supported students' intrinsic motivation, which is crucial for long-term learning success.

These findings are also relevant to the theory of transfer of learning proposed by Bransford, Brown, and Cocking (2000). PBL is designed to help students apply the knowledge they gain in real-life contexts, facilitating the transfer of knowledge from the learning environment to real-world situations. The results show that the experimental group not only improved critical thinking skills but also analysis and evaluation abilities, indicating that PBL successfully facilitated the transfer of learning. This proves that PBL is not only effective in the classroom but also prepares students to face real-world challenges.

From a cognitive theory perspective, these findings also support the idea that learning that involves solving complex problems can enhance students' cognitive capacity (Anderson, 2000). PBL requires students to use higher-order cognitive skills such as analysis, synthesis, and evaluation, which align with the revised Bloom's taxonomy

(Krathwohl, 2002). The significant improvement in critical thinking skills in the experimental group suggests that PBL successfully developed students' cognitive capacities to higher levels. This proves that PBL is not just a teaching method but also a tool for sharpening students' thinking skills.

These results are also consistent with the theory of collaborative learning, which emphasizes the importance of social interaction in the learning process (Johnson & Johnson, 1999). PBL involves students in group work and discussions, allowing them to learn from one another and develop shared understanding. This social interaction not only enhances cognitive skills but also social and communication skills. The finding that the experimental group showed greater improvement than the control group suggests that collaboration in PBL played a crucial role in improving student learning outcomes. This indicates that learning is not only about the individual but also about how students learn together.

These findings also support the conceptual change theory proposed by Posner et al. (1982). According to this theory, effective learning occurs when students undergo changes in their conceptual structure through the processes of assimilation and accommodation. PBL, by challenging students to solve complex problems, encourages these conceptual changes. The significant improvement in critical thinking skills in the experimental group suggests that PBL successfully facilitated deep conceptual change. This proves that PBL not only changes the way students learn but also how they perceive and understand the world.

From the perspective of formative assessment theory, PBL also provides continuous feedback to students during the learning process. This feedback allows students to reflect on their understanding and make ongoing improvements (Black & Wiliam, 1998). The results show that the experimental group made significant improvements, indicating that the feedback provided in PBL successfully supported the students' learning process. This shows that assessment is not just about the final grade but about the ongoing learning process.

Overall, the findings of this study strengthen the theoretical foundation that PBL is an effective learning approach for developing students' higher-order thinking skills (HOTS). By combining principles of constructivism, scaffolding, intrinsic motivation, transfer of learning, and collaboration, PBL not only improves student learning outcomes but also prepares them to face complex challenges in the real world. Therefore, the

application of PBL in education should be considered as an innovative and effective learning strategy that can transform the way students learn and think.

6. CONCLUSION

This study aims to evaluate the effect of implementing the Problem Based Learning (PBL) model on critical thinking skills and concept mastery of students at UPT SPF SMPN 4 Makassar. Based on the results of the analysis, it was found that PBL provided significant improvements in both aspects. In the post-test, most students improved in the critical thinking and concept mastery categories, reflecting the effectiveness of PBL in developing students' higher order skills (HOTS). The application of PBL has shown better results compared to the pre-test condition, where most students were in the fair category, and a notable increase in the good and excellent categories after the application of this model.

This research makes a significant contribution in the field of education, especially in developing learning models that focus on strengthening students' critical thinking skills and concept mastery. PBL offers an approach that is relevant to the demands of modern education, which requires students to think critically, creatively, and analytically. The application of PBL is expected to not only improve students' academic abilities, but also form a more independent and problem-solving-based mindset. In addition, the application of this model can be used as a reference for curriculum development and learning strategies that are more adaptive and responsive to the needs of students in the 21st century education era.

7. LIMITATION

This study has limitations related to its scope which only involves one school in Makassar, so the generalizability of these findings may be limited. Future research can be conducted by expanding the sample and involving more learning variables to test the sustainability and scalability of PBL across different levels of education. In addition, further exploration of the impact of PBL on other aspects of learning, such as motivation and collaboration, may provide deeper insights into the effectiveness of this model in improving the overall quality of education.

