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Original Article Research

Dogomo Makodo: Integrating Science, Movement, and Culture in A Student-Centered to Promote Health Literacy

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Abstract

This study aims the effectiveness of the *Dogomo Makodo* program in enhancing health literacy among elementary school students by integrating physical education, science (IPA), and local wisdom in coastal Morotai. The program incorporates outdoor activities such as traditional games (*Ban Laju, Gasing,* and *Jalan Sehat*) and cultural practices like cooking *Tabojou*, aiming to deepen students' understanding of health concepts, bodily functions, nutrition, and healthy living habits. Using a mixed-methods approach, the study involved 20 upper-grade elementary students. Data were gathered through pre-tests and post-tests to measure cognitive gains, along with Likert-scale questionnaires to explore students' perceptions of the program. Results showed a significant improvement in students' health knowledge and behaviors. The integration of science and physical education provided a meaningful, engaging, and contextual learning experience. Moreover, the use of local cultural elements not only strengthened students' emotional engagement and identity but also extended the learning impact into their homes and communities. The *Dogomo Makodo* model demonstrates an innovative, student-centered educational approach that aligns with the Merdeka Curriculum. It is recommended for replication in other rural and culturally diverse settings to support nationwide efforts in promoting health literacy at the primary education level.

Keywords: health literacy; physical education; science; culture; primary school

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1. INTRODUCTION

The health condition of school-aged children in Indonesia is becoming increasingly concerning and demands serious attention from the education sector. According to UNICEF, (2023), approximately 20% of school-aged children are overweight or obese, affecting around 7.6 million children. This trend of childhood obesity is not only a public health issue but also an

educational one, as it affects students' physical well-being, academic performance, and long-term development. Furthermore, Riskesdas reports that the proportion of individuals aged 10 years and above who engage in insufficient physical activity has risen from 26.2% in 2013 to 33.5% in 2018, indicating a significant decline in active lifestyles. The situation is further aggravated by low consumption of fruits and vegetables, as highlighted by WHO, (2022): only 51.6% of toddlers consume vegetables, and 75.5% consume fruits fewer than five servings per day. These statistics reveal that healthy lifestyles are not being established effectively from an early age, and schools — as the primary educational institution — must play a central role in shaping such habits.

Health literacy — defined as the ability to access, understand, and apply health-related information in meaningful, culturally appropriate ways — must become a central focus in the development of school curricula. Schools are a strategic space for shaping children's behavior and lifestyle, including building health literacy (Fernanda et al., 2021). However, many school curricula still take a fragmented approach; Physical Education (PE) and Natural Sciences (IPA) are taught as separate subjects without integration that supports a holistic understanding of bodily health. This separation results in lost opportunities for interdisciplinary learning, limits student engagement, and prevents meaningful application of knowledge in daily life. The disconnect also reflects a broader issue in the education system, where culturally relevant content and lived experiences of students are often excluded from instructional design.

In North Maluku, particularly on Morotai Island, there is a wealth of cultural wisdom that reflects the values of healthy and balanced living. One such philosophy is "Dogomo Makodo," a traditional concept from the Galela ethnic group that translates as "Healthy and Smart Living." This philosophy reflects the synergy between physical well-being and intellectual growth — a concept aligned with global findings showing that physically active children tend to perform better academically and adopt healthier lifestyles more consistently. Unfortunately, this form of indigenous knowledge is rarely reflected in formal education. Traditional games like *Ban Laju* (a cooperative racing game using used tires) or local nutritious foods such as *Tabojou* (a dish made from sago and fish) are rarely utilized as educational media or content for health or science education. The exclusion of such local wisdom represents a missed opportunity to create culturally responsive pedagogy (Reniyansyah; et al., 2025) .

To respond to these issues, the Dogomo Makodo program is proposed as a localized integration model that combines physical education, science instruction, and cultural knowledge to enhance health literacy among primary school students. This model engages children in physical activities that are culturally familiar — such as traditional games — while simultaneously inviting them to investigate scientific principles related to the human body. For instance, students may measure their heart rate before and after games, discuss the function of the respiratory system, or learn about the nutritional value of traditional foods through guided inquiry. This interdisciplinary design makes learning more interactive, embodied, and directly linked to students' everyday realities.

Preliminary observations conducted at SD Gorua, a primary school in Morotai, reveal several critical gaps. Many teachers struggle to make connections between textbook science material and students' real-life health practices. Physical education, while implemented regularly, often lacks theoretical depth and is not integrated with broader academic objectives. These findings underscore the need for an interdisciplinary model that unites science, movement, and local culture. Prior studies have demonstrated the effectiveness of science education in promoting

cognitive understanding of health concepts (Taher et al., 2023; Dewi & Suniasih, 2023) and of physical education in developing healthy habits and motor skills (Pratiwi et al., 2024; Friskawati et al., 2020). However, these disciplines are typically studied in isolation. There is limited empirical research that examines their integration, especially in contexts where cultural identity could serve as a powerful pedagogical tool.

The Dogomo Makodo learning approach offers a promising framework that not only integrates PE and science but does so in a way that is meaningful to students' cultural backgrounds. Designed to be student-centered and experiential, this approach emphasizes real-world application, active participation, and exploration. Activities are designed to trigger curiosity and connect scientific reasoning with lived experience. By engaging students physically, cognitively, and culturally, the program aims to improve their understanding of health and inspire long-term behavioral change.

The main objective of this study is to explore students' perceptions of this integration and to identify effective and adaptable interdisciplinary teaching strategies for promoting health literacy among primary school children in remote and multicultural areas such as Morotai. By doing so, the study also aims to contribute to the development of innovative, localized education models that promote equity, inclusiveness, and relevance in curriculum design — particularly in regions where infrastructure, resources, and access to quality education are limited. Ultimately, the Dogomo Makodo program seeks to build a bridge between modern science, traditional culture, and physical well-being, laying the foundation for healthier generations through holistic, integrated education.

