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Increased Motivation to Learn Mathematics in Students of Sungai Buloh Malaysia Learning Centre Through Traditional Games

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ABSTRACT

Indonesian diaspora students often experience low motivation in learning mathematics due to abstract instruction and limited culturally relevant learning media. This community service program aimed to enhance mathematics learning motivation among Indonesian elementary students at the Sungai Buloh Learning Studio, Malaysia, through the integration of traditional Indonesian games Bentik, Dakon, and Engklek. The program was designed based on partner needs and implemented as culturally integrated mathematics learning activities. An evaluative one-group pretest–posttest approach was employed to assess changes in students' learning motivation. Participants consisted of 20 third-grade Indonesian diaspora students. Motivation data were collected using the Mathematics Motivation Questionnaire (MMQ) and analyzed descriptively and inferentially using a paired-samples *t*-test and effect size estimation. The results showed a significant increase in mathematics learning motivation after program implementation. The average motivation score improved by 15.00 points, with a statistically significant difference between pretest and posttest scores ($p < 0.001$) and a large effect size ($d = 1.06$). The most notable gains were observed in task value and self-efficacy, indicating that culturally embedded, game-based learning made mathematics more meaningful and accessible to students. In conclusion, traditional game-based mathematics learning is an effective and low-cost strategy for community service programs in diaspora contexts, supporting both learning motivation and cultural identity reinforcement.

Introduction

The young generation of Indonesians living abroad faces increasingly complex challenges in maintaining their national identity amid the dominance of the host country's local culture. This condition is also experienced by students at the Sungai Buloh Learning Studio (SB Sungai Buloh), Malaysia, which serves as a non-formal learning center for Indonesian children in the Selangor region. As part of the Indonesian diaspora community, these children are particularly vulnerable to the erosion of national identity and diminishing attachment to Indonesian cultural values, as highlighted by

Hoon and Chang (2020). These challenges are not merely cultural in nature but also have significant implications for the learning process and educational quality experienced by students.

SB Sungai Buloh, located on Jl. Tempayan Emas, Kampung Paya Jaras Dalam, Selangor, functions as an alternative learning space for Indonesian children, many of whom have limited access to formal education based on the Indonesian national curriculum. In practice, learning activities at this studio continue to face various constraints, particularly regarding the availability of contextual learning media rooted in Indonesian culture. As a result, instructional practices tend to rely on conventional approaches that are less meaningful for students, especially in mathematics learning.

Mathematics is often perceived as a technical, abstract, and decontextualized subject (Boaler, 2016). This perception is also evident among students at SB Sungai Buloh, where mathematics instruction is still dominated by lecture-based methods and repetitive exercises with minimal connection to students' cultural experiences. In fact, mathematics has considerable potential to be developed as a strategic medium for instilling national values when it is contextualized within students' socio-cultural realities. Thus, mathematics learning should not only aim to enhance cognitive competence but also serve as a means of strengthening students' national and cultural identity.

An initial survey conducted by the community service team revealed that approximately 78% of SB Sungai Buloh students perceived mathematics as abstract and boring. The low level of learning motivation was primarily attributed to monotonous instructional methods that lacked relevance to students' cultural identities. This finding is consistent with Middleton and Spanias (1999), who argue that non-contextual learning approaches can significantly reduce students' motivation to learn mathematics. Similarly, Yani and Panjaitan (2021) reported that Indonesian students experienced substantial difficulties in learning mathematics, particularly in less interactive learning environments such as those encountered during the pandemic. In non-formal educational settings such as learning studios, motivation constitutes a critical prerequisite for successful mathematics learning (Schukajlow et al., 2017).

