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Implementation of Project-Based Learning to Improve Numeracy Skills in Indonesian Primary Schools

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ABSTRACT

Indonesia's education reform through the Minimum Competency Assessment (AKM) emphasizes foundational skills in literacy and numeracy. However, primary schools often struggle to implement numeracy instruction aligned with AKM due to traditional teaching practices. This study investigates how project-based learning (PjBL) can support AKM implementation by enhancing numeracy skills in real-life contexts. This qualitative case study was conducted at SD Muhammadiyah 3 Kota Malang, selected for its innovative pedagogical practices. Data were collected through classroom observations, in-depth interviews with school leaders and teachers, and document analysis of lesson plans and school reports. Thematic analysis was conducted using the Miles and Huberman interactive model, supported by triangulation and member checking to ensure data credibility. The implementation of PjBL in mathematics instruction increased student engagement and improved numeracy competencies, particularly in interpreting data, solving contextual problems, and performing basic calculations. A 15% increase in AKM-related numeracy scores was recorded in the school's 2023–2024 education quality report. Key themes identified include real-world contextualization, collaborative teacher planning, parental involvement, and student confidence development. PjBL offers a viable approach to integrating AKM in primary education by connecting mathematical concepts with authentic, everyday experiences. This study highlights the importance of whole-school collaboration, contextual instruction, and community engagement in strengthening students' numeracy outcomes and readiness for competency-based assessments.

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1. INTRODUCTION

In an effort to improve the quality of national education, the Ministry of Education and Culture of the Republic of Indonesia initiated a fundamental change in the student learning assessment system through the implementation of the Minimum Competency Assessment (*Asesmen Kompetensi*

Minimum/AKM), which replaced the National Examination (Ujian Nasional/UN). AKM aims to measure students' core competencies in literacy and numeracy as the foundation for critical thinking, problem-solving, and preparedness to face the challenges of the 21st century (Kemendikbud, 2019) (Peraturan Menteri Riset, Teknologi, 2019). However, at the primary school level, the implementation of this policy still faces various complex challenges, including limited teacher understanding, suboptimal contextual learning facilities, and a lack of integration between pedagogical approaches and competency-based assessment (Venters et al., 2018; Tabone, Rishel, Hartnett, & Szafran, 2020).

Specifically in mathematics learning, the challenges of implementing AKM are even more complex due to the predominance of procedural, rote-based instructional approaches by teachers, rather than concept understanding and real-life application. In fact, the numeracy competencies assessed by AKM emphasize students' abilities to reason mathematically, solve contextual problems, and interpret data in various visual forms such as graphs, tables, and diagrams (Schlegel et al., 2019; Peters, Ehm, Wolstein, & Mischo, 2022). Therefore, there is an urgent need for more innovative, interactive, and meaningful learning approaches to foster comprehensive and sustainable numeracy skills.

In recent years, Indonesia has undergone significant education reform, most notably through the introduction of the Minimum Competency Assessment (Asesmen Kompetensi Minimum/AKM), which aims to measure students' core skills in literacy and numeracy. AKM shifts the focus from content memorization to real-life application, critical thinking, and problem-solving. However, despite the policy shift, many primary school classrooms continue to rely on traditional, teacher-centered approaches that emphasize procedural learning.

There is limited empirical evidence on how AKM-aligned instruction is practically implemented at the classroom level, particularly in primary mathematics education. This study addresses that gap by exploring how Project-Based Learning (PjBL), as a student-centered and contextualized instructional model, can support the implementation of AKM and improve numeracy learning outcomes. Specifically, the study investigates the instructional strategies used, the learning processes observed, and the measurable impacts on student competencies.

The study is guided by the following research question: How does project-based learning contribute to the development of numeracy competencies within the context of AKM implementation in a primary school setting? Previous studies have shown that PjBL enhances student engagement, fosters collaboration, and promotes deeper understanding (Holdway & Hitchcock, 2018)(Hemelt & Lenard, 2020). However, few studies have linked these benefits directly to national competency-based assessments such as AKM. In contrast, research from other countries—such as Australia's NAPLAN, the OECD's PISA, or the TIMSS international benchmark—highlights the importance of aligning pedagogy with assessment frameworks to support students' 21st-century skills (Triventi, Barone, & Facchini, 2021)(Naparan & Alinsug, 2021). These findings suggest a need to contextualize such instructional models within national assessment policies like AKM.

