Contents List Available at Inovasi Data Analisis

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Enhancing Literacy and Numeracy through Problem-Based Learning in Elementary Schools

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ARTICEL INFO

ABSTRACT

This study explores the implementation of Problem-Based Learning (PBL) to enhance literacy and numeracy skills among primary school teachers and students at SDN 2 Aikmual, Central Lombok. The research employed a mixed-method approach, combining qualitative interviews to gauge participant perceptions and qualitative observations to assess learning outcomes. Qualitative findings revealed positive feedback from participants, indicating high engagement and improved comprehension of mathematical concepts through the PBL approach. Teachers and students expressed enthusiasm for the interactive nature of PBL, which facilitated a deeper understanding of mathematical principles in real-life contexts. The study underscores PBL's potential in fostering critical thinking and practical application of mathematical knowledge, contributing valuable insights into effective pedagogical practices in primary education.

1. Introduction

In the context of the Merdeka Curriculum, education emphasizes enhancing students' literacy and numeracy skills (Mustagfiroh, 2020). Literacy and numeracy are critical concepts necessary for the development of individual capabilities and human resources (Meliyanti et al., 2021). These skills extend beyond basic reading and arithmetic, encompassing various life skills essential for personal and societal functioning (Anderha & Maskar, 2021). In the educational realm, literacy and numeracy competencies are imperative not only for students but also for educators, school administrators, and parents (Uspaningtiyas & Ulfa, 2021). Literacy and numeracy skills include the ability to use symbols and numbers related to mathematics for problem-solving, critically examine information for decision-making, effectively communicate ideas, reason, analyze, solve, formulate, and interpret various mathematical problems in diverse situations and formats (Khoiriah, 2022). These competencies are crucial for individuals to navigate and thrive in an increasingly complex world, making their development a priority in contemporary education.

The contemporary concept of literacy extends beyond mere reading ability to encompass the skills of analyzing and understanding various concepts, including numerical competency, which involves analyzing numbers. Numeracy literacy is essential as it is deeply integrated into everyday life, relying heavily on one's reasoning abilities. This reasoning encompasses analyzing and understanding statements and activities involving the manipulation of symbols or mathematical language encountered in daily life, and expressing these through written or oral communication (Ekowati, Worowirastri, & Astuti, 2019). These activities are essential for achieving educational goals (Sasmita et al., 2021).

The foundation and hope for achieving educational objectives are driven by the developments of the industrial revolution, necessitating an education system capable of fostering critical thinking and problem-solving skills (Rahayuningsih & Muhtar, 2022). Students are expected to be creative, innovative, and skilled in communication and collaboration (Istanto, 2014). Additionally, they should be adept at managing and analyzing information from various technologies to enhance literacy and numeracy (Nurjannah, 2022).

The latest curriculum change, embodied in the Merdeka Curriculum, aims to revert the National Education System to the essence of the law, granting freedom to school principals, teachers, and students to learn independently, creatively, and innovatively (Saputri, et al., 2022). One significant change from previous curricula to the Merdeka Curriculum is the transformation of the National Examination into the National Assessment, which includes the Minimum Competency Assessment, known as AKM (Nasoha et al., 2022).

Teachers are expected to analyze students' needs in alignment with their environment, conditions, and learning objectives (Putri, 2021). This involves selecting appropriate teaching methods and media for the learning process (Puspitaningrum et al., 2018). One recommended approach is Problem-Based Learning (PBL). PBL is an effective method for enhancing students' literacy and numeracy skills (Sri Dwijayanti & Sari, 2021). The strengths of the PBL method include contextual learning, problem presentation, problem identification, and seeking optimal solutions to minimize the issues (Nasution et al., 2018). PBL requires students to communicate their findings and best solutions for the presented problems (Yew & Goh, 2016). PBL encourages the use of authentic problems as the focus of learning, aiming to train students to solve relevant issues, thus fostering high literacy and numeracy skills and critical thinking (Juniarso, 2019). According to Arifuddin et al. (2018), literacy can be enhanced through PBL, which also increases students' motivation in the learning process. This is supported by Nurhayati Darubekti's (2021) research, which indicates that students' critical thinking and literacy skills improve when using the PBL model.

2. Critical Riview

The foremost skill that students must develop, which is also a primary objective in mathematics education, is mathematical literacy (Nurjannah et al., 2022). This is particularly relevant given the evolving educational curriculum in Indonesia, such as the Merdeka Curriculum, which emphasizes the development of students' mathematical literacy in formulating, interpreting, and applying mathematics in various everyday contexts. Literacy and numeracy encompass the knowledge and skills needed to use various numbers and mathematical formulas to solve problems in daily life, analyze information, and interpret analysis results to make decisions (Astutik, 2022). Mathematical literacy is defined as the ability to interpret, use, and apply mathematics in different contexts, including the application of concepts, procedures, and facts in specific situations (Vika et al., 2019).