One approach considered relevant to addressing these challenges is the utilization of traditional Indonesian games as learning media. Traditional games such as Bentik, Dakon, and Engklek serve not only as vehicles for cultural preservation but also as powerful pedagogical tools for contextual mathematics learning. Rosa and Orey (2013) emphasize that integrating local culture into mathematics instruction can enhance student engagement and promote meaningful learning. Dakon, for example, inherently develops multiplication and division skills through the manipulation of game seeds (Nor Asyriah et al., 2023), while Engklek effectively supports students' understanding of plane geometry concepts (Sukadariyah et al., 2020). Bentik can likewise be adapted to strengthen arithmetic skills and intuitive estimation.

The use of traditional games in mathematics instruction aligns with the concept of playful learning, which emphasizes active participation, enjoyment, and the stimulation of intrinsic motivation (Plass et al., 2015). Through play-based activities, students learn mathematical concepts indirectly while simultaneously internalizing Nusantara cultural values. Consequently, learning becomes more meaningful not only from a cognitive

perspective but also from an affective and socio-cultural standpoint.

Although numerous studies have examined the impact of traditional games on students' cognitive learning outcomes (e.g., Nugrahani & Rupa, 2007; Sukadariyah et al., 2020), quantitative investigations focusing on their effect on mathematics learning motivation within Indonesian diaspora communities remain limited. In fact, motivational aspects are particularly crucial in the socio-cultural context of SB Sungai Buloh. A community service program initiated in 2024 introduced traditional game-based learning interventions; however, empirical documentation of their impact on students' learning motivation as community partners is still lacking.

Based on a needs analysis conducted with the partner institution, the community service team designed a mathematics learning intervention utilizing three traditional games: (1) Bentik for arithmetic skills, (2) Dakon for number operations, and (3) Engklek for geometry learning. SB Sungai Buloh was selected as the program site due to its representation as the largest Indonesian learning community in Selangor. This program explicitly integrates mathematics learning with cultural identity reinforcement through participatory Nusantara game activities.

As part of the program evaluation, this community service initiative assesses the effectiveness of traditional games in enhancing students' motivation to learn mathematics at SB Sungai Buloh using a one-group pretest–posttest design (Adhantoro et al., 2025). This evaluation aims to provide empirical insight into the affective impact of the service intervention rather than to establish causal claims typical of experimental research. The findings are expected to serve as a foundation for developing culturally integrated mathematics learning models within community service programs, particularly for Indonesian diaspora communities abroad.

Method

This community service activity employed an evaluative approach using a one-group pretest–posttest design, as recommended by Creswell and Creswell (2018, p. 159). This design was selected to evaluate changes in the mathematics learning motivation of the target partners after participating in a traditional game-based learning program, without the use of a comparison group. Such an approach is considered appropriate within the context of community service initiatives involving a limited number of participants while prioritizing partner comfort and program sustainability (Fraenkel et al., 2019).

The community service program was implemented in the form of a mathematics learning intervention integrating traditional Indonesian games, namely Bentik, Dakon, and Engklek. The activities were conducted over 12 learning sessions during the period of 4–6 February 2025, with each session lasting 90 minutes. Each session was systematically designed to integrate grade-appropriate mathematical concepts into traditional game activities. The duration and intensity of the program were determined based on the recommendations of Plass et al. (2015), who emphasize that game-based learning interventions require sufficient exposure time to elicit changes in affective domains, particularly learning motivation.

The target participants of the community service program were 20 third-grade elementary school students (aged 8–9 years) who were actively enrolled at the Sungai Buloh Learning Studio, Malaysia. Participants were selected using purposive sampling techniques (Etikan et

al., 2016), taking into account partner characteristics and the objectives of the community service activity. The inclusion criteria were: (1) Indonesian citizenship, (2) active participation in the learning studio program, and (3) written parental or guardian consent. All participants were involved voluntarily and were informed of their right to withdraw from the activity at any time, in accordance with ethical principles in educational and community-based activities (BERA, 2018). Demographic data indicated that 55% of participants were female and 45% were male, with an average length of residence in Malaysia of 3.2 years (SD = 1.1).

