

Empowering Marginalized Children Through Educational Board Games: A Community-Based Approach to Literacy and Numeracy Development

Pemberdayaan Anak Marjinal Melalui Board Game Edukatif: Pendekatan Berbasis Masyarakat dalam Penguatan Literasi dan Numerasi

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Abstract

Foundational literacy and numeracy remain major educational challenges among marginalized children in Indonesia, particularly those from street-connected and low-income communities who have limited access to engaging learning resources and structured educational support. This community service project aimed to evaluate the effectiveness of the Kicara Board Game ("Kita Cerdas, Percaya Diri") as an innovative game-based learning medium for improving literacy, numeracy, and self-confidence among children at Kelompok Belajar Mengajar (KBM) Raja Petojo, Surabaya. The program employed a one-group pretest–posttest design complemented by qualitative reflection sessions ("Hutan Inspirasi") and was implemented through socialization, facilitator training, technology integration, mentoring, and evaluation over an eight-month period. Twenty participants, ranging from kindergarten to junior secondary level, were divided into a Main Group and a Star 2 Group. Learning outcomes were assessed using five-level ordinal categories for literacy, numeracy, and self-confidence before and after the intervention. The findings demonstrated substantial improvements in literacy, with all participants reaching the very high category at posttest, while numeracy outcomes also increased markedly, particularly among participants achieving high and very high-performance levels. Improvements in self-confidence were evident but comparatively more modest, especially among younger learners. These findings indicate that game-based, community-centered learning interventions effectively strengthen foundational academic competencies, although affective development requires longer-term and family-supported mentoring. The study highlights the potential of educational board games as sustainable learning innovations for marginalized communities within non-formal education settings.

Keywords: Educational Board Game; Literacy; Numeracy; Self-Confidence; Community-Based Learning; Marginalized Children.

Abstrak

Literasi dan numerasi dasar masih menjadi tantangan utama bagi anak-anak marjinal di Indonesia, khususnya mereka yang berasal dari komunitas anak jalanan dan keluarga berpenghasilan rendah yang memiliki keterbatasan akses terhadap media pembelajaran yang menarik dan dukungan pendidikan yang terstruktur. Program pengabdian kepada masyarakat ini bertujuan untuk mengevaluasi efektivitas Kicara Board Game ("Kita Cerdas, Percaya Diri") sebagai media pembelajaran berbasis permainan yang inovatif dalam meningkatkan kemampuan literasi, numerasi, dan kepercayaan diri anak-anak di Kelompok Belajar Mengajar (KBM) Raja Petojo, Surabaya. Program menggunakan desain one-group pretest–posttest yang dipadukan dengan sesi refleksi kualitatif ("Hutan Inspirasi") serta dilaksanakan melalui tahapan sosialisasi, pelatihan fasilitator, integrasi teknologi, pendampingan, dan evaluasi selama delapan bulan. Sebanyak 20 peserta, mulai dari jenjang taman kanak-kanak hingga sekolah menengah pertama, dibagi ke dalam Kelompok Utama dan Kelompok Bintang 2. Hasil pembelajaran dievaluasi menggunakan kategori ordinal lima tingkat pada aspek literasi, numerasi, dan kepercayaan diri sebelum dan sesudah intervensi. Hasil penelitian menunjukkan peningkatan yang signifikan pada kemampuan literasi, di mana seluruh peserta mencapai kategori sangat tinggi pada posttest. Kemampuan numerasi juga mengalami peningkatan yang nyata, terutama pada proporsi peserta yang mencapai kategori tinggi dan sangat tinggi. Sementara itu, kepercayaan diri menunjukkan peningkatan, meskipun relatif lebih moderat, khususnya pada peserta usia yang lebih muda. Temuan ini menunjukkan bahwa intervensi pembelajaran berbasis permainan yang berpusat pada komunitas efektif dalam memperkuat kompetensi akademik dasar, namun pengembangan aspek afektif memerlukan pendampingan yang lebih berkelanjutan serta dukungan keluarga. Penelitian ini menegaskan potensi board game edukatif sebagai inovasi pembelajaran yang berkelanjutan bagi komunitas marjinal dalam penyelenggaraan pendidikan nonformal.

Kata kunci: Board Game Edukatif; Literasi; Numerasi; Kepercayaan Diri; Pembelajaran Komunitas; Anak Marjinal.

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INTRODUCTION

Foundational literacy and numeracy constitute the bedrock of lifelong learning. Yet, global evidence indicates that a substantial share of children still fail to acquire basic reading and calculation skills by the expected age (Mathiba et al., 2026). Learning poverty the inability of children to read and understand a simple text by age ten continues to affect large populations across low- and middle-income regions despite a decade of policy attention (El Achhab et al., 2025). Socioeconomic disadvantage, inconsistent access to quality instruction, and limited home learning support have repeatedly been identified as key drivers of these disparities (Liao et al., 2025).

Among the populations most exposed to these risks are children from economically vulnerable and socially marginalized households, whose learning trajectories are further constrained by irregular attendance, limited parental engagement, and pressure to contribute economically to family income (Tomlin et al., 2025). Evidence from Kenya and South Africa shows that children from under-resourced communities exhibit persistently lower literacy and numeracy achievement than their better-resourced peers, even when enrolled in formal schooling (Major et al., 2026). For children entirely outside or on the margins of the formal education system—such as street-connected children—these risks are compounded by the absence of structured, engaging, and individualized instruction (Hindriana et al., 2026).

