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Training Bilingual Inquiry-Based Mathematics Games for Teachers and Students at SDN 1 Taji Malang

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Abstract

Purpose: This community service program aimed to improve the quality of mathematics ang English learning at SDN 1 Taji, a rural elementary school in Malang Regency with limited access to technology and innovative media. The intervention addressed low teacher capacity in applying inquiry-based methods and low student motivation in learning mathematics and English.

Method: The program involved training teachers, mentoring in lesson plan design, and implementing an inquiry-based bilingual mathematics board game in classrooms. Data were collected through observation, interviews, questionnaires, and documentation, and analyzed using descriptive qualitative and quantitative approaches.

Practical Applications: The results indicated that teachers became more motivated and skilled in interactive instruction, while students showed greater enthusiasm, active participation, and improved conceptual understanding. The bilingual elements also supported contextual English literacy.

Conclusion: The program provided a resource-efficient, replicable, and sustainable model for enhancing mathematics and English learning in rural schools, contributing to educational innovation in under-resourced contexts.

Introduction

SD Negeri 1 Taji, located in Jabung District, Malang Regency, represents one of the rural elementary schools in East Java with limited educational facilities and resources. Most of the local population consists of farmers, farm labourers, and small-scale informal workers, whose socio-economic status is categorized as lower-middle. This condition directly influences the quality of education, particularly in terms of access to technology, innovative teaching methods, and modern learning media. The school has minimal supporting facilities, such as a small library and several rooms. Internet access remains very limited, which restricts opportunities to integrate digital media into the classroom.

Based on preliminary observations and interviews with teachers, mathematics and English instruction at SDN 1 Taji still relies heavily on conventional methods such as lectures and repetitive problem-solving exercises. These approaches often result in passive learning, low motivation, and difficulties in comprehending abstract mathematical and English concepts. Mathematics and English are frequently perceived by students as difficult and monotonous subjects, leading to reduced enthusiasm and participation during lessons. Teachers also acknowledged their lack of experience in applying inquiry-based approaches, despite the relevance of this method to the Merdeka Curriculum, which emphasizes contextual, student-centred, and active learning. The main challenge in mathematics learning at SDN 1 Taji lies in the dominance of conventional methods, which make students passive (Sutarti & Wibawa, 2018; Susanti & Purnomo, 2020). Game-based learning has been proven to increase students' motivation and learning outcomes (Hamari et al., 2016; Huang et al., 2019; Utami & Cahyono, 2019). A bilingual approach also strengthens English literacy within mathematics learning contexts (Sari & Rahmawati, 2021; Syamsuddin & Ahmad, 2021; Yuliana & Pramudita, 2020).

Previous studies have highlighted the potential of innovative learning strategies to address these challenges. For example, Rahayu (2024) argued that educational games can enhance students' motivation and make the learning process more enjoyable and effective. Sutarti and Wibawa (2018) demonstrated that inquiry-based learning encourages students to be actively involved in the learning process, fosters critical thinking, and supports a deeper understanding of concepts. Furthermore, Widayanti and Rahayu (2018) found that bilingual learning media not only strengthen students' mathematical comprehension but also simultaneously support English literacy in contextual and meaningful ways.

Considering these conditions, there is a pressing need for community service programs that directly address the dual challenges faced by teachers and students in rural schools: the lack of innovative teaching practices and the absence of engaging, contextual learning media. The present program, therefore, was designed to introduce and implement an inquiry-based bilingual mathematics board game. This intervention targeted both teachers and students by providing professional training, classroom mentoring, and direct implementation of game-based learning activities.

The expected societal impact of this program is twofold: (1) empowering teachers with the skills and confidence to design and deliver interactive, inquiry-driven, and bilingual mathematics lessons; and (2) increasing student motivation, participation, and comprehension through enjoyable, game-based activities that simultaneously develop English literacy. By offering a sustainable and replicable model, this initiative seeks to contribute to broader educational transformation in rural settings, where innovation and global competence are urgently needed but often constrained by limited resources.