Data collection was conducted to evaluate the impact of the community service program on participants' mathematics learning motivation. The instrument used was the Mathematics Motivation Questionnaire (MMQ), adapted from Glynn et al. (2011) and contextually adjusted for Indonesian diaspora students. The instrument demonstrated good reliability, with a Cronbach's alpha coefficient of 0.87. The MMQ measures five dimensions of learning motivation: (1) intrinsic goal orientation, (2) extrinsic goal orientation, (3) task value, (4) control of learning beliefs, and (5) self-efficacy, using a five-point Likert scale.

The pretest was administered on 4 February 2025 prior to the implementation of the traditional game-based learning sessions, while the posttest was conducted on 6 February 2025 after the completion of all program activities. Questionnaire administration was directly supervised by the community service team to ensure participants' comprehension of the instructions and questionnaire items, considering the elementary school age of the participants.

The collected data were analyzed descriptively and inferentially as part of the program evaluation process. Inferential analysis employed a paired-samples *t*-test using SPSS version 28.0 to examine differences in motivation scores before and after program implementation (Field, 2018). Prior to hypothesis testing, data normality was assessed using the Shapiro–Wilk test with a criterion of $p > 0.05$, while variance homogeneity was examined using Levene's Test. The null hypothesis (H_0) stated that there was no significant difference between pretest and posttest motivation scores ($\mu_1 = \mu_2$), whereas the alternative hypothesis (H_1) stated that there was a significant increase in motivation following participation in the community service program ($\mu_1 < \mu_2$) at a significance level of $\alpha = 0.05$.

To strengthen the interpretation of the evaluation results, the magnitude of the program's impact was calculated using Cohen's *d* effect size. Effect size interpretation followed the criteria proposed by Lakens (2013), where $d = 0.2$ indicates a small effect, $d = 0.5$ a medium effect, and $d = 0.8$ a large effect. The results of this analysis serve as a reflective basis for assessing program effectiveness and for formulating recommendations for future culture-based community service initiatives within Indonesian diaspora communities.

Result and Discussion

a. Implementation Results

The results of the community service program were evaluated through descriptive and inferential analyses of students' mathematics learning motivation before and after participation in traditional game-based learning activities. The evaluation focuses on documenting the effectiveness of the intervention as a service program for Indonesian diaspora students rather than establishing

causal generalizations typical of experimental research.

1. Descriptive Statistical Test

The descriptive statistics of students' mathematics learning motivation scores, measured using the Mathematics Motivation Questionnaire (MMQ), are presented in Table 1. Table 1 summarizes the pretest and posttest motivation scores of 20 Indonesian diaspora students participating in the learning activities at the Sungai Buloh Learning Studio, Malaysia.

Table 1. Descriptive Statistics of Mathematics Learning Motivation Score

Variable	N	Mean (Rerata)	SD	Min	Maks
Pretest	20	60.25	6.18	50	70
Posttest	20	75.25	15.14	55	103

As shown in Table 1, prior to the implementation of the traditional game-based learning program (pretest), students' average motivation score was 60.25 (SD = 6.18), with scores ranging from 50 to 70. This score range indicates a moderate-to-low level of initial motivation toward mathematics learning. The relatively low standard deviation suggests a homogeneous motivational profile among participants, reflecting a shared experience of limited engagement with mathematics. This condition aligns with Middleton and Spanias (1999), who argue that students in non-formal learning environments often demonstrate uniformly low motivation when instruction relies heavily on conventional, decontextualized approaches (Andyani et al., 2024).

The minimum pretest score of 50 reflects significant challenges in students' perceptions of mathematics as an abstract and disengaging subject. Boaler (2016) emphasizes that such decontextualized instruction can diminish students' perceived task value, resulting in low motivation and disengagement. Within the context of the Sungai Buloh Learning Studio, this finding confirms the relevance of the partner's initial needs assessment, which identified mathematics as one of the least motivating subjects for students.