This study is grounded in constructivist learning theory, particularly Bruner's framework, which emphasizes the importance of learning through discovery and real-life experiences. Project-based learning aligns with constructivist principles by engaging students in meaningful tasks that connect mathematical concepts with real-world contexts. Through this lens, the implementation of PjBL serves as both an instructional strategy and a tool for competency development aligned with the AKM framework.

By examining the experience of SD Muhammadiyah 3 Kota Malang—an Indonesian primary school recognized for its innovative approach to AKM integration—this research aims to contribute to the broader discourse on how assessment reform can be supported through pedagogical innovation.

2. METHODS

2.1. Research Design and Approach

This study employed a descriptive qualitative approach aimed at providing an in-depth portrayal of the implementation process of the Minimum Competency Assessment (AKM) in mathematics learning for upper-grade students at SD Muhammadiyah 3 Kota Malang. This approach was chosen to enable the researcher to capture the learning dynamics in a contextual, natural, and comprehensive manner, including how teachers design numeracy instruction, how students interact during the learning process, and how the school principal and the broader school ecosystem support the integration of AKM.

The selection of SD Muhammadiyah 3 Kota Malang was not only based on its high AKM performance but also due to its consistent implementation of project-based and contextual learning models, the school's collaborative teaching culture, and recognition by the local education office for pedagogical innovation. The school was awarded as a high-achievement institution in the BOS Performance category based on AKM results and had implemented a STEAM-based approach throughout all grade levels, including an early introduction to literacy and numeracy from Grade 1.

The use of a descriptive qualitative research design is appropriate in this context, as it allows for the exploration of complex phenomena that cannot be quantitatively measured, but can be examined through the experiences, actions, and perceptions of educational stakeholders (Confrey et al., 2018)(Davidson et al., 2018).

2.2. Research Site and Subjects

The research was conducted at SD Muhammadiyah 3 Kota Malang, selected for its strong commitment to integrating literacy- and numeracy-based learning in accordance with the AKM framework. The school has also demonstrated measurable improvements in its educational quality report and has been recognised as one of the best-performing schools in AKM-based progress.

The research subjects consisted of:

a) The principal,
b) Fourth-grade teachers, and
c) Fourth-grade students.

The researcher conducted direct observations of five Grade 4 mathematics lessons during September to November 2024. These observations focused on contextual numeracy instruction through project-based activities. Additionally, eight school documents were analyzed, including lesson plans, student learning modules, report cards (Rapor Mutu), visual documentation of project activities (e.g., bazaars and guest teacher programs), and AKM-related assessment records.

A purposive sampling technique was used to select informants who were considered to have relevant, in-depth, and experienced knowledge regarding the implementation of the Minimum Competency Assessment (AKM).

2.3. Data Collection Techniques

The data analysis process employed Miles and Huberman's interactive model, consisting of data collection, data reduction, data display, and conclusion drawing. Thematic coding was conducted manually. Codes were first generated inductively from transcribed interviews, field notes, and document data. These codes were then grouped into themes reflecting core areas such as "project-based learning in numeracy," "student engagement," "school-wide collaboration," and "contextual mathematics practices." Although no qualitative software (e.g., NVivo or ATLAS.ti) was used, the credibility of findings was ensured through triangulation (sources and techniques), peer debriefing, and member checking with participants.

Data collection was carried out using three complementary techniques (method triangulation), namely:

a) In-depth Interviews
   Structured and semi-structured interviews were conducted with the school principal and fourth-grade teachers. The interview topics included understanding of the AKM framework, strategies for teaching numeracy, integration of literacy into mathematics instruction, as well as the challenges and solutions encountered during the implementation of AKM.
b) Direct Observation
   The researcher observed the mathematics learning process that integrated AKM-based numeracy activities. The observations covered teaching methods, use of instructional media, teacher-student interactions, and project-based activities such as school bazaars and tile pattern simulations in mathematics lessons.
c) Document Analysis
   The documents analyzed included lesson plans, the school's quality report (rapor mutu pendidikan), school policies related to AKM, and records of numeracy and literacy learning activities.

2.4. Data Analysis and Validity Verification Techniques

The research adhered to ethical standards and received approval from the Graduate Program of Universitas Muhammadiyah Malang. Prior to data collection, informed consent was obtained from all participants, including the school principal, classroom teachers, and students' parents. The participants were assured of the confidentiality and voluntary nature of their involvement. Pseudonyms were used in transcripts and reports to protect participant identities.