Method

This community service program employed a participatory action research (PAR) approach to ensure that the intervention was collaborative, context-specific, and aligned with the needs of SDN 1 Taji. The methodology was designed to address two main problems: the lack of innovative teaching practices among teachers and the low motivation of students in learning mathematics. The program applied workshops, mentoring, and media

implementation, which have been recognized as effective approaches in school-based community service (Rahayu & Widayanti, 2018, 2022). Data were collected through observation, questionnaires, and interviews, then analyzed using both descriptive qualitative and quantitative techniques (Wijayanti & Prasetyo, 2023).

Participants

The program engaged three primary stakeholder groups: (a) twenty classroom and subject teachers from grades I–VI at SDN 1 Taji Malang; (b) students, with intentional focus on upper elementary grades III–VI as the core participants for classroom implementation of the mathematics games; and (c) a Community Service Team comprising three specialist lecturers in mathematics education, bilingual pedagogy, and instructional media development, augmented by two university student field assistants. This multi-tiered participation structure ensured comprehensive coverage of both educator training and student-facing pedagogical application.

Data Collection Methods

A multi-instrument approach was employed to rigorously evaluate program implementation and outcomes. Classroom observations during game-based learning sessions utilized structured observation sheets to systematically document student engagement, participation dynamics, and interaction patterns. Semi-structured pre- and post-program interviews with teachers captured evolving perceptions, implementation challenges, and reflective insights regarding inquiry-based and bilingual methodologies. Complementing these qualitative measures, simple Likert-scale questionnaires administered to students quantified shifts in interest, enjoyment, and perceived mathematical comprehension. Finally, extensive documentation—including photographs, videos, and field notes—provided contextual visual and narrative evidence of program activities, creating a robust evidentiary foundation.

Procedural Design

Execution followed a five-phase systematic framework. The initiative commenced with Socialization, wherein program objectives, anticipated benefits, and timelines were formally introduced to school leadership and teaching committees. This was succeeded by Training and Workshops delivering specialized instruction to teachers on inquiry-based learning strategies, bilingual education techniques, and practical application of mathematics board games. The Game Development and Distribution phase involved designing and supplying customized bilingual (Indonesian-English) board game sets modeled after monopoly mechanics, complete with question, bonus, and penalty cards. Subsequently, Implementation and Mentoring enabled teachers to conduct classroom practice sessions using the games under direct guidance from the service team. The process culminated in Evaluation and Follow-up, incorporating structured feedback collection, distribution of sustainability-focused guidebooks, and planning for future competition-based learning activities to ensure longitudinal impact.

Data Analysis

A mixed-methods analytical strategy integrated qualitative and quantitative dimensions. Thematic analysis of interview transcripts, observation notes, and documentation identified recurring patterns in teacher motivation, student participation efficacy, and emergent implementation challenges. Concurrently, descriptive statistical analysis of questionnaire data—following rigorous data cleansing to exclude incomplete responses—quantified trends in student-reported interest, enjoyment, and comprehension through percentage-based representations. Crucially, triangulation cross-validated findings across all four data sources (observation, interviews, questionnaires, documentation), significantly enhancing the credibility, reliability, and methodological rigor of the overall evaluation.

Risk Mitigation

Potential risks identified included low teacher attendance during training, limited time for classroom implementation, and student unfamiliarity with bilingual terms. To mitigate these risks, the team scheduled flexible training sessions, provided ongoing mentoring, and created

bilingual support materials with simple language adaptation.

Table 1. Program Participants

No	Name (Initials)	Title/Role	Age	Involvement
1	T1	Class Teacher	35	Workshop, mentoring
2	T2	Mathematics Teacher	38	Implementation
3	T3	Class Teacher	42	Workshop
…	…	…	…	…
10	T10	Class Teacher	33	Implementation

Source: Author's Work, 2025.

Result

Program Implementation and Outcomes

The six-week community service program, "Training of Inquiry-Based Bilingual Mathematics Games for Teachers and Students of SDN 1 Taji Malang," systematically engaged school leaders, teachers, and students across five phased stages. Initiated through a socialization meeting with the principal, eight teachers, and the school committee, the program established institutional buy-in by clarifying objectives, benefits, and activity timelines. This foundation enabled the subsequent teacher training workshops, where all 20 participating teachers developed competencies in inquiry-based pedagogy, bilingual strategies, and game integration through simulations and hands-on practice with the custom-designed board game.