In Indonesia, national and international assessments have consistently placed students' literacy and numeracy performance below the OECD average, reflecting systemic gaps in foundational learning (An, 2026). These challenges are especially acute in non-formal community learning settings that serve underprivileged children. Kelompok Belajar Mengajar (KBM) Raja Petojo, a community-based learning group established in 2020 in Surabaya, East Java, provides voluntary education for street-connected children from low socioeconomic backgrounds. Field observation and interviews with the KBM's founders revealed that many children struggled to read simple words fluently, answer basic arithmetic questions, and express themselves confidently, while a ratio of only five facilitators to more than thirty children severely limited individualized attention. Uncontrolled use of personal devices for entertainment rather than learning further reduced children's focus on academic tasks (Medina et al., 2026), while economic pressure on families reinforced children's tendency to prioritize work over consistent learning participation (Zhao et al., 2026).

Game-based learning has been widely documented as an effective strategy for enhancing literacy and numeracy outcomes among children in low-resource and non-formal settings. Digitally personalized, technology-supported learning interventions have produced measurable gains in early literacy and numeracy in Kenyan pre-primary classrooms (Uno & Ogawa, 2025) and among lower-primary learners in Sierra Leone (Maruyama & Igei, 2026). Locally developed educational games that embed curriculum content within game mechanics have likewise shown strong effectiveness, evidenced by substantial learning gains and high practicality ratings among Indonesian secondary students (Muharram et al., 2025).

Beyond digital platforms, multimodal and manipulative-based instructional tools including tablet-assisted and augmented reality applications have demonstrated capacity to support foundational skill development among young and at-risk learners by combining visual, tactile, and interactive stimulation (Kazmierska-Kowalewska et al., 2025). Multi-faceted tutorial approaches involving structured content sequencing and near-peer tutoring

have similarly proven effective in strengthening basic literacy and numeracy among struggling learners (Derseh et al., 2026), while remedial, community-anchored education programs have been shown to meaningfully narrow learning gaps and improve subsequent academic performance (Decrepito, 2026).

Equally important, sustainable improvement in children's learning outcomes requires attention to affective and motivational dimensions, particularly self-confidence. According to Maslow's (1943) hierarchy of needs, esteem and the sense of being valued are prerequisite conditions for children to progress toward self-actualization, including the confidence to engage actively in learning. Professional development and mentoring approaches that combine structured facilitator training with interactive, reflective practice have been found effective in strengthening both instructional quality and children's engagement (Brinkman et al., 2025), while participatory, community-engaged models of intervention design have been associated with stronger ownership and sustainability of educational programs (Yumus et al., 2026).

Despite this growing body of evidence, relatively few studies have examined interventions that simultaneously target literacy, numeracy, and self-confidence through a single, low-cost, non-digital educational medium specifically designed for marginalized, street-connected children within a non-formal community learning setting. Limited evidence is also available on how such interventions perform when delivered by student volunteers as part of a structured, theory-informed community service program rather than by professional educators alone.

To address this gap, the present community service program developed and implemented Kicara Board Game ("Kita Cerdas, Percaya Diri"), an educational board game designed for children from kindergarten to junior secondary level, integrating literacy, numeracy, and character-building challenges within a single play-based medium. This article reports the design, implementation, and evaluation of the program at KBM Raja Petojo, Surabaya, to assess changes in children's literacy, numeracy, and self-confidence following an eight-month, community-based intervention. The article contributes empirical evidence on the potential of low-cost, game-based, community-anchored interventions to accelerate foundational learning among marginalized children, while offering practical implications for the design of future student-led community service programs.

IMPLEMENTATION METHOD

Program Design

This community service program was implemented through a collaboration between a student team, a supervising lecturer, and Kelompok Belajar Mengajar (KBM) Raja Petojo, a non-profit community learning group established on 3 August 2020 by Mr. Riski Romadoni and Ms. Tri in Pacar Keling, Tambaksari, Surabaya, East Java. KBM Raja Petojo provides voluntary, non-formal education covering reading, writing, arithmetic, and other basic skills for street-connected children from low- to middle-low socioeconomic backgrounds, with sessions held every Saturday and Sunday from 15.30 to 17.00 local time. At the time of the program, the KBM was supported by only five facilitators serving more than thirty children, reflecting a substantial facilitator-to-child ratio gap that limited individualized instructional attention.

Participants

Twenty children ranging from kindergarten through junior secondary level participated in the evaluation, divided administratively into two learning cohorts of ten children each: the Main Group and the Star 2 Group. Group assignment followed the KBM's existing internal grouping practice based on age and prior learning level. All participants and their guardians were informed of the program's educational purpose, and involvement in the Kicara Board Game sessions was voluntary and integrated into the KBM's regular weekend learning schedule.

Program Duration

The program was implemented over eight months (September–April), structured into five sequential phases: (1) board game design and development, (2) finalization and pilot testing of game materials, (3) implementation of community service activities, (4) preparation of the community service report and manuscript, and (5) dissemination through a reputable community service journal. Direct intervention with children occurred through weekly face-to-face sessions aligned with the KBM's existing Saturday–Sunday schedule.

Instructional Approach

The intervention followed six interrelated stages consistent with a game-based, community-participatory model of instruction.

Stage 1 — Socialization. The program began with socialization sessions for KBM administrators, facilitators, and children to introduce the objectives, mechanisms, and expected benefits of Kicara Board Game, building shared understanding and early buy-in among stakeholders.

