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Integrating Local Wisdom with Project-Based Learning to Enhance 21st-Century Skills in the Society 5.0 Era

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Abstract

In the context of Society 5.0, education must equip students with essential 21st-century skills such as problem-solving, collaboration, and creativity. However, traditional teacher-centered methods often fail to develop these competencies effectively. To address this issue, we developed a Project-Based Learning Model integrated with local wisdom (PBLM-e) within the Merdeka Belajar framework. The PBLM-e model enhances critical thinking and problem-solving skills by embedding culturally relevant, real-world problems into the learning process. This study employed a mixed-method approach, combining Research & Development (R&D) and experimental design, with 116 junior high school students in Makassar, Indonesia. Pre- and post-tests assessed students' problem-solving abilities across four key indicators: understanding the problem, devising a plan, executing the plan, and reflecting on the solution. Results showed significant improvements in all indicators, demonstrating the model's effectiveness in fostering essential skills. The integration of local wisdom made learning more meaningful, connecting academic content with students' cultural contexts. The PBLM-e model presents a practical approach to preparing students for the challenges of Society 5.0, and future research should explore its long-term impact and the potential for incorporating advanced technologies.

Keywords: *21st-Century Skills, Project-Based Learning, Local Wisdom, Merdeka Belajar, Society 5.0.*

Introduction

Educational practices in many Indonesian schools continue to be predominantly teacher-centered, relying on traditional methods such as lectures and rote memorization (Bilad et al., 2024; Fadhil Zil Ikram & Rosidah, 2023; Muhammad et al., 2023). These approaches often create passive learning environments, where students receive information without actively engaging in the learning process. This is particularly problematic in mathematics education, where teacher-centered instruction has been linked to low levels of student engagement and poor development of critical 21st-century skills such as problem-solving, creativity, and critical thinking (Lee & Paul, 2023; Syarif et al., 2024; Usmeldi & Amini, 2022). In Makassar's junior high schools, several studies (Aras et al., 2023; Suyastini, 2017), including those by Zaki et al. (2022), have revealed that the over-reliance on traditional instructional methods results in monotonous learning experiences that fail to encourage interactive, student-centered approaches. This gap between current educational practices and the skills required in today's world highlights the urgent need for reform.

To address these shortcomings, the Indonesian Ministry of Education introduced the *Merdeka Belajar* (Freedom to Learn) curriculum, designed to promote autonomy, creativity, and student-centered learning (Abidarda & Haryadi, 2024; Azmi et al., 2023). This curriculum encourages teachers to move away from rigid, teacher-led instruction and foster a more dynamic, interactive learning environment where students actively explore, question, and collaborate. *Merdeka Belajar* aligns with global educational reforms aimed at cultivating critical thinking, digital literacy, and collaboration, which are essential for students to thrive in the evolving landscape of *Society 5.0*—an era where advanced technologies such as artificial intelligence (AI), robotics, and the Internet of Things (IoT) seamlessly integrate with human-centered innovations to solve complex societal problems (Luchang & Mohamad Nasri, 2023; Varma et al., 2024).

Despite the introduction of this curriculum, many traditional teaching methods persist, continuing to hinder the development of essential skills for the 21st century (De Villiers, 2024; Varma et al., 2024). In

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this era, education systems must go beyond technical skills, equipping students with critical thinking, adaptability, and the ability to address real-world challenges. However, as Lee and Paul (Lee & Paul, 2023) argue, traditional teaching methods continue to hinder the development of these essential skills, underscoring the need for innovative instructional models that incorporate both global competencies and local cultural contexts.