The game development phase yielded a sustainable resource: a monopoly-style bilingual (Indonesian-English) board game featuring question, bonus, and penalty cards, which was then deployed during classroom implementation across four upper-grade classrooms (III–VI). Direct mentoring and evaluation accompanied this stage, with the service team observing sessions, collecting observational data, administering student questionnaires, and conducting teacher interviews to refine the game and compile a practical guidebook for future use.

Measurable Outputs and Impacts

Quantifiable achievements aligned with program targets (Table 2), including 90% of teachers demonstrating proficiency in inquiry methods, active game usage in three classroom sessions, and sustained student engagement across all four target classes. Critically, teacher impacts manifested as heightened confidence in interactive pedagogy, with 19 of 20 teachers successfully integrating the game into lesson plans. As one mathematics teacher noted: "The game made my students more enthusiastic. They were no longer afraid of mathematics and naturally used English terms" (T2, 2025), underscoring the guidebook's role in enabling independent replication.

Student outcomes were equally significant: observational data confirmed >80% active participation in bilingual term usage and collaborative problem-solving, while 85% of students reported increased enjoyment of mathematics and 78% indicated improved conceptual understanding via questionnaires. A Grade III student's testimonial encapsulated this shift: "Learning mathematics became more fun; I now know English mathematical vocabulary too" (2025). Visual documentation further validated these findings, capturing teachers in workshops, students engaged in gameplay, and the formal handover of resources.

Interpretation and Scholarly Alignment

These results directly addressed SDN 1 Taji's dual challenges of limited teacher capacity and low student motivation. Teachers' enhanced confidence in bilingual game integration corroborates Wang and Tahir's (2020) evidence that interactive media strengthens teacher-student engagement. Similarly, the surge in student motivation aligns with Utami and Cahyono's (2019) findings on board games' role in fostering active participation, while the

acquisition of English mathematical terminology substantiates Syamsuddin and Ahmad's (2021) research on bilingual scaffolding. Crucially, sustainability was engineered through tangible outputs—the physical game set and teacher guidebook—ensuring continued application beyond the program's six-week duration. The triangulated evidence (observation, interviews, surveys, and documentation) collectively demonstrates that the synergy of inquiry-based methods, bilingual exposure, and gamified learning catalyzed transformative improvements in both pedagogical practice and student learning experiences.

Discussion

Structured Program Impact Analysis

The implementation of inquiry-based bilingual mathematics games at SDN 1 Taji Malang achieved its core objectives, demonstrating transformative effects on pedagogical practices and student learning outcomes. Teachers exhibited heightened motivation and enhanced capacity to design interactive activities, while students reported increased enthusiasm and conceptual comprehension—findings consistent with Rahayu's (2024) research on game-based learning's efficacy in reducing classroom boredom and boosting engagement.

Teacher Capacity Development

The program catalyzed significant growth in teacher competence with inquiry-based and bilingual methodologies. Pre-intervention, most educators relied exclusively on conventional lectures due to unfamiliarity with innovative strategies. Post-workshop and mentoring, however, 90% of teachers successfully integrated the bilingual board game into classroom instruction. This shift aligns with Sutarti and Wibawa's (2018) evidence that inquiry-based approaches empower teachers to foster student exploration and active participation, moving beyond passive knowledge transmission.

Student Learning Enhancement

Students experienced dual benefits: elevated motivation and contextual English literacy development. Observational data revealed natural usage of mathematical English terms (e.g., "addition," "subtraction," "penalty") during gameplay, corroborating Widayanti and Rahayu's (2018) assertion that bilingual media cultivates global competence in young learners. Quantitatively, 85% of students affirmed heightened enjoyment of mathematics through this method, reflecting Gee's (2017) edutainment framework wherein game-based integration improves attention and knowledge retention by merging educational content with engaging mechanics.

Societal and Institutional Impacts

Beyond classroom dynamics, the initiative spurred broader institutional transformation. By providing sustainable resources—physical game sets and teacher guidebooks—the program established foundations for ongoing pedagogical innovation in rural education. Though no direct economic effects emerged, three key societal contributions were documented: (1) strengthened teacher professionalism in resource-constrained settings; (2) enhanced student self-confidence in mathematics; and (3) advancement of national bilingual literacy goals. These outcomes collectively signal alignment with Indonesia's educational priorities for global readiness.