Data analysis was conducted using the interactive model proposed by Miles and Huberman, which consists of the following stages:

a) Data Collection
   Data were collected throughout the interview, observation, and document study processes.
b) Data Reduction
   The collected data were filtered and summarized to focus on key themes such as implementation strategies, student numeracy outcomes, and the role of teachers.
c) Data Display
   Data were organized in the form of narratives, quotations, and tables to facilitate thematic analysis and interpretation.
d) Conclusion Drawing and Verification
   Conclusions were drawn based on emerging patterns and were then verified through triangulation and confirmation with the informants (member checking).
   To ensure data validity and reliability, this study applied the following techniques:

a) Source Triangulation**:** Comparing data from the principal, teachers, and students.
b) Method Triangulation: Cross-checking data obtained from interviews, observations, and document analysis.
c) Member Checking: Confirming the interpreted findings with the informants.
d) Audit Trail: Maintaining detailed records of the data collection and analysis process to ensure transparency and traceability.

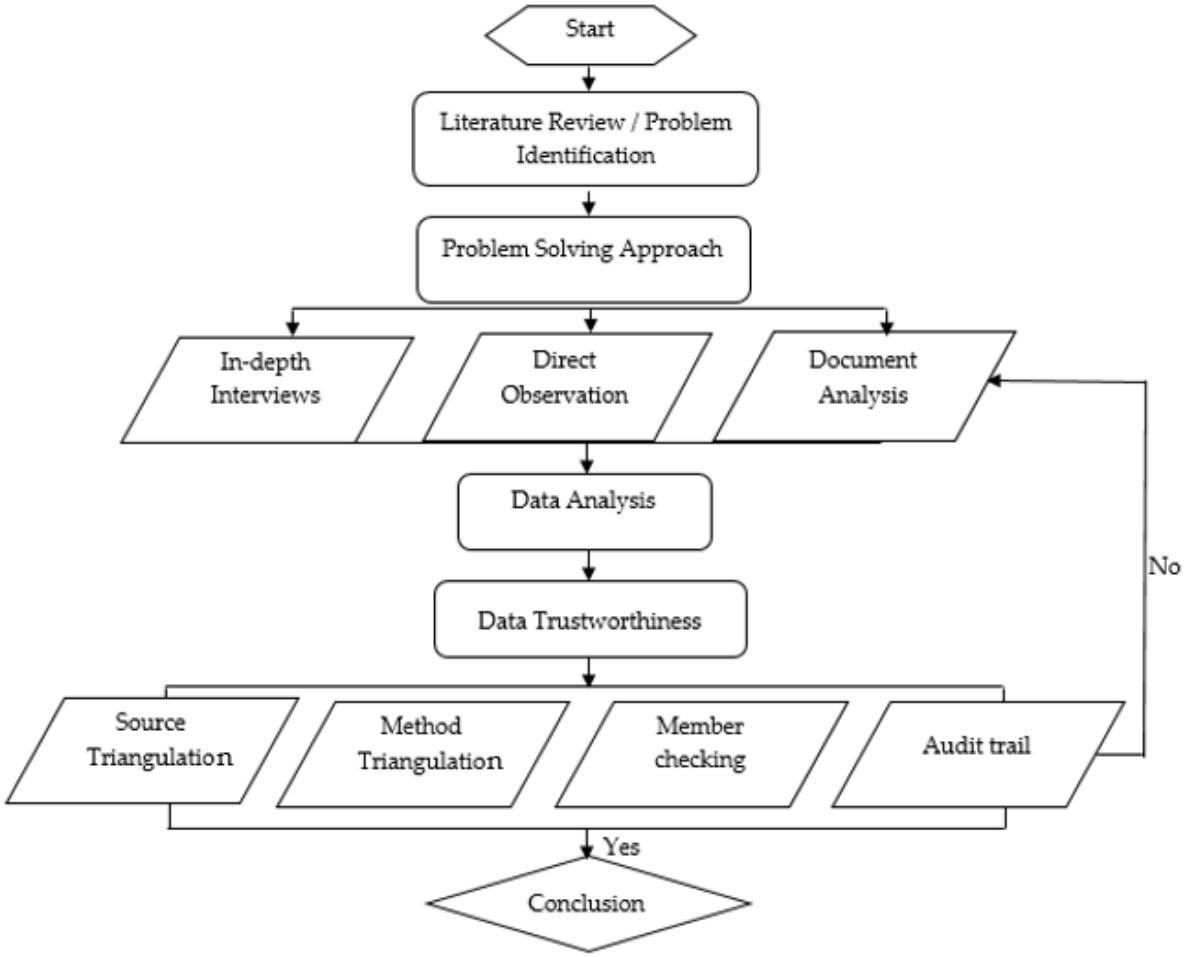

Figure 1. Qualitative Research Flow

3. FINDINGS AND DISCUSSION

3.1. Findings of the Study

This section presents the results of the study, organized into four major themes that align with the research objectives. The data were collected through interviews, classroom observations, and document analysis.

3.1.1 Theme 1: Real-World Contextualization through Project-Based Learning

SD Muhammadiyah 3 Kota Malang implemented contextual numeracy learning through project-based activities. Observations from five mathematics lessons revealed that students were involved in practical exercises such as calculating multiples using tile patterns in the classroom and performing simple transactions during school bazaars.

> *"We designed a lesson using tile arrangements. Students calculated multiples based on real patterns in the classroom. They worked in teams and discussed their results." (Grade 4 Teacher)*

Supporting documents, including lesson plans and visual records, confirmed the school's consistent effort to embed numeracy in real-life applications, in line with AKM principles.

3.1.2 Theme 2: Teacher Collaboration and Shared Practice

Collaboration among teachers played a central role in the implementation of AKM-based instruction. Daily discussions were held before and after class to share strategies, challenges, and reflections.

> *"We regularly meet before class to evaluate what went well and what needs adjustment. This really helps us grow together as a teaching team." (Principal)*

Documentation of meeting notes and planning records supported this collaborative culture.

3.1.3 Theme 3: Community and Parental Engagement