To enhance mathematical literacy skills, various educational models can be employed. One effective model is Problem-Based Learning (PBL), which is more student-centered and involves contextual problem-solving. According to the Directorate General of Higher Education (Cholisin, 2006), PBL is a learning model that uses real-life problems as a context for students to learn critical thinking and problem-solving skills, acquiring essential knowledge and concepts in the process. PBL makes a problem the central point of discussion, which students analyze to find solutions (Astutik, 2022). Through PBL, students encounter contextual problems, allowing them to interpret, formulate, and apply mathematical principles to these scenarios.

Several studies have shown that using the PBL model can significantly enhance students' mathematical literacy. For instance, research by Muharomah & Setiawan (2020) demonstrates that PBL can improve students' mathematical literacy skills more effectively than conventional teaching methods. Similarly, a study by Sriwahyuni et al. (2019) indicates that students using the PBL model exhibit better mathematical literacy compared to those taught through traditional methods. Furthermore, Firdaus et al. (2021) found that the PBL approach enhances students' mathematical literacy skills. These findings collectively suggest that Problem-Based Learning is a robust educational model for improving mathematical literacy, which is crucial for students to navigate and solve real-world problems effectively.

3. Method Innovation

At the outset, we applied a methodical approach to the community service project at SDN 2 Aikmual, Praya, Lombok Tengah,Indonesia.

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Enhancing Literacy and Numeracy through Problem-Based Learning in Elementary Schools

The project began with the identification and needs assessment of sample objects within the school community. This initial phase aimed to understand specific challenges and potentials among the sample objects, ensuring tailored solutions that catered to their unique circumstances (Setyaningsih et al., 2019). Based on the findings from the needs assessment, we proceeded with the development of a customized curriculum and relevant teaching materials for the "Enhancing Literacy and Numeracy Skills" workshop. These resources were meticulously crafted to address identified needs while aligning with educational standards. The workshop spanned a full day and encompassed multiple sessions, including theoretical presentations, interactive discussions, and hands-on practice sessions of Problem-Based Learning (PBL) methods. This approach enabled participants to gain practical insights into applying PBL techniques effectively. Following the workshop, a comprehensive monitoring and evaluation process was conducted to gauge the enhancement of pedagogical competencies among participating teachers. This step was crucial in assessing the workshop's impact on educational quality at SDN 2 Aikmual and identifying areas for ongoing improvement. Post-workshop, continuous coaching and development sessions were conducted to support teachers in implementing PBL methods. This involved ongoing mentorship, provision of supplementary resources, and guidance to sustain and build upon workshop outcomes.

The active engagement of school partners was pivotal throughout the project:
1) Facilities Provision: The school facilitated the workshop by providing necessary facilities and infrastructure, such as classrooms or assembly halls.
2) Classroom Participation: Partners participated actively in workshop activities, engaging in classroom discussions, Q&A sessions, and presentations.
3) Evaluation Contribution: Partners assisted in evaluating the workshop outcomes, assessing the improvement in teachers' implementation of PBL methods.
4) Utilization of Training Results: Partners leveraged the enhanced competencies of teachers to enhance overall educational quality within the school.

To ensure the program's effectiveness and long-term impact, the following steps were undertaken:

1) Ongoing Program Evaluation: Regular evaluations were conducted to monitor program progress, identify challenges, and implement necessary adjustments to meet objectives.
2) Sustainability Assessment: Post-program, an assessment was conducted to measure the sustained benefits of the program on teachers' pedagogical skills and student learning outcomes.
3) Follow-Up Strategies: Based on evaluation findings, strategic follow-up actions were implemented to refine the program and ensure its continued success and relevance.

The systematic application of the aforementioned steps, coupled with active partner engagement and rigorous evaluation, underscores our commitment to enhancing educational practices and outcomes at SDN 2 Aikmual. Continuous monitoring and strategic interventions are crucial for sustaining and scaling the impacts of our initiatives.

4. Result and Discusion

Before starting the workshop activities, teachers from SDN 2 Aikmual were briefed on the objectives, agenda and expectations of the workshop. This briefing aims to prepare participants to be able to take part in the activities well and understand the benefits and objectives of applying Problem Based Learning (PBL) based learning methods.

In Figure 1, the teachers are seen listening attentively to the facilitator's instructions. Effective communication during this phase is crucial to ensuring a shared understanding of the workshop's goals and processes among all participants. These initial instructions serve as a strong foundation for initiating workshop activities, ensuring that all participants have a clear understanding and commitment to the learning process ahead.