Sustainability and Scalability

Durability was engineered through low-cost, non-digital resources designed for teacher autonomy. The bilingual board game and guidebook enable indefinite replication, while the model's adaptability to similar rural contexts supports McGill et al.'s (2014) principle that sustainable interventions prioritize practicality and contextual flexibility. This approach resonates with Huang et al. (2019) and Zainuddin et al.'s (2020) findings that reusable, simple media achieve higher replication rates in underserved schools than technology-dependent solutions.

Challenges and Adaptive Solutions

Implementation hurdles included: initial teacher difficulties in lesson plan integration (addressed through tailored mentoring); student hesitancy in English usage (mitigated via scaffolded bilingual materials); and limited program duration restricting implementation iterations (resolved through flexible scheduling). These barriers mirror Sari and Rahmawati's (2021) observations on language adoption challenges, underscoring the need for extended mentoring periods in future iterations to deepen pedagogical assimilation.

Forward-Looking Recommendations

Key lessons emphasize the synergy between teacher capacity building and student-centered media innovation, with institutional support proving critical to success. To amplify impact, future initiatives should: (a) engage parents to extend bilingual practice into home environments; (b) develop digital game variants contingent on improved rural internet access; and (c) partner with local education offices for systemic scaling. Such strategies would further advance Yuliana and Pramudita's (2020) vision for community-embedded bilingual literacy while addressing Wijayanti and Prasetyo's (2023) call for inquiry-based games that holistically develop critical thinking and problem-solving skills.

Synthesis

This program substantiates that contextually designed, bilingual game-based learning serves as a cost-effective catalyst for dual transformation: elevating teacher professionalism in inquiry-based pedagogy while simultaneously advancing students' mathematical understanding and global competence. As illustrated in Figure 1, the visible synergy between teacher guidance and student engagement during gameplay epitomizes the model's potential to redefine mathematics education in resource-constrained settings—proving that simplicity, sustainability, and scholarly alignment can collectively overcome entrenched educational challenges.

Conclusion

This community service program was designed to enhance the quality of mathematics learning at SDN 1 Taji, a rural elementary school with limited resources, by introducing an inquiry-based bilingual mathematics board game. The program's objectives were twofold: (1) to empower teachers with strategies for interactive and bilingual instruction, and (2) to increase student motivation, participation, and comprehension in mathematics.

The findings demonstrated that the program achieved these objectives effectively. Teachers gained confidence and competence in applying inquiry-based methods and integrating bilingual approaches into their lessons. Students exhibited increased enthusiasm and engagement during mathematics classes, with 85% reporting greater enjoyment and 78% acknowledging improved understanding of concepts when using the board game. The integration of bilingual elements also strengthened contextual English literacy, aligning with national curriculum goals.

The practical implications of these findings highlight that low-cost, non-digital game-based media can serve as an effective solution in rural schools where access to advanced technology is limited. The program offers a replicable model that balances innovation with accessibility, making it adaptable to other under-resourced educational contexts. A unique contribution of this initiative lies in its dual focus: simultaneously enhancing mathematics learning and bilingual literacy through inquiry-based, game-oriented pedagogy. This approach expands existing knowledge by demonstrating that educational interventions need not be technologically complex to be impactful; rather, they must be context-sensitive, sustainable, and engaging.

Nonetheless, several limitations were noted. The short six-week timeframe restricted the number of classroom iterations and limited the opportunity for longitudinal assessment. Additionally, some teachers and students initially struggled with the integration of bilingual

elements. These constraints underscore the need for extended mentoring and follow-up activities in future programs.

Future research and community service initiatives should explore the digital adaptation of such games, broaden parental involvement in bilingual reinforcement, and scale up implementation across multiple schools to assess wider impacts. These findings reinforce the literature that game-based and inquiry strategies are effective solutions for mathematics learning in under-resourced schools (Hamari et al., 2016; Zainuddin et al., 2020). A unique contribution of this program is the integration of bilingual elements into game-based educational models (Rahayu & Widayanti, 2018; Widayanti & Rahayu, 2018). In conclusion, this program underscores the value of combining inquiry-based learning, bilingual education, and game-based strategies to foster meaningful change in rural education. The outcomes are worth consideration by educators, policymakers, and community service practitioners as they offer practical, replicable pathways toward more engaging and globally relevant mathematics education.

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