The school actively engaged parents through the "guest teacher" program, where parents were invited to share their professions and experiences with students. These activities linked literacy and numeracy to real-world applications.

> *"After listening to a guest parent who was a journalist, I wanted to read and write more like them." (Student)*

Photos and program documentation showed high student interest and participation.

3.1.4 Theme 4: Student Empowerment and Confidence

Through project-based learning and contextual instruction, students developed increased confidence in solving AKM-related problems. Interviews indicated that students felt better prepared and more engaged.

> *"I enjoy math more now because we use things like money and games. It helps me understand better." (Student)*

Observation data and student reflections confirmed that learning activities were effective in improving student motivation and comprehension.

Table 1. Summary of Findings

Theme	Evidence Sources	Examples
Contextualized Learning	Observation, Interviews, Documents	Tile math, school bazaar, project worksheets
Teacher Collaboration	Interviews, Planning Records	Daily briefings, co-teaching strategies
Parental Involvement	Observation, Documents	Guest teacher program, student reflections
Student Empowerment	Interviews, Observations, AKM Practices	Confidence quotes, active participation

Each theme addresses one or more of the research objectives: the implementation of AKM, student learning outcomes, and key factors contributing to AKM success at the school.

3.2. Implementation of AKM in Mathematics Learning

The AKM implementation at SD Muhammadiyah 3 Kota Malang reflects a shift toward contextual and meaningful learning, with teachers applying project-based and thematic approaches to integrate

literacy and numeracy. Activities like calculating expenses at bazaars and arranging tiles for math concepts illustrate real-life application beyond traditional problem-solving.

The strategies implemented by the teachers align with Bruner's constructivist theory (1960) (Corcoran, Cheung, Kim, & Xie, 2018), which emphasizes that learning should enable students to construct their own understanding through exploration and interaction with their environment. In this approach, the teacher functions as a facilitator of exploration rather than merely a transmitter of information. This view is consistent with (Connor et al., 2020), who assert that in the context of AKM, mathematics instruction should be designed based on real-life experiences to foster students' critical and reflective thinking skills.

Furthermore, the project-based approach has proven effective in enhancing student engagement and learning motivation. Research by (V. A. Coelho, Romão, Silva, & Saldanha, 2021) shows that elementary school students engaged in problem-based learning demonstrated significant improvements in numeracy skills and confidence in solving AKM-contextualized problems. This observation is echoed by teachers at SD Muhammadiyah 3, who noted that students became more active and self-assured when working on narrative-based numeracy problems.