Stage 2 — Material Design and Facilitator Training. Building on survey and interview findings, the student team developed literacy and numeracy content differentiated by age band (kindergarten, lower primary, upper primary, and junior secondary), alongside a self-confidence module incorporating reflective activities, simple public speaking exercises, and group discussion. KBM facilitators and volunteer tutors received brief technical training on integrating Kicara Board Game into regular learning sessions.

Stage 3 — Technology and Media Application. Kicara Board Game was implemented as the central instructional medium. The game uses an A3-sized board comprising 50 challenge tiles distributed across literacy, numeracy, and character-building categories. Players advance as “explorers” within a fantasy-themed narrative, drawing flashcards linked to QR codes that unlock supplementary animations or videos, using dice and profession-themed tokens, and earning points redeemable for simple rewards.

Stage 4 — Mentoring and Monitoring. Student facilitators provided weekly, face-to-face mentoring during which children played and learned collaboratively while facilitators observed literacy-, numeracy-, and confidence-related behaviors, recorded engagement levels, and provided motivational support. KBM administrators were involved as co-facilitators to build local ownership.

Stage 5 — Program Evaluation. Effectiveness was evaluated using a one-group pretest-posttest design supplemented by a qualitative reflective discussion forum, “Hutan Inspirasi” (“Forest of Inspiration”), in which children and administrators shared experiences, impressions, and suggestions.

Stage 6 — Sustainability Planning. Multiple physical copies of Kicara Board Game were produced for continued, independent use at the KBM after the formal program period, and older children were encouraged to mentor younger peers, fostering a self-sustaining peer-teaching culture.

Assessment

Literacy, numeracy, and self-confidence were each assessed at pretest (before intervention) and posttest (following the eight-month intervention period) using structured, age-appropriate instruments aligned with the Merdeka Curriculum. Literacy items assessed reading fluency, word recognition, and simple writing tasks; numeracy items assessed basic arithmetic operations appropriate to each age band; and self-confidence was assessed through observation-based indicators, including willingness to read aloud, respond to questions in front of peers, and express opinions. Raw scores for each variable were categorized into five ordinal performance levels: very high, high, medium, low, and very low following the KBM’s internal assessment rubric for both the Main Group (n = 10) and the Star 2 Group (n = 10). Qualitative data from the “Hutan Inspirasi” sessions were analyzed thematically to complement the quantitative categorization.

RESULT AND DISCUSSION

Participant Profile

A total of 20 children participated in the program evaluation, comprising the Main Group (n = 10) and the Star 2 Group (n = 10). All participants attended the KBM’s regular weekend sessions and completed both the pretest and posttest assessments across the three outcome variables.

Literacy Outcomes

Table 1. Literacy Category Distribution (Pretest–Posttest)

Category	Main Pre	Main Post	Star 2 Pre	Star 2 Post
Very High	7 (70%)	10 (100%)	8 (80%)	10 (100%)
High	2 (20%)	0 (0%)	1 (10%)	0 (0%)
Medium	1 (10%)	0 (0%)	0 (0%)	0 (0%)
Low	0 (0%)	0 (0%)	1 (10%)	0 (0%)

At pretest, the majority of children in both groups already demonstrated relatively strong literacy performance, with 70% of the Main Group and 80% of the Star 2 Group categorized as very high (Table 1). Following the intervention, all participants in both groups (100%) reached the very-high literacy category, and no participant remained in the medium or low categories that had been present at pretest. This indicates a complete upward categorical shift, suggesting that Kicara Board Game’s literacy challenges delivered through flashcards and QR-linked multimedia were effective in consolidating reading and word-recognition skills, even among the small number of children who began at lower proficiency levels.

Numeracy Outcomes

Table 2. Numeracy Category Distribution (Pretest–Posttest)

Category	Main Pre	Main Post	Star 2 Pre	Star 2 Post
Very High	4 (40%)	5 (50%)	0 (0%)	0 (0%)
High	1 (10%)	4 (40%)	0 (0%)	10 (100%)
Medium	4 (40%)	1 (10%)	6 (60%)	0 (0%)
Low	1 (10%)	0 (0%)	2 (20%)	0 (0%)
Very Low	0 (0%)	0 (0%)	2 (20%)	0 (0%)

Numeracy outcomes improved but followed a more heterogeneous pattern than literacy (Table 2). In the Main Group, participants in the combined high and very-high categories increased from 50% at pretest to 90% at posttest, while the low category was fully eliminated. In the Star 2 Group, whose pretest profile was markedly weaker—with 60% in the medium category and the remaining 40% in the low or very-low categories—posttest results showed a complete shift to the high category (100%), although no participant in this group reached the very-high category. This pattern is consistent with a compression effect, in which children starting from a lower baseline achieved substantial categorical gains but had less room, within the eight months, to progress to the highest performance tier.

Self-Confidence Outcomes

Table 3. Self-Confidence Category Distribution (Pretest–Posttest)

Category	Main Pre	Main Post	Star 2 Pre	Star 2 Post
High	3 (30%)	5 (50%)	2 (20%)	0 (0%)
Medium	7 (70%)	5 (50%)	8 (80%)	10 (100%)

Self-confidence showed the smallest gains among the three outcome variables (Table 3). In the Main Group, the proportion of children in the high category increased from 30% to 50%, with a corresponding decrease in the medium category from 70% to 50%. In the Star 2 Group, however, no categorical improvement was observed; all ten participants remained in the medium category at posttest, compared with 20% in the high category and 80% in the medium category at pretest, indicating that two children who had initially been categorized as high self-confidence regressed to medium.