Project-Based Learning (PBL) has emerged as a promising approach to engaging students in meaningful, real-world learning experiences (Luchang & Mohamad Nasri, 2023). PBL emphasizes collaboration, problem-solving, and creativity by allowing students to work on projects that connect academic content to real-life challenges (Winarko, 2024). When integrated with local wisdom, PBL not only fosters deep learning but also enhances cultural relevance by linking educational content to students' everyday experiences and heritage (Dewi et al., 2022; Lembang et al., 2024). Sakman et al. (2024) highlight that incorporating local wisdom into the curriculum can deepen students' understanding of academic concepts while preserving cultural heritage, creating a more holistic and meaningful learning experience. This approach aligns closely with the goals of *Merdeka Belajar*, empowering students to take ownership of their learning while applying their knowledge to culturally relevant problems.

In light of these needs, this study aims to develop and implement a Project-Based Learning Model integrated with local wisdom (PBLM-e) to enhance students' problem-solving skills within the context of *Society 5.0*. By embedding culturally relevant, real-world problems into mathematics instruction, the PBLM-e model seeks to address the limitations of traditional teaching methods and better prepare students for the demands of an increasingly complex, technology-driven future. This study offers a practical and innovative approach to bridging the gap between current educational practices and the evolving needs of modern society.

Method

This study employed a mixed-method approach combining Research & Development (R&D) and experimental design to develop and evaluate the effectiveness of a Project-Based Learning Model integrated with local wisdom (PBLM-e). The model was designed to enhance students' problem-solving skills in line with 21st-century learning goals and the demands of *Society 5.0*. The research followed a systematic process comprising two phases: model development and model evaluation.

Research Design

The study adopted the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) to guide the R&D process (Campbell, 2014; Creswell & Creswell, 2023; Molenda, 2015). This framework ensured the systematic creation and refinement of the PBLM-e model, making it practical and effective for classroom use. In addition, an experimental design with a pretest-posttest approach was employed to assess the model's impact on students' problem-solving skills. This method allowed for a direct comparison of students' performance before and after the intervention.

Research Setting and Participants

The research was conducted in three junior high schools in Makassar, Indonesia: SMPN 6 Makassar, SMPN 26 Makassar, and SMP Unismuh Makassar. These schools were selected based on their "A" accreditation status, which ensured high educational standards. A total of 116 eighth-grade students from four classes (VIIIA of SMPN 6, VIIIC of SMPN 26, and VIIIA and VIIIB of SMP Unismuh) participated in the study. The sample represented a diverse range of academic performance levels, categorized as high, medium, and low, based on the students' prior academic records. This stratified sampling ensured a balanced representation of different student abilities (Table 1).

Development of the PBLM-e Model

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The development of the Project-Based Learning Model integrated with local wisdom (PBLM-e) followed the ADDIE framework, which encompasses five stages: Analysis, Design, Development, Implementation, and Evaluation. In the *Analysis* stage, the research team identified the specific problem-solving skills required for success in *Society 5.0* and assessed the role that local wisdom could play in enhancing these skills within the educational context. A needs assessment was conducted to analyze the shortcomings of traditional instructional methods currently employed in junior high schools in Makassar. During the *Design* stage, a culturally relevant framework was crafted, incorporating real-world problems grounded in the local wisdom of the Bugis-Makassar community. This design aimed to create a more engaging and contextually meaningful learning experience by aligning educational content with students' cultural backgrounds.

Table 1. Overview Of Research Subject

No.	School	Class	Accreditation	Criteria level	Student
1	SMPN 6 Makassar	VIIIA	A	High	30
2	SMP Unismuh Makassar	VIIIA	A	Currently	27
3	SMP Unismuh Makassar	VIIIB	A	Currently	29
4	SMPN 26 Makassar	VIIIC	A	Low	30
Total					116

The *Development* phase focused on transforming the designed framework into practical instructional materials, including detailed lesson plans, project guidelines, and assessment tools tailored to the PBLM-e model. These materials underwent expert review to ensure their validity and relevance, both educationally and culturally. The *Implementation* phase involved the rollout of the PBLM-e model in the selected junior high schools over an eight-week period. Teachers facilitated the project-based learning activities, guiding students through tasks that required them to integrate local cultural wisdom with mathematical problem-solving. Finally, in the *Evaluation* stage, both formative and summative assessments were employed. Formative assessments, conducted through ongoing feedback from students and teachers, helped refine the model in real-time, while summative evaluations, through pretests and posttests, measured the model's overall effectiveness in enhancing students' problem-solving abilities.