Following the implementation of the traditional game-based learning intervention, the posttest results show a substantial improvement in students' motivation. As indicated in Table 1, the average posttest score increased to 75.25, representing a 24.9% increase or a mean gain of 15.00 points. This improvement demonstrates that the integration of Bentik, Dakon, and Engklek into mathematics learning effectively enhanced students' motivational dispositions. The increase supports the premise that culturally contextualized learning activities can make mathematics more meaningful and engaging for learners (Rosa & Orey, 2013).

However, the posttest results also reveal an increase in score variability, with the standard deviation rising from 6.18 to 15.14 and the score range expanding to 55–103. This increased variability suggests differential responses to the intervention. Two important phenomena can be inferred. First, several students exhibited very high motivation scores (above 90), indicating strong engagement and positive emotional responses to culturally embedded learning activities. Second, some students showed more moderate gains, reflecting varying levels of participation and adaptation to playful learning strategies. This pattern is consistent with Plass et al. (2015), who

highlight that cultural background, prior experiences, and individual engagement levels act as moderating variables in game-based learning environments.

The maximum posttest score of 103 further confirms the potential of traditional games to function as cultural scaffolds that strengthen students' self-efficacy and intrinsic motivation. Schukajlow et al. (2017) suggest that contextual and meaningful learning experiences can significantly enhance students' beliefs in their own mathematical capabilities, particularly in non-formal learning settings.

2. Assumption Testing and Hypothesis Evaluation

Before conducting inferential analysis, the assumption of normality for the distribution of motivation score differences (posttest minus pretest) was tested using the Shapiro–Wilk test. The results indicated $W = 0.952$ with $p = 0.207$, which exceeds the significance threshold of $\alpha = 0.05$. This finding confirms that the data do not significantly deviate from a normal distribution, satisfying the assumptions required for parametric testing (Field, 2018). The use of the Shapiro–Wilk test is appropriate for small sample sizes, as recommended by Razali and Wah (2011), thereby strengthening the methodological rigor of the program evaluation.

The results of the paired samples *t*-test are presented in Table 2. As shown in Table 2, the inferential analysis yielded a statistically significant difference between pretest and posttest motivation scores, with $t(19) = -4.746$ and $p < 0.001$. The negative *t*-value consistently indicates that the mean pretest score (μ_1) was lower than the mean posttest score (μ_2), supporting the alternative hypothesis that students' motivation increased following participation in the community service program.

Table 2. Paired Samples t-test results

	Mean Difference	SD Difference	t-hit	df	p-value	Cohen's d
Post–Pre	15.00	14.14	4.746	19	< 0.001	01.06

The mean difference of +15.00 points (SD difference = 14.14) reflects a meaningful improvement in students' motivational levels. The magnitude of the intervention's impact, measured using Cohen's *d*, was 1.06, which is categorized as a large effect according to Lakens (2013). From a practical perspective, this effect size implies that approximately 85% of students achieved posttest motivation scores above the pretest mean (McGraw & Wong, 1992). Such a shift is substantial in the context of motivation enhancement and underscores the practical value of the intervention.

Furthermore, the 95% confidence interval for the mean difference, ranging from 7.57 to 22.43, indicates that even under conservative estimates, the program produced a notable increase in motivation. This finding enhances confidence in the robustness of the results and suggests that the observed improvements are not merely statistical artifacts but reflect genuine changes in students' learning experiences.

From a pedagogical and community service perspective, an increase of more than 15 points on the MMQ scale is considered educationally significant. Glynn et al. (2011) emphasize that such gains correspond to meaningful shifts in students' intrinsic interest, task value, and self-efficacy. Therefore, the results demonstrate that the traditional game-based learning program successfully addressed the partner's identified needs by enhancing

students' motivation while simultaneously reinforcing Indonesian cultural identity.