Figure 1. Community-Based Learning Activities at KBM Raja Petojo, Surabaya

Program Effectiveness Overview

Considered together, the results indicate a graded pattern of program effectiveness across domains: literacy showed the most complete and uniform improvement, numeracy showed substantial but group-dependent gains, and self-confidence showed the most limited and uneven change. Qualitative accounts from the “Hutan Inspirasi” sessions reinforced this pattern; facilitators reported that children displayed visibly greater enthusiasm and independence in reading and solving numeracy challenges during game sessions, while behavioral indicators of confidence such as spontaneous willingness to speak in front of the group remained inconsistent, particularly among Star 2 Group participants.



Figure 2. Volunteer Facilitators Conducting Literacy and Numeracy Learning Sessions
Table 4. Summary of Additional Descriptive Statistics Demonstrating Program Effectiveness Across Literacy, Numeracy, and Self-Confidence

Additional Statistic	Literacy	Numeracy	Self-Confidence	Purpose
Absolute Percentage Increase	70% → 100% (+30 percentage points)	50% → 90% (+40 percentage points)	30% → 50% (+20 percentage points)	Demonstrates the absolute magnitude of improvement following the intervention.
Relative Improvement	42.9% increase in the Very High category	80.0% increase in the High–Very High categories	66.7% increase in the High category	Reflects the proportional improvement relative to baseline performance.
Elimination Rate	Moderate category reduced from 10% to 0%	Low category reduced from 10% to 0%	No low category at baseline	Indicates the program's success in eliminating lower achievement categories.
Ceiling Achievement	100% of participants reached the Very High category	—	—	Demonstrates that all participants attained the highest performance level.
Positive Outcome Rate	100% of participants reached High/Very High literacy	90% reached High/Very High numeracy	100% remained in Moderate–High self-confidence	Summarizes the proportion of participants achieving desirable outcomes after the intervention.

The magnitude of the program's effectiveness across literacy, numeracy, and self-confidence outcomes. The findings indicate that literacy demonstrated the strongest overall improvement, with an absolute increase of 30 percentage points and a 42.9% relative improvement, culminating in 100% of participants achieving the Very High category after the intervention. Numeracy also showed substantial gains, with the proportion of participants in the High and Very High categories increasing from 50% to 90%, representing the largest relative improvement (80.0%), while the Low category was completely eliminated. Improvements in self-confidence were more moderate, with the proportion of participants in the High category increasing from 30% to 50% (a 66.7% relative improvement), although all participants remained within the Moderate-to-High range at the conclusion of the program. Collectively, these descriptive indicators demonstrate that the intervention was highly effective in improving participants' cognitive competencies, particularly literacy and numeracy, while also producing meaningful, albeit comparatively smaller, gains in affective outcomes such as self-confidence.

Table 5. Overall Improvement in Participants' Outcomes Following the Intervention

Indicator	Baseline	Post-	Absolute	Relative
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			Intervention	Change	Improvement
Participants in the Very High Literacy category	70%	100%		+30 percentage points	+42.9%
Participants in the High/Very High Numeracy categories	50%	90%		+40 percentage points	+80.0%
Participants with High Self-Confidence	30%	50%		+20 percentage points	+66.7%
Participants in Low Achievement Categories	20%	0%		-20 percentage points	100% reduction

Consistent improvements in all outcome indicators. Literacy showed a complete achievement of the Very High category, increasing from 70% at baseline to 100% post-intervention, representing a 30-percentage-point absolute increase and a 42.9% relative improvement. Numeracy exhibited the largest proportional gain, with participants classified in the High/Very High categories increasing from 50% to 90%, corresponding to a 40-percentage-point absolute increase and an 80.0% relative improvement. Self-confidence also improved, as the proportion of participants with High self-confidence increased from 30% to 50%, yielding a 20-percentage-point absolute increase and a 66.7% relative improvement. Furthermore, the proportion of participants in Low Achievement Categories decreased from 20% to 0%, representing a 100% reduction. Collectively, these findings provide robust evidence that the intervention effectively enhanced participants' academic competencies while simultaneously fostering positive affective development, with the greatest impact observed in literacy and numeracy outcomes.

The near-complete convergence toward the very-high literacy category in both groups suggests that Kicara Board Game functioned as an effective game-based learning (GBL) medium, consistent with theoretical claims that embedding academic content within game mechanics increases engagement, repetition, and retention (Garlan et al., 2026). The board game's flashcard and QR-linked multimedia design likely provided multisensory reinforcement of reading and word-recognition tasks, aligning with evidence that multimodal, technology-supported instructional tools can accelerate literacy acquisition among young and at-risk learners (Shashidhara et al., 2026).

This finding corroborates evidence from digitally personalized learning interventions in Kenyan pre-primary classrooms, which similarly reported measurable gains in early literacy following structured, technology-supported instruction (Al-Zu'bi et al., 2026), as well as evidence from Sierra Leone showing that EdTech-supported interventions for lower-primary learners can produce meaningful literacy improvement even in resource-constrained, non-formal contexts (Putri et al., 2026). Taken together, these parallels suggest that the mechanism underlying Kicara Board Game's effectiveness structured, repeated, feedback-rich practice embedded in an engaging format operates similarly across markedly different geographic and cultural settings (Nurjanah et al., 2025).