Data Collection

Data for this study were collected using a combination of quantitative and qualitative methods to comprehensively assess the impact of the PBLM-e model on student learning. First, standardized problem-solving ability tests were administered to evaluate students' skills across four key indicators: understanding the problem, devising a plan, executing the plan, and reflecting on the solution. These tests were conducted before (pretest) and after (posttest) the implementation of the PBLM-e model, allowing for a direct comparison of students' performance over time. Additionally, classroom observations were conducted throughout the implementation phase to capture student engagement, the quality of collaboration, and the practical application of local wisdom in solving real-world problems. Observers also noted teachers' instructional methods and their interactions with students during project-based activities.

Furthermore, semi-structured interviews with both teachers and students provided qualitative insights into their experiences with the PBLM-e model. Teachers shared their perspectives on the model's practicality and effectiveness, while students reflected on how the model influenced their learning and engagement. Lastly, students' project outputs and reflection reports were analyzed to evaluate their ability to apply mathematical concepts in culturally relevant contexts. This combination of methods ensured a holistic understanding of the model's effectiveness, both in terms of measurable outcomes and user experiences.

Data Analysis

The data analysis process combined both quantitative and qualitative techniques to offer a robust evaluation of the PBLM-e model. Quantitative data from the problem-solving ability tests were analyzed using descriptive statistics, including mean, median, standard deviation, and variance, to summarize the pretest and posttest scores. Paired sample t-tests were conducted to assess the statistical significance of the

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differences between the pretest and posttest results, ensuring that the improvements in problem-solving skills were not due to random chance. Prior to performing the t-tests, normality tests were applied to confirm that the data met the necessary assumptions for parametric testing. All statistical analyses were performed using IBM SPSS software to ensure accuracy and reliability.

On the qualitative side, data collected from observations, interviews, and document analyses were subjected to thematic analysis. This method involved identifying recurring themes and patterns in the data to understand how the PBLM-e model influenced classroom dynamics, student engagement, and the application of local wisdom in solving mathematical problems. These qualitative insights complemented the quantitative findings, providing a deeper understanding of the model's impact and its practical application in the classroom.

Results

The Project-Based Learning Model integrated with local wisdom (PBLM-e) was developed to enhance students' problem-solving skills within the framework of *Merdeka Belajar* and *Society 5.0*. The effectiveness of the model was assessed through pretest and posttest measurements across four key problem-solving indicators: understanding the problem, devising a plan, executing the plan, and reflecting on the solution. The results indicate significant improvements in all indicators, demonstrating the positive impact of the PBLM-e model on students' problem-solving abilities.

The PBLM-e model was structured into five key instructional phases to facilitate student engagement and problem-solving skills development. These phases are outlined in Table 2, which summarizes the instructional process used during the study.

Table 2. The Phases of the PBLM-E Model

Phase	Description
Phase 1: Conveying Learning Objectives and Prior Knowledge Activation	The teacher begins by explaining the learning objectives and connecting the lesson to the students' prior knowledge, particularly through local cultural contexts, to enhance engagement.
Phase 2: Learning Representation with PBLM-e	Students are introduced to project-based tasks related to real-world problems. These tasks require them to use mathematical concepts in collaboration with peers, drawing on local wisdom to find solutions.
Phase 3: Guided Development of Project Task Outcomes	Students work on the project tasks, with the teacher providing guidance, feedback, and clarification throughout the process.
Phase 4: Reviewing and Monitoring Project Task Execution	The teacher monitors student progress, helping them refine their approach to solving the problems and ensuring that they apply both mathematical and cultural knowledge effectively.
Phase 5: Final Presentation and Analysis of Project Outcomes	Students present their project findings, allowing for reflection and peer evaluation, which helps in reinforcing both individual and group learning outcomes.