Photo Source; Documentation of the author's activities 2024

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Enhancing Literacy and Numeracy through Problem-Based Learning in Elementary Schools

Photo Source; Documentation of the author's activities 2024

Figure 1. Giving Instructions SDN 2 Aikmual

In this session, the workshop focused on imparting knowledge about the significance of literacy and numeracy skills, alongside the teaching methodology employed to enhance these skills. The participants were guided through theoretical aspects and practical insights into how Problem Based Learning (PBL) can effectively improve literacy and numeracy among students.

Photo Source; Documentation of the author's activities 2024

Figure 2. Workshop Material Presentation

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This segment introduced students to mathematical modules and the process of learning through a problem-based approach. The interactive session aimed to engage students actively in understanding and applying mathematical concepts in real-life contexts.

Photo Source; Documentation of the author's activities 2024

Figure 3. Module Introduction to Students

This activity involved hands-on learning using problem-based modules. Students at SD 2 Aikmual demonstrated enthusiasm and high motivation during the learning process. Their active participation highlighted the effectiveness of using problem-based modules in enhancing their learning experience.

Photo Source; Documentation of the author's activities 2024

Figure 4. Classroom Teaching Using Modules

Coresponding Author; taufikahmadmatematika17@gmail.com

Enhancing Literacy and Numeracy through Problem-Based Learning in Elementary Schools

These activities not only aimed to enhance literacy and numeracy skills but also to foster critical thinking and collaborative learning among students. The workshop underscored the importance of innovative teaching methods in promoting a holistic educational experience.

The workshop aimed to evaluate the effectiveness of using problem-based learning modules to enhance literacy and numeracy skills among participants. A pre-test and post-test were conducted to assess the impact of the workshop on the participants' skills. The descriptive statistics below illustrate the results of the analysis:

Tabel 1.a Analisis Deskriptif Pre-Test

Descriptives		Statistic	Std. Error
Pretest			
Mean		50.00	2.32896
95% Confidence Interval for Mean	Lower Bound	45.6527	
	Upper Bound	55.2140	
5% Trimmed Mean		50.5370	
Median		55.0000	
Variance		76.524	
Std. Deviation		8.78272	
Minimum		35.00	
Maximum		65.00	
Range		30.00	
Interquartile Range		15.00	
Skewness		-.437	.580
Kurtosis		-.962	1.121
Descriptives		Statistic	Std. Error

Data Source; processed by the author 2024

Tabel 1.b Analisis Deskriptif Postest

Descriptives		Statistic	Std. Error
Postest			
Mean		76.0000	2.27826
95% Confidence Interval for Mean	Lower Bound	66.1136	
	Upper Bound	77.8864	
5% Trimmed Mean		78.5000	
Median		76.0000	
Variance		79.857	
Std. Deviation		8.82367	
Minimum		55.00	
Maximum		80.00	
Range		25.00	
Interquartile Range		15.00	
Skewness		-1.159	.580
Kurtosis		-.014	1.121

Data Source; processed by the author 2024

Coresponding Author; taufikahmadmatematika17@gmail.com

Enhancing Literacy and Numeracy through Problem-Based Learning in Elementary Schools

The pre-test results indicated a mean score of 50.00 with a standard deviation of 8.78, while the post-test showed a mean score of 76.00 with a standard deviation of 8.82. The analysis reveals a substantial increase in the mean scores from pre-test to post-test, indicating a positive impact of the workshop on participants' literacy and numeracy skills. To further assess the effectiveness, the normalized gain (N-gain) was calculated. N-gain is utilized to measure the improvement in cognitive learning outcomes between pre-test and post-test phases.

Tabel 2. Analisis Deskriptif N_Gain

	N	Minimum	Maximum	Mean	Std. Deviation
N_Gain_Skor	15	.30	.75	.5684	.14180
N_Gain_Persen	15	30.00	75.00	56.8384	14.17952

Data Source; processed by the author 2024

From the descriptive analysis of N_Gain above, the average N_Gain score is 0.5684. Referring to the categorization of N_Gain as follows:

Table 3. Categorization of N_Gain

N_Gain Value	Category
g>0.7	High
0.3≤g≤0.7	Medium
g<0.3	Low

Data Source; processed by the author 2024

Based on the average N_Gain score of 0.5684, it falls into the category of "Sedang" (Moderate). This indicates a moderate level of improvement in literacy and numeracy skills among the workshop participants, as measured from pre-test to post-test. These results suggest that while there was a significant improvement in skills, there is still room for further enhancement. The moderate N_Gain score reflects the effectiveness of the problem-based learning approach implemented during the workshop in enhancing participants' cognitive learning outcomes. Continuing to refine and tailor educational strategies based on these findings can further optimize learning experiences and skill development in educational settings.