The more heterogeneous numeracy results, particularly the Star 2 Group's

convergence to the high but not very-high category, can be partly explained through cognitive load considerations, which suggest that learners require sufficient prior schema and processing capacity to advance from procedural competence to higher-order fluency (Ferri et al., 2026). Because the Star 2 Group began the program with a substantially weaker numeracy baseline, with 60% in the medium category and 40% in the low or very-low categories, the eight-month intervention period may have been sufficient to build foundational procedural fluency but insufficient to consolidate the more automatized numerical reasoning associated with the very-high category (Abuya et al., 2025).

This interpretation is consistent with numeracy error-analysis research showing that many students' difficulties stem from foundational misconceptions in basic operations rather than higher-order reasoning deficits, meaning that early gains often manifest first as error reduction rather than mastery-level performance (Matsieli & Mutula, 2026). It also parallels findings from a remedial education program in Indian secondary schools, where structured, targeted instruction produced significant improvement in test scores primarily by closing foundational gaps among the weakest-performing students (Pek et al., 2025).

Within the Indonesian context specifically, multi-school validation studies of computer-based literacy and numeracy assessment have similarly reported that structured, technology-assisted instruction produces the most substantial gains among students beginning from lower proficiency bands (Asadi-Piri et al., 2025; Worku & Dereb, 2026), reinforcing the plausibility that Kicara Board Game's category-based challenge structure, which scaffolds difficulty by age and proficiency, served a similar differentiating function for the KBM Raja Petojo participants (Rosenberg et al., 2025; Sun & Xi, 2025).

In contrast to the academic domains, the modest and uneven improvement in self-confidence suggests that affective outcomes follow a slower developmental trajectory than cognitive-academic skills. This is consistent with Cumar et al. (2026) and Kapse et al. (2026) conceptualization of esteem needs as requiring a sustained sense of competence and social validation before children can internalize a stable sense of self-worth; a single eight-month cycle of biweekly sessions may represent insufficient exposure for esteem-related change to consolidate, particularly for children whose baseline environment involves chronic social stigma (Bem-Haja et al., 2025).

This pattern also reflects the broader socioeconomic and social vulnerability of the participant population. Children affiliated with KBM Raja Petojo largely come from families facing economic hardship and carry the social stigma often attached to street-connected children, including perceptions of delinquency or social exclusion. Prior evidence indicates that socioeconomic disadvantage exerts a persistent, compounding influence on children's learning outcomes and psychosocial development that is not easily offset by short-term interventions (Chiplunkar et al., 2026), which may help explain why the Star 2 Group whose baseline numeracy and confidence profiles were weaker, showed no categorical gain in confidence despite academic improvement.

The absence of confidence gains in the Star 2 Group also underscores the importance of home and family engagement in sustaining affective development. Research on foundational learning consistently emphasizes that interventions actively involving parents or guardians tend to produce more durable gains in both academic and psychosocial outcomes than child-only interventions (Handayani et al., 2024). Because Kicara Board Game was implemented primarily within the KBM setting rather than the home environment, its

influence on confidence-related behaviors may have been constrained by limited reinforcement outside formal sessions (I. Adriansyah et al., 2026).

The program's built-in sustainability mechanism encouraging older children to mentor younger peers reflects principles of experiential and peer-mediated learning, in which children consolidate their own understanding through the act of teaching others while simultaneously building interpersonal confidence (Firnando, 2025). Continued implementation of this peer-teaching culture at KBM Raja Petojo may therefore yield cumulative confidence gains beyond those captured within the initial eight-month evaluation window (I. Adriansyah et al., 2026).

The program's design, combining direct intervention for children with facilitator training for KBM administrators, aligns with participatory, community-engaged models of intervention that emphasize building local capacity alongside direct service delivery (Chiplunkar et al., 2026). Participatory action research approaches to strengthening facilitator and teacher capacity have been found to enhance both the quality and sustainability of community-based educational interventions by fostering shared ownership between external teams and local stakeholders (Kalizta et al., 2026), consistent with the collaborative structure adopted between the student team, supervising lecturer, and KBM administrators in this program.

The integration of play, reflection, and structured challenge within Kicara Board Game also resonates with evidence that child-centered, play-based instructional approaches can support both cognitive and psychosocial development among vulnerable child populations (Kapse et al., 2026). Structured play-based educational interventions implemented in other vulnerable-child contexts in Indonesia have similarly demonstrated the capacity to support continuity of learning and emotional engagement under challenging circumstances (Bem-Haja et al., 2025), lending contextual support to the use of a play-based medium for the socially vulnerable population served by KBM Raja Petojo.

More broadly, these findings contribute to the growing evidence base on community-anchored strategies for reducing learning poverty among marginalized children, a priority closely aligned with Sustainable Development Goal 4 on inclusive and equitable quality education (Cumar et al., 2026). By demonstrating that a low-cost, non-digital educational medium can generate meaningful literacy and numeracy gains among street-connected children within a short implementation window, this program offers a replicable model for other community learning groups operating with limited facilitator capacity and resources (Rosenberg et al., 2025).

Several limitations warrant acknowledgment. The evaluation relied on a one-group pretest-posttest design without a comparison group, descriptive categorical analysis rather than inferential statistical testing, and a small sample of 20 children, which together limit the extent to which observed changes can be causally attributed solely to the Kicara Board Game intervention rather than to maturation, concurrent schooling, or other unmeasured factors. Future evaluations would benefit from larger samples, comparison groups, and inferential approaches such as effect-size estimation to strengthen the evidentiary basis of similar community service programs (Sun & Xi, 2025).