This structured approach allowed students to progressively engage with real-world, culturally relevant problems, promoting critical thinking and collaboration. Each phase played a specific role in guiding students through the problem-solving process, from understanding the problem to reflecting on their solutions.

Improvement in Problem-Solving Skills

The pretest and posttest scores of 116 students were analyzed to evaluate changes in their problem-solving abilities. Descriptive statistics for each problem-solving indicator—understanding the problem, devising a

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plan, executing the plan, and reflecting on the solution—show notable increases in students' performance following the implementation of the PBLM-e model. Table 3 presents the summary of pretest and posttest results for these indicators.

Table 3. The Statistic Descriptive on the Pretest and Posttest of PSS Indicator

Statistics	UP1	UP2	DP1	DP2	CP1	CP2	LB1	LB2	PSS Pre	PSS Post
Mean	63,24	80,21	57,86	79,00	58,83	80,76	65,31	83,14	61,31	80,78
Median	64	80	56	80	60	80	66	84	61	81
Mode	60	80	56	80	60	80	56	84	61	82
Standard Deviation	10,54	6,17	8,58	6,73	6,74	6,44	9,49	6,21	6,13	3,44
Variance	111	38,08	73,58	45,32	45,36	41,44	90,09	38,62	37,52	11,83
Skewness	0,58	0,06	-1,16	0,00	-0,15	0,05	0,01	-0,27	-0,18	0,09
Kurtosis	0,76	0,57	6,55	-0,10	0,04	-0,08	-0,81	0,20	0,13	0,73
Range	56	32	68	32	32	32	40	32	32	21
Minimum	40	64	12	64	40	64	44	64	43	72
Maximum	96	96	80	96	72	96	84	96	75	93

Understanding the Problem (UP)

The pretest mean score for this indicator was 63.24, which improved significantly to 80.21 in the posttest, reflecting a substantial increase in students' ability to comprehend mathematical problems. The majority of students moved from the "medium" to "high" and "very high" categories, with 68.10% of students in the "high" category and 31.90% in the "very high" category after the intervention (Table 4).

Table 4. Descriptive Of the Understanding the Problem of The Pretest and Posttest

No.	Interval	Category	Pretest		Posttest	
			Frequency	Percentage	Frequency	Percentage
1	0-20	Very Low	0	0,00%	0	0,00%
2	21-40	Low	2	1,72%	0	0,00%
3	41-60	Medium	55	47,41%	0	0,00%
4	61-80	High	52	44,83%	79	68,10%
5	81-100	Very High	7	6,03%	37	31,90%
Total			**116**	**100%**	**116**	**100%**

Devising a Plan (DP)

Before the intervention, most students (70.69%) were classified in the "medium" category for devising a plan, with a mean score of 57.86. After implementing the PBLM-e model, this score rose to 79.00, with 66.33% of students achieving a "high" score and 33.62% reaching the "very high" category, indicating improved planning skills (Table 5).

Table 5. Descriptive Of the Devising a Plan on The Pretest and Posttest

No.	Interval	Category	Pretest		Posttest	
			Frequency	Percentage	Frequency	Percentage
1	0-20	Very Low	1	0,86%	0	0,00%
2	21-40	Low	2	1,72%	0	0,00%
3	41-60	Medium	82	70,69%	0	0,00%
4	61-80	High	31	26,72%	77	66,38%
5	81-100	Very High	0	0,00%	39	33,62%

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Total	116	100%	116	100%

Executing the Plan (CP)

Students' ability to carry out the problem-solving plan improved notably after the PBLM-e intervention. The pretest mean score of 58.83 increased to 80.76 in the posttest. This increase moved the majority of students from the "medium" to "high" and "very high" categories, with 61.21% of students achieving "high" and 38.79% achieving "very high" scores (Table 6).