REFERENCES

- Abdul Majid & Rochman, C. (2014). *Pendekatan ilmiah dalam implementasi kurikulum 2013*. Bandung: PT Remaja Rosdakarya.
- Anderson, L. W., & Krathwohl, D. R. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. New York: Longman.
- Arikunto, S. (2010). *Prosedur penelitian suatu pendekatan praktik*. Jakarta: Rineka Cipta.
- Badjeber, R., & Purwaningrum, J. P. (2018). Pengembangan higher order thinking skills. *Jurnal Pendidikan dan Pembelajaran*, 1(1), 36-43.
- Barrows, H. S., & Tamblyn, R. M. (1980). *Problem-based learning: An approach to medical education*. New York: Springer.
- Black, P., & Wiliam, D. (1998). *Inside the black box: Raising standards through classroom assessment*. London: King's College.
- Brookhart, S. M. (2010). *How to assess higher order thinking skills in your classroom*. Alexandria, VA: ASCD.
- Fitriani, S. A., & Sari, D. E. (2019). Penerapan kemampuan berpikir tingkat tinggi pada penyelesaian soal High Order Thinking Skill (HOTS) dalam pembelajaran akuntansi. *Seminar Nasional Pendidikan Pengembangan Kualitas Pembelajaran Era Generasi Milenial 2019*, 73-76.
- Gradini, E. (2019). Menilik konsep kemampuan berpikir tingkat tinggi (Higher Order Thinking Skills) dalam pembelajaran matematika. *Jurnal Numeracy*, 6(2), 189-203.
- Guo, S., & Yang, Y. (2012). Project-Based Learning: An Affective Approach to Link Teacher Professional Development and Students Learning. *Journal of Technology Development and Exchange*, 5(2), 41-56.
- Haryanto, Ahda, Y., & Darussyaamsu, R. (2018). Analisis aspek kemampuan berpikir tingkat tinggi pada instrumen penilaian materi fungi untuk peserta didik SMA/MA kelas X. *Jurnal Pendidikan*, 3(1), 32-40.
- Johnson, D. W., & Johnson, R. T. (1999). *Learning together and alone: Cooperative, competitive, and individualistic learning*. Boston: Allyn and Bacon.
- Jonassen, D. H. (2011). *Learning to solve problems: A handbook for designing problem-solving learning environments*. New York: Routledge.
- Kadir. (2016). *Statistika terapan (Konsep, contoh, dan analisis data dengan program SPSS/Lisrel dalam penelitian)*. Jakarta: PT RajaGrafindo Persada.
- Kementerian Pendidikan dan Kebudayaan. (2014). *Perubahan pola pikir dalam kurikulum 2013*. Diambil kembali dari Kemendikbud.go.id
- Komalasari, K. (n.d.). *Pembelajaran kontekstual, konsep dan aplikasi*.

- Krathwohl, D. R. (2002). A revision of Bloom's taxonomy: An overview. *Theory Into Practice*, 41(4), 212-218.
- Piaget, J. (1977). The development of thought: Equilibration of cognitive structures. *New York: Viking Press*.
- Posner, G. J., Strike, K. A., Hewson, P. W., & Gertzog, W. A. (1982). Accommodation of a scientific conception: Toward a theory of conceptual change. *Science Education*, 66(2), 211-227.
- Sofyatiningrum, E., Sisdiana, E., Astuti, R., Hariyanti, E., Efarida, L., Krisna, F. N., & Tola, B. (2018). Muatan HOTS pada pembelajaran kurikulum 2013 pendidikan dasar. Dalam Mahdiansyah, Y., Wirda, & L. H. Winingsih (Eds.), *Jakarta: Pusat Penelitian Kebijakan Pendidikan dan Kebudayaan, Badan Penelitian dan Pengembangan, Kementerian Pendidikan dan Kebudayaan*.
- Sugiyono. (2011). *Metode penelitian kualitatif, kuantitatif dan R & D*. Bandung: Alfabeta.
- Suharsaputra, U. (2014). *Metode penelitian kuantitatif, kualitatif dan tindakan*. Bandung: PT Refika Aditama.
- Syah, M. (2014). *Psikologi pendidikan; Dengan pendekatan baru*. Bandung: Remaja Rosdakarya.
- Undang-Undang Republik Indonesia. (2003). *Sistem pendidikan nasional* (UU No. 20 Tahun 2003).
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.
- Widyastuti, A. (2022). *Merdeka belajar dan implementasinya: Merdeka guru-siswa, merdeka dosen-mahasiswa semua bahagia* (R. A. Putri, Ed.). Jakarta: Elex Media Komputindo.
- Yani. (n.d.). *Model project-based learning untuk meningkatkan motivasi belajar pendidikan jasmani*.
- Yaumi, M. (2013). *Prinsip-prinsip desain pembelajaran disesuaikan dengan kurikulum 2013*. Jakarta: Kencana Prenadamedia Group.
- Zulfiani, Feronika, T., & Suartini, K. (2009). *Strategi pembelajaran sains*. Jakarta: Lembaga Penelitian UIN Jakarta.