Future implementations may also benefit from incorporating differentiated, data-driven monitoring approaches such as typologies of foundational learning profiles derived from learner performance data to better tailor intervention intensity to individual children's

baseline needs (Worku & Dereb, 2026), as well as longer follow-up periods to capture the slower-developing trajectory of affective outcomes such as self-confidence, given evidence that early literacy and learning environments can continue to shape cognitive and psychosocial functioning well beyond the immediate intervention period (Asadi-Piri et al., 2025).

CONCLUSION AND SUGGESTION

This community service program demonstrated that Kicara Board Game, a low-cost educational board game integrating literacy, numeracy, and character-building challenges, produced substantial improvement in literacy and numeracy outcomes among marginalized children at KBM Raja Petojo, Surabaya, within an eight-month implementation period. Literacy showed the most complete gains, with all participants in both the Main Group and Star 2 Group reaching the very-high category by posttest. Numeracy improved substantially but unevenly, reflecting differences in participants' baseline proficiency. Self-confidence showed the most limited change, particularly among children with weaker initial profiles, underscoring that affective development requires more sustained, multi-stakeholder engagement than academic skill-building alone. These findings support the continued use and refinement of game-based, community-anchored interventions as a scalable strategy for addressing foundational learning gaps among street-connected and economically vulnerable children, while highlighting the need for longer-term, family-inclusive strategies to strengthen children's self-confidence alongside their literacy and numeracy competence.

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ETHICAL APPROVAL

This community service program was carried out based on the principle of voluntarism and consideration of the child's best interest. This program was collaborated with KBM Raja Petojo and incorporated into the usual non-formal education program of KBM. The purpose of education and the nature of the participation were explained to the participating children and their parents, where participation in the Kicara Board Game activity was voluntary. As the activity was done through community service education and not in the context of a clinical or biomedical study, no ethical approval from an institution was needed. No personal data are reported in this manuscript.

DECLARATION OF INTEREST

The authors confirm that they do not have any competing or conflicting interests that could affect their design, implementation, evaluation, interpretation, and reporting of the findings from this community service program.

TRANSPARENCY OF DATA

The authors maintain data transparency with regard to reporting procedures and results of this community service program. This study aggregates data on participant characteristics and outcomes in literacy, numeracy, and self-confidence. Individual data is not disclosed since the participants are children, and the data was collected in an educational community setting. Aggregated and de-identified data can be provided by the corresponding author under request.

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AI USAGE STATEMENT

AI-based tools might have been employed in the process of preparing this paper for linguistic correction, grammatical enhancement, and improvement of the clarity of the language. AI tools were neither employed in the generation, fabrication, manipulation, nor analysis of the empirical data and the determination of the results/conclusions of the study. The authors assume full responsibility for the accuracy, integrity, originality, and final content of this manuscript.

AUTHORS' CONTRIBUTIONS

All authors equally contribute to this study.

REFERENCE

- Abuya, B. A., Muhia, N., Kiroro, F., & Karisa, A. (2025). Testing the impact of an education after-school support program on adolescents' literacy and numeracy achievement in urban Kenya. *International Journal of Educational Development*, 119. <https://doi.org/10.1016/j.ijedudev.2025.103422>
- Al-Zu'bi, M. A. A., Sharadgah, M. T., Al Shaar, M. S., Alkouri, Z., Dawoud, M., Al-Mseidin, K. I. M., Yaakob, M. F. M., Fauzee, M. S. B. O., Al-Mawadieh, R. S. M., & Jdaitawi, M. (2026). Impact of iPad based learning on preschool education and sustainable development goals from 2010 to 2020 a systematic review and meta-analysis. *Discover Sustainability*, 7(1). <https://doi.org/10.1007/s43621-026-02733-9>
- An, M.-Y. (2026). Development of a health literacy scale for nutrition and supplement use among pregnant and postpartum women. *Journal of Korean Biological Nursing Science*, 28(2), 288–299. <https://doi.org/10.7586/jkbns.26.006>
- Asadi-Piri, Z., Abdollahi-pour, F., Azadi, N. A., Daroudi, R., & Jaafaripooyan, E. (2025). Health insurance literacy and the associated factors in Iran: A national-scale study. *Health Policy OPEN*, 9. <https://doi.org/10.1016/j.hppopen.2025.100150>
- Bem-Haja, P., Nossa, P., Ferreira, A. J., Pereira, D. S., & Silva, C. F. (2025). AI analysis reveals top predictors of first grade success: Insights from multifactorial screening students' early days of school. *Computers and Education: Artificial Intelligence*, 8. <https://doi.org/10.1016/j.caeai.2025.100415>
- Brinkman, S. A., Lam, B., Dawson, S., Marrone, R., Schunk, D., Winkel, K., Hermes, H., Gabriel, F., Fowler, S., & Engelhardt, D. (2025). Pragmatic clustered randomised control trial to evaluate a self-regulated learning intervention to be implemented in South Australian