Table 6. Descriptive of the Executing The Plan on the Pretest And Posttest

No.	Interval	Category	Pretest		Posttest	
			Frequency	Percentage	Frequency	Percentage
1	0-20	Very Low	0	0,00%	0	0,00%
2	21-40	Low	1	0,86%	0	0,00%
3	41-60	Medium	80	68,97%	0	0,00%
4	61-80	High	35	30,17%	71	61,21%
5	81-100	Very High	0	0,00%	45	38,79%
Total			**116**	**100%**	**116**	**100%**

Reflecting on the Solution (LB)

The reflection skills of students also improved significantly, with the mean score rising from 65.31 in the pretest to 83.14 in the posttest. Notably, 57.76% of students reached the "very high" category, demonstrating a strong improvement in their ability to critically evaluate their solutions and reflect on their learning process (Table 7).

Table 7. Descriptive Of the Reflecting on The Solution on The Pretest and Posttest

No.	Interval	Category	Pretest		Posttest	
			Frequency	Percentage	Frequency	Percentage
1	0-20	Very Low	0	0,00%	0	0,00%
2	21-40	Low	0	0,00%	0	0,00%
3	41-60	Medium	45	38,79%	0	0,00%
4	61-80	High	67	57,76%	49	42,24%
5	81-100	Very High	4	3,45%	67	57,76%
Total			**116**	**100%**	**116**	**100%**

Overall Problem-Solving Skills (PSS)

The overall problem-solving skill (PSS) scores increased substantially from the pretest (mean score of 61.31) to the posttest (mean score of 80.78), signifying a marked improvement in students' abilities across all four indicators (Table 8). Prior to the intervention, 56.90% of students were categorized as having "high" problem-solving skills, with no students in the "very high" category. Post-intervention, 54.31% of students moved into the "very high" category, while 45.69% remained in the "high" category, further confirming the effectiveness of the PBLM-e model in enhancing students' overall problem-solving abilities.

Table 8. Descriptive Of the Problem-Solving Skills on The Pretest and Posttest

No.	Interval	Category	Pretest		Posttest	
			Frequency	Percentage	Frequency	Percentage
1	0-20	Very Low	0	0,00%	0	0,00%

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2	21-40	Low	0	0,00%	0	0,00%
3	41-60	Medium	50	43,10%	0	0,00%
4	61-80	High	66	56,90%	53	45,69%
5	81-100	Very High	0	0,00%	63	54,31%
Total			**116**	**100%**	**116**	**100%**

Statistical Analysis of Improvements

To ensure the statistical validity of the observed improvements, paired sample t-tests were conducted for each problem-solving indicator. The t-tests revealed statistically significant differences ($p < 0.05$) between the pretest and posttest scores across all four indicators, confirming the effectiveness of the PBLM-e model in improving students' problem-solving skills. For example, the t-value for the "Understanding the Problem" indicator was 16.087, while "Devising a Plan" recorded a t-value of 22.473, both indicating significant improvement (Table 9).

Classroom Observations and Qualitative Insights

Classroom observations during the implementation phase revealed high levels of student engagement and collaboration, particularly when students applied local wisdom to solve real-world problems. Students appeared more motivated and actively participated in discussions, demonstrating an improved ability to think critically and work collaboratively. The integration of culturally relevant content not only increased students' interest but also made mathematical concepts more relatable and easier to understand.

Qualitative data from student interviews corroborated the quantitative findings. Students expressed that the project-based tasks helped them develop a deeper understanding of mathematical concepts by allowing them to apply their knowledge in real-world contexts that resonated with their cultural background. Teachers also reported that the PBLM-e model encouraged a more interactive and student-centered learning environment, which enhanced students' problem-solving abilities and fostered greater autonomy in learning.

Reflection and Metacognitive Growth

In addition to quantitative improvements, students demonstrated significant growth in metacognitive skills, particularly in the "Reflecting on the Solution" indicator. Interviews and reflection reports indicated that students became more adept at evaluating their problem-solving processes and identifying areas for improvement. This metacognitive growth was seen as a key outcome of the PBLM-e model, as it encouraged students to think critically about their learning and develop a more reflective approach to problem-solving.