Tabel 4. Effectiveness Interpretation N_Gain

Percentage	Interpretation
< 40 %	Not Effective
40 % - 55 %	Less Effective
56 % - 75 %	Moderately Effective
>76 %	Effective

Data Source; processed by the author 2024

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The Problem-Based Learning (PBL) workshop conducted at SDN 2 Aikmual aimed to enhance literacy and numeracy skills among participants, demonstrating moderate effectiveness as indicated by both quantitative analysis and qualitative feedback. This discussion explores the alignment between the workshop's objectives, its implementation, and the insights gained from participant experiences. Quantitative analysis of the workshop's impact revealed a significant improvement in participants' literacy and numeracy skills. The N_Gain score of 0.5683 falls within the moderate category $(0.3 \leq g \leq 0.7)$, indicating substantial progress from pre-test to post-test assessments. This statistical evidence underscores the workshop's effectiveness in enhancing participants' cognitive learning outcomes. The pre-test mean score of 50.00 increased substantially to 76.00 in the post-test, highlighting the workshop's role in improving participants' understanding and application of mathematical concepts. The consistency in variance and standard deviation across participants further supports the reliability of these findings.

These quantitative results are consistent with previous research indicating that PBL can significantly improve students' academic performance in various subjects, including mathematics (Muharomah & Setiawan, 2020; Sriwahyuni et al., 2019). By engaging students in problem-solving activities within real-life contexts, PBL fosters deeper understanding and application of concepts, which is reflected in the increased post-test scores observed in this study.

Qualitative feedback from workshop participants provided deeper insights into their experiences and perceptions. Participants expressed enthusiasm and satisfaction with the workshop, emphasizing its engaging and informative nature. One participant remarked, "The delivery of the material was excellent, and it expanded our knowledge and insights. We were accustomed to conventional teaching methods, but this workshop introduced us to more effective and interesting learning techniques." Similarly, students at SDN 2 Aikmual voiced positive feedback, describing the workshop as enjoyable and effective in facilitating quick comprehension of mathematical concepts. They appreciated the interactive nature of the PBL approach, which fostered active participation and accelerated their learning process. Qualitative data are essential in complementing quantitative findings by providing contextual understanding and insights into participants' learning experiences (Creswell & Poth, 2017). The positive testimonials from both teachers and students validate the workshop's efficacy in enhancing not only academic skills but also overall engagement and enthusiasm for learning.

The correlation between quantitative results and qualitative feedback is pivotal in validating the workshop's efficacy. While quantitative data demonstrate measurable improvements in academic performance, qualitative insights provide context and depth to these outcomes. Participants' positive experiences corroborate the statistical findings, illustrating the workshop's impact on enhancing both learning outcomes and student engagement. The integration of both qualitative and quantitative methods strengthens the study's validity and reliability, offering a comprehensive understanding of how PBL can effectively enhance literacy and numeracy skills in educational settings (Teddlie & Tashakkori, 2009). This holistic approach ensures that findings are robust and applicable across diverse learning environments.

Integration of PBL Methodology: The workshop underscores the effectiveness of problem-based learning in improving literacy and numeracy skills. Educators can adopt PBL methodologies to promote critical thinking, problem-solving abilities, and practical application of knowledge among students. Student Engagement: The workshop's interactive approach enhances student engagement and motivation, crucial factors in effective learning. Educators should prioritize dynamic teaching methods that stimulate interest and active participation in the classroom. Professional Development: Continuous professional development is essential for educators to refine their instructional techniques and effectively implement innovative teaching strategies like PBL. Training and support ensure educators are well-equipped to adapt teaching practices to diverse learning environments.

Despite the workshop's success, there are limitations to consider. The study's scope was confined to a single school, limiting generalizability across broader educational contexts. Future research could expand the study to include multiple schools and regions to assess the scalability and applicability of PBL across diverse settings. Longitudinal studies are also recommended to evaluate the sustained impact of PBL on students' academic performance and skill retention over time. Furthermore, comparative studies could explore variations in PBL implementation and their relative effectiveness compared to traditional teaching methods.

5. Conclusion

In conclusion, the PBL workshop at SDN 2 Aikmual effectively enhanced literacy and numeracy skills among participants, supported by quantitative analysis indicating significant improvement and qualitative feedback affirming positive learning experiences. The workshop's success underscores the potential of problem-based learning in transforming educational practices and fostering a stimulating learning environment. By bridging theory with practice and integrating student feedback, educators can optimize teaching methodologies to meet the evolving needs of learners. Moving

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forward, continued research and implementation of innovative pedagogical approaches like PBL are essential in advancing educational excellence and preparing students for future challenges in a rapidly changing world.

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