The implemented instruction also places a strong emphasis on student collaboration. Group discussions, teamwork, and reflective activities are integral components of the learning process. These methods not only strengthen students' mathematical understanding but also develop their communication and social skills. As (F. J. Coelho, Evanschitzky, Sousa, Olya, & Taheri, 2020) and (Magadley, Amara, & Jabareen, 2019) explains, the integration of social skills in numeracy instruction enriches the learning experience and deepens students' comprehension of abstract concepts.

With a structured approach and strong learning ecosystem, the implementation of AKM at SD Muhammadiyah 3 Kota Malang illustrates that competency-based assessment can serve as an entry point for building adaptive, participatory, and transformative learning processes—particularly in mathematics education.

The teachers at SD Muhammadiyah 3 Kota Malang design learning activities that are integrated with literacy and numeracy, as described by the principal during an interview:

> *"The implementation of AKM provides a clear framework for teachers to design more interactive and contextual learning activities, creating a learning environment that focuses not only on content mastery but also on deep understanding and the application of concepts in everyday life. The instruction is designed using a thematic approach that encourages students to read, analyze, and solve problems within real-life contexts. To strengthen literacy, the school implements a guest teacher program, in which a parent with a specific profession is invited to share their experiences and insights. Additionally, a quiz tree activity is used to reinforce knowledge retention. To enhance numeracy skills, the school organizes bazaar events, where students engage in real-world mathematical applications such as budgeting, counting, and managing transactions."*

The statement from the principal's interview is further supported by a fourth-grade teacher, as reflected in the following excerpt:

> *"All teachers at SD Muhammadiyah 3 Kota Malang consistently apply a variety of instructional methods that emphasize conceptual understanding and real-life application. These methods include the use of relevant teaching aids, educational games, and project-based activities that actively engage students. By utilizing tools such as math blocks, objects from the surrounding environment, and other visual calculation aids, students are able to directly observe the connection between mathematical concepts and their practical applications. This not only makes learning more engaging but also helps students grasp the material more effectively.The activities we conduct include project-based learning, group discussions, and story-based problem-solving exercises that reflect the AKM context. In addition, we use visual media such as graphs and tables to strengthen students' numeracy skills. To enhance literacy, the school also runs a guest teacher*

program, where a parent with a particular profession is invited to share their experiences. We also use a quiz tree activity to reinforce knowledge. For numeracy reinforcement, we organize school bazaars as hands-on learning experiences."

To increase active student engagement in the learning process, teachers incorporate educational games, utilize the surrounding environment and everyday objects, and implement various project-based learning activities. As stated by a fourth-grade teacher during the interview:

"At SD Muhammadiyah 3 Kota Malang, we design learning experiences using games and by utilizing objects from the surrounding environment. Students are not only learning theoretical concepts but are also practicing collaborative problem-solving. Project-based activities are an integral part of the instructional approach in fourth grade. By engaging students in real-world projects, they are given opportunities to apply what they have learned in broader contexts, thereby deepening their understanding of the subject matter."

The implementation of literacy- and numeracy-integrated instruction using a project-based learning model has demonstrated a significant improvement in students' understanding of multiplication and factor concepts. Student feedback indicates that they feel more confident when tackling problems related to these topics. This is supported by a statement from a fourth-grade student at SD Muhammadiyah 3 Kota Malang, as follows:

"With the project-based learning model, it becomes easier for us to understand the material because we can directly see how multiplication concepts apply in daily life. I also feel more confident when solving problems given by the teacher. I really enjoy it when parents come and share stories about their professions—it inspires me to learn more about reading and writing. The school bazaar also helps strengthen our numeracy. During the bazaar, we learn to count money and make buying and selling transactions. It really helps us better understand number concepts and how to calculate."

The following is documentation of the implementation of literacy- and numeracy-integrated learning activities.

Figure 2. Documentation of Bazaar Activities and Student Journalism Practice for Strengthening Literacy and Numeracy Skills

Figure 3. Documentation of Classroom Learning Activities

Based on the in-depth findings of this study, it can be concluded that the implementation of the Minimum Competency Assessment (AKM) in mathematics instruction at SD Muhammadiyah 3 Kota Malang has been carried out effectively and innovatively. Teachers at the school have successfully designed thematic learning activities integrated with literacy and numeracy, shifting the focus beyond mere content mastery to creating relevant, contextual, and meaningful learning experiences for students.