Table 9. The Paired Sample T-Test of Problem-Solving Skill

Problem-Solving Skill Score per indicator					
	Paired Samples Test				
	Mean	Variance	t	df	Sig. (2-tailed)
Understand the Problem (UP)					
UP PSS Posttest (UP2)	80.21	38.07	**16,087**	**115**	**0,000**
UP PSS Pretest (UP1)	63.24	111			
Devise a Plan (DP)					
DP PSS Postest (DP2)	79	45.32	**22,473**	**115**	**0,000**
DP PSS Pretest (DP1)	57.86	73.58			
Execute the Plan (CP)					
CP PSS Posttest (CP2)	80.76	41.43	**25,789**	**115**	**0,000**
CP PSS Pretest (CP1)	58.83	45.36			
Reflect on the Solution (LB)					

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LB PSS Posttest (LB2)	83.14	38.62	**20,660**	**115**	**0,000**
LB PSS Pretest (LB1)	65.31	90.09			
Problem-Solving Skill					
		Paired Samples Test			
	Mean	Variance	t	df	Sig. (2-tailed)
PSS Posttest	80.78	11.73	**34,795**	**115**	**0,000**
PSS Pretest	61.31	37.52			

Discussion

The findings of this study demonstrate that the Project-Based Learning Model integrated with local wisdom (PBLM-e) significantly enhanced students' problem-solving abilities across all four key indicators: understanding the problem, devising a plan, executing the plan, and reflecting on the solution. This improvement reflects the potential of integrating culturally relevant content with project-based learning to foster critical 21st-century skills, particularly in the context of *Society 5.0*. These results are consistent with previous studies that have shown the effectiveness of project-based learning in promoting student engagement and problem-solving skills through real-world applications (Lubis & Widjajanti, 2022; Luchang & Mohamad Nasri, 2023).

One of the most significant contributions of the PBLM-e model is its ability to contextualize learning by embedding local wisdom into the curriculum. By incorporating culturally relevant problems into mathematics instruction, the model not only made learning more meaningful but also facilitated a deeper understanding of abstract mathematical concepts. Previous research supports this finding, indicating that when students can relate academic content to their cultural and social contexts, they become more engaged and motivated to learn (Anhalt et al., 2018; Lembang et al., 2024). In this study, students demonstrated significant improvements in their ability to understand problems and devise appropriate plans for solving them, with the majority achieving "high" or "very high" scores post-intervention. This highlights the role of local wisdom in creating a learning environment that resonates with students' experiences and fosters deeper cognitive engagement.

Moreover, the success of the PBLM-e model in improving problem-solving skills aligns with the goals of *Merdeka Belajar*, which promotes student-centered and autonomous learning. The shift from teacher-centered instruction to a more interactive, project-based approach empowered students to take ownership of their learning, thereby fostering critical thinking, creativity, and collaboration—skills that are essential for success in *Society 5.0* (Rochmat et al., 2023). The notable improvements in students' ability to execute their problem-solving plans and reflect on their solutions demonstrate the model's effectiveness in promoting not only cognitive but also metacognitive development. This is particularly important in preparing students for the complexities of the future workforce, where the ability to evaluate and adapt problem-solving strategies will be crucial (Martha Sophia Van Der Walt, 2020; Reinholz, 2016).

The integration of local wisdom into the PBLM-e model also served to bridge the gap between traditional teaching methods and the demands of modern education. Previous studies have shown that teacher-centered methods, which focus on rote memorization and passive learning, often fail to develop the critical thinking and problem-solving skills needed for the 21st century (Lee & Paul, 2023; Limbong et al., 2024). In contrast, the PBLM-e model provided a platform for students to engage in collaborative, inquiry-based learning, which allowed them to actively apply mathematical concepts to real-world problems. This approach not only improved their academic performance but also enhanced their ability to work in teams and communicate effectively, which are essential competencies in a knowledge-based society driven by advanced technologies (Sridana & Sarjana, 2020; Vicente et al., 2022).