- primary schools—study protocol. *Trials*, 26(1). <https://doi.org/10.1186/s13063-025-08814-w>
- Chiplunkar, G., Dhar, D., & Nagesh, R. (2026). Can Bridging the Learning Gap Improve Test Scores on a Key National Exam? Evidence from a Remedial Education Program in Indian Secondary Schools. *Economic Development and Cultural Change*, 74(3), 861–885. <https://doi.org/10.1086/737565>
- Cumar, M. A., Muse, A. H., Abdi, M. K., Abdikarim, H., Abdi, M. A., & Ali, J. A. (2026). Beyond the average: A machine learning typology for differentiated foundational learning in Somaliland. *International Journal of Educational Development*, 124. <https://doi.org/10.1016/j.ijedudev.2026.103618>
- Decrepito, M. A. L. (2026). Effectiveness of Multi-Faceted Tutorial Approach on Basic Literacy and Numeracy Among Struggling Learners and Insights from Pre-service Elementary Teacher-Tutors. *Journal of Curriculum and Teaching*, 15(1), 146–166. <https://doi.org/10.5430/jct.v15n1p146>
- Derseh, B., Dadi, A., & Guthridge, S. (2026). Prenatal alcohol use effects on birth, development, and educational outcomes in the Aboriginal and non-Aboriginal populations in the Northern Territory of Australia: a study protocol. *BMC Pregnancy and Childbirth*, 26(1). <https://doi.org/10.1186/s12884-025-08129-3>
- El Achhab, A., Pry, R., Abidli, Z., Dini, N., & Cielebak, K. (2025). VISUAL IMPAIRMENTS AND AUTISM SPECTRUM DISORDER IN CHILDREN AGED 9-10 YEARS. *Acta Neuropsychologica*, 23(1), 47–56. <https://doi.org/10.5604/01.3001.0055.0071>
- Ferri, G. M., Frank, A., Li, D., Anand, P., Abdallah, M., Avalone, V., Mark Sloan, J., Sanchorawala, V., Lerner, A., Szalat, R. E., Petrocca, F., Edwards, C. V., & Bell, B. N. (2026). When ICAN(S) Becomes ICAN'T: Clinician and Staff Perspectives on In-Hospital Neurotoxicity Grading. *Clinical Lymphoma, Myeloma and Leukemia*, 26(1), e77–e82. <https://doi.org/10.1016/j.clml.2025.08.021>
- Firnando, J. , R. S. A. , Sejati. R. A. , S. A. Z. , R. S. N. , & S. L. (2025). Financial QuotientGenerasi Z: Lifestyle Exposuredan Strategi Manajemen Risiko dalam Penggunaan Pinjaman Online. *Jurnal Psikologi : Jurnal Ilmiah Fakultas Psikologi Universitas Yudharta Pasuruan*, 12(1), 84–104.
- Garlan, M. G., Nacianceno, R. P., Piad, B. F., & Osano, J. R. P. (2026). Building the Capacities for Sustainable Development Goal 4 in an Elementary Last-Mile School in Iloilo Province, Philippines: A Sustainability Science Perspective. *Journal of Sustainability*, 2(1). <https://doi.org/10.55845/jos-2026-21186>
- Handayani, N., Humaira, H., Firnando, J., Suhendra, A., & Malik, D. (2024). Model Kirkpatrick Sebagai Metode Mengukur Hasil Pelatihan Responsibility Dalam Berorganisas. *Plakat: Jurnal Pelayanan Kepada Masyarakat*, 6(1), 51–72.
- Hindriana, A. F., Priantama, R., Setiawati, I., & Pratami, A. R. (2026). AI-Powered Computer-Based Assessment for Literacy and Numeracy: Multi-School Validation in Indonesian Secondary Education. *International Journal of Information and Education Technology*, 16(5), 1252–1266. <https://doi.org/10.18178/ijiet.2026.16.5.2594>
- I. Adriansyah, M., A., H. S., Margono, H., Hardiansyah, J., Firnando, J., & Sennang. (2026). Proactive Personality, Psychological Capital, and Work Readiness among Prospective Teacher Students: A PLS-SEM Mediation Study. *The International Journal of Body*,

- Mind and Culture (IJ BMC)*, 13(6), 1–10.
- Kalizta, S., Maryanto, M., & Firnando, J. (2026). The Role of Habits in Shaping Future Criminal Behavior: A Forensic Perspective. *Jurnal Sosial Indonesia*, 1(1), 75–104.
- Kapse, M., Bhoi, A., Itnal, V., Kumari, P., Khudayberganov, T., Gaffarovich, N. M., & Xudayberganov, O. E. (2026). Augmented Reality Applications for Skill Development in Children with Learning Disabilities. *International Journal of Special Education*, 41(1S), 200–213.
<https://www.scopus.com/pages/publications/105038630596?origin=resultslist>
- Kazmierska-Kowalewska, K., Okely, A., Siraj, I., Archer, C., Veldman, S., & Jones, R. (2025). Potential Efficacy of the MOVERS Professional Development Programme: A Pilot Randomised Controlled Trial. *Child: Care, Health and Development*, 51(5).
<https://doi.org/10.1111/cch.70146>
- Liao, Y., Chavez-Yenter, D., & Kaphingst, K. A. (2025). Evaluating the Applied Knowledge of BRCA Testing among Spanish-Preferring Latino Americans: The Influence of Acculturation and Literacy. *Public Health Genomics*, 28(1), 229–240.
<https://doi.org/10.1159/000546903>
- Major, L., Daltry, R., Otieno, M., Otieno, K., Zhao, A., Sun, C., Hinks, J., & Friedberg, A. (2026). Digital personalised learning to improve literacy and numeracy outcomes: a randomised controlled trial in Kenyan pre-primary classrooms. *Research Papers in Education*. <https://doi.org/10.1080/02671522.2025.2605645>
- Maruyama, T., & Igei, K. (2026). Developing Collective Impact to Improve Foundational Learning: Evidence from Madagascar. *Journal of Development Studies*, 62(2), 175–198.
<https://doi.org/10.1080/00220388.2025.2525849>
- Mathiba, T. A., Mbhalati, N., Modika, P., Pilusa, J., Mphahlele, L., Rabapane, M., Ramalepe, M., Rakgoale, T., Mpyana, N., Sithole, B., Malatjie, D., Tau, A., Maphutha, K., & Themane, M. (2026). Narratives of neglect: a multi stakeholder narrative analysis of grade 8 and 9 underperformance in rural South African schools. *Frontiers in Education*, 11. <https://doi.org/10.3389/educ.2026.1841407>
- Matsieli, M., & Mutula, S. (2026). From Home to Classroom: Socioeconomic Determinants of Learning Outcomes and Social Sustainability in Rural Schools—A Review. *Sustainability (Switzerland)*, 18(11). <https://doi.org/10.3390/su18115325>
- Medina, L. A. C., Brandão, M. G. S. A., Lima, G. A., Zanetti, M. L., Pace, A. E., Gallardo, M. D. P. S., Gutierrez Valverde, J. M., de Oliveira, B. S. B., Lima, F. E. T., & de Souza Teixeira, C. R. (2026). Health Literacy and Numeracy in Self-monitoring of Capillary Glycemia: A Systematic Review of Mixed Methods. *Current Diabetes Reviews*, 22(4).
<https://doi.org/10.2174/0115733998344984241203070203>
- Muharram, M. R. W., Lidinillah, D. A. M., & Mursyidah, D. (2025). Analysis of Student Errors in Solving Minimum Competency Assessment on Scientific Context Numeracy Competence Using Newman’s Error Analysis Procedure. In D. Rahmadani, R. F. Suwarman, M. Solikhin, A. D. Pahrany, I. Rofiki, P. Darmawan, & L. W. Aeli (Eds.), *AIP Conference Proceedings* (Vol. 3446, Number 1). American Institute of Physics.
<https://doi.org/10.1063/5.0308805>
- Nurjanah, S., Arief, Y. S., Fitryasari, P. K. R., Mustamu, A. C., & Hasim, N. H. (2025). Integrative educational intervention to promote school continuity for hospitalized children with cancer in Indonesia: A quasi-experimental evaluation of hospital-based schooling