Mathematics instruction is no longer separated from real-life contexts; rather, it is structured to help students understand the connection between numeracy concepts and everyday activities. Through various methods such as tile arrangement projects, school bazaars, quiz trees, and parent involvement in the guest teacher program, students are encouraged to participate actively, think critically, and develop collaborative and social skills.

Numeracy skills are concretely strengthened through activities such as buying and selling simulations, money counting, and mathematical pattern interpretation, which not only improve learning outcomes but also foster students' motivation and self-confidence. Teachers provide constructive feedback consistently to support students' continuous improvement throughout the learning process.

The success of AKM implementation is strongly supported by school leadership that fosters innovation, the professionalism of reflective and adaptive teachers, and the active involvement of parents in supporting holistic education. This collaboration among stakeholders creates a learning ecosystem that effectively strengthens students' foundational competencies in line with the goals of the AKM.

Therefore, the practices implemented at SD Muhammadiyah 3 Kota Malang can serve as a model of best practice in AKM application at the primary school level, particularly in developing literacy and numeracy skills in a comprehensive and sustainable manner.

3.3. Student Literacy and Numeracy Outcomes

A significant improvement in AKM numeracy results was clearly observed in the 2023 and 2024 educational quality reports (*rapor mutu pendidikan*) of SD Muhammadiyah 3 Kota Malang. According to teachers, students showed increased abilities in reading graphs, interpreting tables, and solving word problems involving numerical calculations. These outcomes indicate that students' understanding has shifted from procedural knowledge toward conceptual comprehension and practical application of basic mathematical concepts.

These findings are supported by research conducted by (Bakmohammadi & Noorzai, 2020) and (Asbell-Clarke et al., 2021), which stated that students' success in AKM is strongly influenced by regular exposure to visual data-based learning and the integration of literacy and numeracy across various classroom activities. At SD Muhammadiyah 3, teachers have adopted these practices through the use of visual media such as sales graphs from school bazaars, contextual worksheets, and guided discussions to enhance students' understanding.

In addition to academic achievement, students also demonstrated increased motivation to learn. Many students expressed that mathematics learning became more enjoyable when connected to real-life activities, such as buying and selling during school bazaars or calculating logistical needs for class projects. Research by (Gray, McElveen, Green, & Bryant, 2020) and (de Mendonca, da Silva Rosa, & Bello, 2019) emphasized that an active and interactive learning environment has a positive impact on students' perceptions of mathematics, thereby increasing their interest and engagement in the learning process.

The learning model implemented at the school also encourages students to think across disciplines. Through the integration of the STEAM approach (Science, Technology, Engineering, Arts, and Mathematics), students not only learn arithmetic but also engage in designing, pattern recognition, and making predictions. This aligns with the findings of (Sauve & Schonert-Reichl, 2019), which highlight that the STEAM approach enhances numeracy competencies by fostering integrative and analytical thinking among students.

Overall, the students' literacy and numeracy achievements suggest that contextual and collaborative mathematics instruction can improve both cognitive and affective learning outcomes. This serves as further evidence that the integration of AKM into classroom practices contributes meaningfully to the enhancement of primary education quality.

The implementation of AKM at SD Muhammadiyah 3 Kota Malang has had a positive impact on student learning outcomes, as stated by the principal during an interview:

> *"Students' numeracy scores have shown consistent improvement over the years. In the 2023 educational quality report (*rapor mutu pendidikan*), SD Muhammadiyah 3 Kota Malang received a "Good" rating with higher scores compared to the previous year. This achievement is the result of collaborative efforts among teachers, students, and parents in supporting the learning process. Moreover, the mathematics instruction applied at the school is highly focused on developing students' core competencies, enabling them to understand concepts more effectively."*

The statement from the principal is reinforced by a fourth-grade teacher, who shared the following during an interview:

> *"We implement various interactive and contextual learning strategies. By using the Project-Based Learning model, students are encouraged to actively participate in understanding the concept of multiples through hands-on activities. The 2024 educational quality report shows further significant improvement, again earning a 'Good' rating with higher scores than in 2023. This indicates that students are not only memorizing content but also understanding and applying numeracy concepts in real-life situations."*