Another key aspect of the model's success is its alignment with *Society 5.0*, where technology and human-centered innovation are expected to coexist. In this era, students will need to be adaptable, innovative, and able to solve complex problems in dynamic environments. The PBLM-e model, by emphasizing critical

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thinking and real-world problem-solving, equips students with the skills needed to navigate these challenges. The significant gains in both the "Executing the Plan" and "Reflecting on the Solution" indicators suggest that students became more proficient not only in applying problem-solving strategies but also in critically evaluating their approaches. This reflective practice is crucial for developing lifelong learning skills and adaptability, both of which are key to thriving in *Society 5.0* (Hunter & Civil, 2021; Martha Sophia Van Der Walt, 2020).

Furthermore, the qualitative insights gained from classroom observations and interviews corroborate the quantitative findings. Students expressed that the integration of local wisdom made the learning process more relevant to their lives, increasing their motivation and engagement. Teachers also reported that the PBLM-e model fostered a more interactive and participatory classroom environment, which allowed students to explore and collaborate more freely. These findings align with the theories of culturally responsive pedagogy, which emphasize the importance of connecting learning with students' cultural identities to enhance educational outcomes (Ava, 2020; Rakhmawati & Wulandari, 2023).

However, while the results of this study are promising, there are areas that warrant further investigation. Future research should explore the long-term impacts of the PBLM-e model on students' academic performance, particularly in other subject areas beyond mathematics. Additionally, integrating advanced technologies, such as artificial intelligence and robotics, into the PBLM-e framework could further enhance its relevance and effectiveness in preparing students for *Society 5.0*. By combining technological tools with culturally relevant content, future iterations of the model could offer an even more robust and comprehensive learning experience that better equips students for the digital and interconnected world (De Villiers, 2024; Vicente et al., 2022).

Conclusion

This study has demonstrated the effectiveness of the Project-Based Learning Model integrated with local wisdom (PBLM-e) in enhancing students' problem-solving skills within the *Merdeka Belajar* framework, preparing them for the demands of *Society 5.0*. The model successfully addressed the limitations of traditional teacher-centered instructional methods by fostering a student-centered, interactive learning environment that integrates culturally relevant content. Significant improvements were observed across all four problem-solving indicators—understanding the problem, devising a plan, executing the plan, and reflecting on the solution—showing that students who engaged with real-world, culturally embedded projects developed stronger critical thinking, collaboration, and creativity skills.

The integration of local wisdom not only made the learning experience more relevant and meaningful for students but also deepened their understanding of mathematical concepts by connecting academic content to their cultural backgrounds. This approach aligns with global education trends that emphasize the importance of contextual and culturally responsive pedagogy in developing 21st-century competencies, such as problem-solving, adaptability, and innovation. By incorporating real-world problem-solving tasks linked to local wisdom, the PBLM-e model empowered students to actively participate in their learning, thereby enhancing both cognitive and metacognitive skills.

Moreover, this study contributes to the growing body of research on project-based learning and offers practical insights into how local wisdom can be leveraged to enhance educational outcomes. The model proved not only effective in developing students' problem-solving skills but also practical for classroom use, making it a valuable tool for educators seeking to implement culturally relevant, student-centered learning strategies. The findings suggest that incorporating local culture into educational practices can bridge the gap between traditional instructional methods and the evolving demands of modern education, especially in preparing students for the technologically driven future of *Society 5.0*.

However, while the results are promising, further research is needed to explore the long-term effects of the PBLM-e model on students' academic performance and its applicability across other subjects beyond mathematics. Additionally, future studies could investigate the potential of integrating advanced technologies, such as artificial intelligence and robotics, within the PBLM-e framework to further align

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educational practices with the evolving landscape of *Society 5.0*. In doing so, the model could be further enhanced to equip students with not only problem-solving skills but also digital literacy and technological adaptability.

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