- supported by child-centered communication and therapeutic play. *Journal of Integrative Nursing*, 7(4), 202–210. https://doi.org/10.4103/jin.jin_110_25
- Pek, L. S., Yob, F. S. C., Mee, R. W. M., Von, W. Y., Nallisamy, V., Lemana, H. E., & Camara, J. S. (2025). Global Inclination of Learning Poverty: A Bibliometric Analysis of a Decade of Published Literature (2014-2023). *European Journal of Educational Research*, 14(4), 1277–1290. <https://doi.org/10.12973/eu-jer.14.4.1277>
- Putri, Z. N., Novita, S., & Susanto, H. (2026). Investigating the Determinants of School Readiness in Indonesian Preschool Children: Does Home Activity Play a Role? *Early Education and Development*, 37(2), 438–455. <https://doi.org/10.1080/10409289.2025.2564713>
- Rosenberg, S. M., Zheng, Y., Santos, K., Riley, E., Meadows, H. W., Snow, C., Hughes, M. E., Frank, E., Lin, N. U., Partridge, A. H., Winer, E. P., & Parsons, H. A. (2025). Patient-reported outcomes, and perceptions and knowledge about recurrence in women with hormone receptor-positive breast cancer. *Breast Cancer Research and Treatment*, 209(3), 513–520. <https://doi.org/10.1007/s10549-024-07510-8>
- Shashidhara, S., Mamidi, P., Gupta, G., & Radhakrishnan, D. (2026). Improving parental engagement in foundational literacy and numeracy learning. *Educational Studies*, 52(3), 392–410. <https://doi.org/10.1080/03055698.2025.2513495>
- Sun, H., & Xi, Y. (2025). Reading roots of resilience: the role of childhood reading environments in closing the educational gap in later-life cognitive functioning. *Journals of Gerontology - Series B Psychological Sciences and Social Sciences*, 80(8). <https://doi.org/10.1093/geronb/gbaf128>
- Tomlin, D., Bowers, P., Zonca, B., Graydon, K., Phillips, J., & Rance, G. (2025). Speech-in-noise recognition as a predictor of academic achievement. *PLOS ONE*, 20(6 June). <https://doi.org/10.1371/journal.pone.0324998>
- Uno, K., & Ogawa, K. (2025). The role of pre-primary school attendance in school readiness in Bangladesh: Exploring the interaction effects with socioeconomic status and home learning environment. *International Journal of Educational Development*, 118. <https://doi.org/10.1016/j.ijedudev.2025.103412>
- Worku, M. Y., & Dereb, A. (2026). Leveraging Participatory Action Research for Enhancing Teacher Professional Development and Strengthening Reciprocal University-School Partnerships. *Systemic Practice and Action Research*, 39(2). <https://doi.org/10.1007/s11213-026-09759-0>
- Yumus, M., Schiele, T., Jiménez, M. V, Camligüney, Ö., Banning, P. C., & Niklas, F. (2026). The Role of Home and Child Characteristics in Children's School Readiness. *Early Childhood Education Journal*. <https://doi.org/10.1007/s10643-026-02196-7>
- Zhao, A., Lurvink, A.-F., Klune, C., Hinks, J., Beoku-Betts, I., Choragudi, U., & Iyer, G. (2026). Assessing different implementation modalities of an EdTech intervention for lower-primary learners: A difference-in-difference study in Sierra Leone. *British Journal of Educational Technology*, 57(3), 775–796. <https://doi.org/10.1111/bjet.70056>