An interactive and enjoyable learning atmosphere, where instructional methods such as games and projects are used regularly, has made the mathematics learning process more engaging for students. As stated by a fourth-grade student during an interview:

> *"I enjoy learning mathematics because we often do fun activities like games and projects. This helps me understand the material more easily. After participating in interactive learning activities, I feel more confident when working on AKM questions. I also like it when the teacher explains concepts using real-life examples."*

These interview statements confirm that the implementation of AKM at SD Muhammadiyah 3 Kota Malang has successfully improved students' literacy and numeracy outcomes. With a "Good" rating in the 2023 report and further improvement in 2024, there has been significant progress in students' foundational competencies. This success reflects the collaborative efforts among school leaders, teachers, students, and parents in creating a supportive and conducive learning environment.

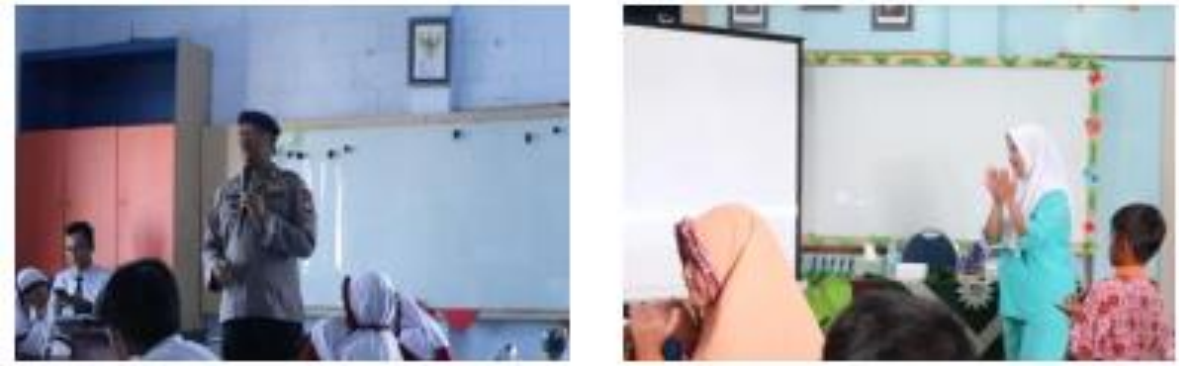

Figure 4. Documentation of the Guest Teacher Program Activities

The implementation of AKM at SD Muhammadiyah 3 Kota Malang has positively impacted student numeracy outcomes, as seen in the upward trend in the 2023 educational quality report. This success is supported by Project-Based Learning, which enables students to apply mathematical concepts in real-life contexts like tile projects and school bazaars. An interactive classroom atmosphere boosts confidence and motivation, while parental involvement through the guest teacher program enhances learning relevance. This integrated approach offers a replicable model for effective AKM implementation in other primary schools.

Discussion

The discussion of this study highlights that the successful implementation of the Minimum Competency Assessment (AKM) at SD Muhammadiyah 3 Kota Malang is strongly influenced by a collaborative and systemic approach involving school leaders, teachers, students, and parents. Rather than treating AKM as a standalone assessment activity, the school embedded literacy and numeracy development into daily instructional practices from the beginning of the academic year. This finding reinforces the idea that competency-based assessment is most effective when it is aligned with ongoing teaching and learning processes, not when it is introduced as an isolated testing agenda. The principal's role as an instructional leader was central in creating this alignment by encouraging innovation, fostering reflective dialogue, and supporting learning models that emphasize context, projects, and student engagement. Leadership that prioritizes pedagogical coherence and teacher empowerment has been widely recognized as a key driver of successful educational reform, particularly in assessment-oriented initiatives (Meyers et al., 2019).

Teacher collaboration emerged as one of the most influential supporting factors in AKM implementation. Daily discussions before and after lessons enabled teachers to reflect on instructional strategies, share classroom experiences, and collectively respond to students' learning needs. This reflective practice aligns with the concept of professional learning communities, where continuous dialogue and peer support contribute to improved instructional quality (Vidergor et al., 2019). The findings suggest that teachers' shared responsibility for literacy and numeracy development across grade levels helped establish a coherent learning progression, ensuring that students developed foundational competencies consistently over time. Such collaboration also allowed teachers to use formative assessment data more effectively, adjusting instruction based on students' strengths and difficulties. This supports previous research indicating that reflective teaching and data-informed instruction are critical for enhancing student learning outcomes in competency-based assessment systems (Meyers et al., 2019).