Overall, the findings presented in Table 1 and Table 2 indicate that the integration of traditional Indonesian games into mathematics learning is an effective strategy within community service initiatives targeting diaspora learners. Beyond improving motivation, the program fostered a culturally responsive learning environment that aligns with the broader goals of community empowerment, cultural preservation, and educational inclusion.

b. Discussion

The findings of this community service program demonstrate that the integration of traditional Indonesian games Bentik, Dakon, and Engklek effectively enhanced the mathematics learning motivation of Indonesian diaspora students at the Sungai Buloh Learning Studio, Malaysia. As reflected in Tables 1 and 2, the average motivation score increased by 15.00 points following the intervention ($p < 0.001$; $d = 1.06$), indicating a large practical effect according to Lakens (2013). From a community service perspective, these results confirm that culturally grounded learning activities can meaningfully address the motivational challenges identified during the initial needs assessment, where 78% of students reported that mathematics was boring and difficult.

Rather than positioning these outcomes as generalized causal claims, the results should be interpreted as evidence of the effectiveness of the implemented service program in responding to the specific educational needs of the partner community. The substantial improvement in motivation suggests that the intervention successfully transformed mathematics learning from a decontextualized and abstract activity into a culturally meaningful experience for participating students.

A closer examination of the motivation dimensions measured by the Mathematics Motivation Questionnaire (Glynn et al., 2011) indicates that the most pronounced increases occurred in task value (37%) and self-efficacy (32%). These findings are consistent with the descriptive patterns shown in Table 1, particularly the expanded range of posttest scores (55–103), which reflects heterogeneous student responses to culturally mediated learning experiences. For example, the use of Dakon, which involves concrete seed manipulation, helped students visualize and internalize abstract division concepts. This observation aligns with Nor Asyriah et al. (2023), who emphasize the pedagogical value of Dakon in arithmetic learning. In the context of this community service activity, such hands-on cultural scaffolding played a crucial role in enhancing students' confidence and perceived relevance of mathematical tasks.

The motivational gains observed in this program are in line with earlier studies on traditional games in educational settings, such as Nugrahani and Rupa (2007). However, the present activity contributes a distinctive practical insight by demonstrating particularly strong effects within a diaspora learning context, as indicated by an average improvement exceeding 24%. Previous studies, such as Sukadariyah et al. (2020), primarily emphasized cognitive outcomes especially geometry learning through Engklek whereas the present program highlights holistic motivational outcomes. This is significant, as motivation is widely recognized as a key factor for sustaining long-term engagement and learning persistence in mathematics (Schukajlow et al., 2017), particularly in non-formal educational environments.

From a theoretical standpoint, the outcomes of this community service activity reinforce the playful learning framework proposed by Plass et al. (2015) by underscoring the role of cultural attachment as an important motivational catalyst. The findings suggest that culturally familiar games do more than provide enjoyment; they foster emotional connection, relevance, and meaning in learning activities. Practically, the intervention also offers an accessible and low-cost solution for learning studios, as the estimated cost of less than RM 50 per student yielded a motivation increase equivalent to 1.06 standard deviations. Beyond educational outcomes, the socio-cultural significance of the program is notable, as the use of traditional Indonesian games simultaneously supported the preservation of national identity among diaspora students living within the dominant Malaysian cultural environment (Hoon & Chang, 2020).

Despite these positive outcomes, several limitations of the community service activity should be acknowledged. First, the relatively small number of participants (n = 20) and the absence of a comparison group limit the transferability of the findings to other contexts (Creswell & Creswell, 2018). Second, the short duration of the intervention 12 sessions conducted over a brief period did not allow for the assessment of long-term motivational sustainability. Additionally, the relatively high standard deviation of the score differences (SD = 14.14), as shown in Table 2, suggests the presence of moderating variables, such as differing levels of cultural assimilation or prior learning experiences, which were not explicitly controlled within the scope of this service activity.

When viewed through the lens of the Pancasila Student Profile, the observed increases in task value and self-efficacy indicate the internalization of key character dimensions, including independence (*mandiri*), mutual cooperation (*gotong royong*), and global diversity (*berkebinekaan global*) (Ishartono et al., 2024). By embedding cultural elements that were familiar and meaningful to students, mathematics learning shifted from a procedural activity to a personally relevant experience (Cahyati et al., 2021). This aligns with the principles of culturally responsive teaching, which emphasize affirming learners' cultural identities to foster deeper engagement and learner agency (Jannati et al., 2025). In diaspora settings, such an approach not only enhances academic motivation but also nurtures a sense of belonging that supports positive learner identity and resilience.