The active involvement of parents through initiatives such as the "guest teacher" program further strengthened AKM implementation by connecting classroom learning with real-life experiences. Parents contributed practical knowledge related to professions, daily numeracy use, and problem-solving, which helped students see the relevance of literacy and numeracy beyond school. This finding

is consistent with studies showing that family engagement positively influences students' academic readiness and motivation, particularly in numeracy learning (Nyoni & Botma, 2019; Shin et al., 2019). By positioning parents as learning partners rather than passive observers, the school expanded the learning ecosystem and reinforced the contextual nature of AKM competencies. This approach also helped bridge the gap between formal instruction and everyday applications of mathematics and literacy, making learning more meaningful for students.

From the students' perspective, peer collaboration and a supportive classroom environment played an important role in their learning success. Students reported that studying together, helping one another, and engaging in group discussions made learning more enjoyable and improved their understanding. This aligns with Vygotsky's sociocultural theory, which emphasizes that learning is socially constructed through interaction and shared experiences. When students are encouraged to collaborate and support one another, they are more likely to take academic risks, ask questions, and develop deeper conceptual understanding. The inclusive and flexible classroom atmosphere observed in this study fostered confidence and motivation, which are essential for success in competency-based assessments like AKM.

The use of contextual and project-based learning approaches further supports the theoretical framework of contextual learning theory, which stresses the importance of linking academic content to authentic situations (Shin et al., 2019). Activities such as calculating tile patterns, managing transactions in school bazaars, and solving real-world problems allowed students to apply numeracy skills in meaningful contexts. This approach not only enhanced engagement but also supported deeper understanding, as students could directly observe the usefulness of mathematical concepts. Nyoni and Botma (2019) similarly argue that contextualized learning experiences lead to better student performance and stronger conceptual retention. In this study, project-based and thematic learning made mathematics less abstract and more accessible, which is particularly important in the development of minimum competencies assessed by AKM.

The findings also contribute to existing knowledge by offering a concrete model of how AKM preparation can be integrated into everyday instructional practices rather than treated as test preparation. The whole-school approach, involving leadership, teachers, parents, and students, demonstrates that AKM success depends on collective and sustained efforts. Additionally, the emphasis on formative assessment, reflection, and feedback loops highlights the importance of assessment for learning rather than assessment of learning. By continuously monitoring student progress and adjusting instruction, teachers were able to build students' confidence and competence gradually, supporting the broader goals of AKM.

Despite these contributions, several limitations must be considered. The study was conducted at a single school, which may limit the generalizability of the findings to other contexts with different resources, cultures, or leadership styles. Observations were also limited to Grade 4, while AKM is administered in Grade 5, creating a gap between instructional preparation and formal assessment outcomes. Furthermore, data analysis relied on manual thematic coding, which, although systematic, may limit replicability compared to software-assisted analysis. These limitations suggest that the findings should be interpreted as context-specific insights rather than universal conclusions.

Future research could build on this study by employing longitudinal designs to examine the sustained impact of contextual and collaborative AKM-based instruction over multiple years. Comparative studies across public, private, and faith-based schools would also help identify contextual factors that influence AKM implementation. Additionally, research on scalability is needed to explore how the strategies identified in this study can be adapted to schools with different capacities and constraints. Overall, this study underscores that the success of AKM lies not only in assessment design or instructional techniques but in the strength of collaboration, contextual learning, and shared commitment among all educational stakeholders.

4. CONCLUSION

In conclusion, this study finds that the successful implementation of the Minimum Competency Assessment (AKM) at SD Muhammadiyah 3 Kota Malang is driven by the integration of contextual, project-based learning within a collaborative and reflective school ecosystem involving teachers, school leaders, students, and parents, which collectively contributes to the improvement of students' numeracy competencies beyond mere compliance with assessment standards. However, this research is limited by its focus on a single school context and a specific grade level, which may restrict the generalizability of the findings to other educational settings. Therefore, future research is recommended to involve multiple schools with diverse characteristics, apply longitudinal designs to examine the sustainability of AKM-oriented instructional practices, and explore how such collaborative and contextual learning models can be scaled and adapted across different educational contexts to strengthen AKM implementation and broader competency-based education reform.

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