Furthermore, the use of traditional games as culturally mediated instructional tools illustrates the feasibility of integrating local wisdom into mathematics learning without compromising conceptual rigor (Anggriyani et al., 2025). The game-based scaffolding enabled students to progress from concrete manipulation toward abstract reasoning, consistent with sociocultural learning theory, which views cognition as inherently situated within social and cultural contexts (Nurmeidina et al., 2025). In this regard, mathematics learning becomes a value-laden process rather than a context-free activity (Venketsamy et al., 2025), supporting the holistic objectives of elementary education.

Based on these reflections, several recommendations can be proposed for future community service initiatives: (1) implementing quasi-experimental service programs with comparison groups across different diaspora contexts (e.g., Singapore or the Netherlands) to examine consistency of outcomes; (2) conducting longitudinal evaluations to assess motivational retention over 6–12 months; and (3) employing mixed-methods approaches to

explore moderating variables, such as cultural attachment, through qualitative interviews or observations.

Overall, the findings of this community service program support policies that encourage the integration of traditional games into the curricula of Indonesian learning studios abroad. The Ministry of Education of the Republic of Indonesia may consider developing a "Cultural Mathematics" module tailored for diaspora communities facing high assimilation pressures. In conclusion, culturally integrated learning approaches function not only as effective pedagogical strategies but also as meaningful instruments for community empowerment and the preservation of national identity.

Conclusion

This community service program demonstrates that the integration of traditional Indonesian games Bentik, Dakon, and Engklek into mathematics learning activities effectively enhances the learning motivation of Indonesian diaspora students at the Sungai Buloh Learning Studio, Malaysia. The evaluation results indicate a substantial increase in students' mathematics motivation following the implementation of culturally integrated learning activities, as reflected by a meaningful improvement in overall motivation scores and a large practical effect. These findings confirm that the program successfully addressed the partner's initial challenge of low student motivation toward mathematics learning.

The greatest improvements were observed in the dimensions of task value and self-efficacy, suggesting that culturally familiar and playful learning experiences helped students perceive mathematics as more meaningful, relevant, and attainable. Through concrete and interactive game-based activities, abstract mathematical concepts were transformed into accessible learning experiences, fostering students' confidence and intrinsic engagement. In the context of non-formal education for diaspora communities, this motivational shift is particularly significant, as motivation serves as a foundational condition for sustained learning and academic persistence.

Beyond its pedagogical impact, the program also carries important socio-cultural value. The use of traditional Indonesian games functioned not only as an instructional strategy but also as a medium for cultural transmission and identity reinforcement among diaspora students. By embedding elements of local wisdom and national culture into learning activities, the program contributed to strengthening students' sense of belonging and cultural pride while navigating the dominant cultural environment of the host country. This aligns with the broader objectives of community service initiatives, which emphasize empowerment, cultural preservation, and contextualized educational support.

Despite these positive outcomes, the results should be interpreted within the scope of a community service evaluation. The limited number of participants and the short duration of implementation restrict the generalizability of the findings and preclude conclusions regarding long-term effects. Nevertheless, the program provides valuable empirical and practical insights into how culturally responsive, low-cost, and easily implementable learning strategies can be effectively applied in Indonesian learning studios abroad.

In conclusion, the findings suggest that traditional game-based mathematics learning represents a viable and impactful approach for community service programs targeting diaspora learners. This approach not only enhances students' learning motivation but also bridges cognitive development with cultural identity

formation. As such, it holds promise for broader application in similar community learning settings and may inform future initiatives and policy directions aimed at supporting Indonesian diaspora education through culturally grounded pedagogical models.

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