2. METHOD

2.1 Participants

The primary participants were 20 fourth-grade students (11 girls and 9 boys), aged 10–11 years, from SDN Gorua, a public elementary school in North Morotai, North Maluku. Additional data were gathered from teacher interactions and observer field notes recorded by trained assistant researchers. All participants were selected based on ethical considerations and developmental readiness for participating in research involving conceptual understanding and behavioral tasks.

2.2 Research Design

This study employed a convergent mixed-methods design, which integrates both qualitative and quantitative approaches within a single research framework (Icuk et al., 2024). The rationale for using this design lies in the multidimensional nature of the research objective, which seeks to understand not only measurable changes in students' health literacy but also the lived experiences and contextual insights surrounding the implementation of the Dogomo Makodo program. By combining the strength of numerical data with the richness of narrative accounts, the study was able to generate a comprehensive understanding of how the integration of physical education and science, grounded in local culture, impacts primary students' knowledge, attitudes, and behaviors regarding health. The convergent design allowed both strands of data—qualitative and quantitative—to be collected and analyzed concurrently and then merged to compare and interpret the results in an integrated manner. This type of design is particularly suitable for student-centered research in educational settings, where assessing both cognitive

outcomes and emotional engagement is essential for evaluating program effectiveness.

2.3 Instruments

The data in this study were drawn from three primary sources: a) Student knowledge data, obtained through pre-test and post-test assessments to capture measurable changes in health literacy understanding; b) Student feedback data, collected via a structured questionnaire aimed at gauging students' perceptions, attitudes, and learning experiences**.** To ensure that the questionnaire instrument used to measure parental perceptions and support for the *Dogomo Makodo* program meets high standards of quality and is appropriate for use within the context of basic education research, a content validity assessment was conducted. This assessment involved a systematic review by a panel of experts comprising a school principal, a professor specializing in basic education, and an education practitioner with expertise in curriculum development and assessment. Each expert evaluated the questionnaire items based on three key criteria: 1) The relevance of the content to the research objectives; 2) The clarity of language and comprehensibility for the target respondents, and 3) The alignment of each item with the variable indicators defined in the conceptual framework of the study. Through this review process, the experts offered substantive feedback on several items—for instance, recommending simplification of wording to enhance accessibility for students from diverse backgrounds, and suggesting adjustments to better reflect the local cultural context of Morotai. Based on this input, the researcher revised several items to ensure that each statement accurately represented the intended construct, free from bias or semantic ambiguity. As part of the initial testing phase, a pilot trial of the questionnaire was also conducted with a small group of respondents (10 students) who were not part of the main study sample. The purpose of this trial was to confirm that all questionnaire items were easily understood and could be answered consistently by the target population, prior to deployment in the primary data collection. The content validity of the questionnaire instrument was established through both expert review and empirical testing, confirming its appropriateness for use in research examining students' understanding of the integration of physical education, science, and local wisdom within the *Dogomo Makodo* program; c) Learning observation data, gathered through in-situ classroom observations to capture behavioral engagement, participation, and real-time responses during program activities.

2.4 Procedures

Procedures was conducted over a six-week period during the Dogomo Makodo program implementation, which involved 12 learning sessions (twice per week for 30 minutes). The process involved multiple techniques to ensure data richness and credibility: a) Knowledge Test (Pre–Post Design): A set of 10 multiple-choice questions aligned with program learning outcomes was administered before and after the program. These items were designed to measure students' understanding of key health concepts, such as body systems, nutrition, physical activity, and hygiene practices; b) Student Questionnaire: A 15-item Likert-scale questionnaire developed specifically for this study was used to assess students' perceptions of the integrated learning experience. The items addressed four domains: science, physical activity, health literacy, and cultural relevance; c) Structured Observation: Ten trained student researchers conducted systematic observations using observation checklists during the program. They recorded aspects such as student engagement, participation in physical activities, comprehension of science concepts, and peer collaboration. Training ensured consistency in recording and minimized observer bias. All data collection adhered to ethical protocols, including obtaining informed

consent from parents and verbal assent from the children, ensuring voluntariness and understanding among the young participants.

2.5 Data Analysis

Data analysis followed a triangulation strategy to enhance the validity and depth of findings: a) Quantitative data (pre- and post-test scores, questionnaire results) were analyzed using descriptive and inferential statistics. The mean difference between pre-test and post-test scores was tested using a paired samples t-test to determine statistical significance. The internal consistency of the questionnaire was measured using Cronbach's Alpha to ensure reliability; b) Qualitative data from classroom observations were analyzed using thematic coding. Observers' field notes were reviewed to identify recurring themes related to student engagement, cultural connection, and comprehension of health concepts. These themes were triangulated with the quantitative findings to enrich interpretation; c) The integration of findings was conducted at the interpretation stage, where results from both data types were compared, contrasted, and merged to build a coherent narrative about the program's impact on student health literacy. This integrated analysis provided not only evidence of knowledge improvement but also deeper insights into how students engaged with the cultural and physical aspects of the learning model.

3 RESULTS

The results of this study demonstrate the effectiveness of the Dogomo Makodo program in enhancing primary school students' health literacy through an integrated, culturally contextual, and experiential learning approach. Analysis of the pre-test and post-test scores reveals a statistically significant improvement in students' understanding of health-related concepts, indicating not only cognitive gains but also the successful application of learning strategies rooted in students' lived experiences.

Table 1. presents descriptive statistics of students' knowledge scores before and after participating in the program. The average score increased by 2.85 points, reflecting a substantial positive change in learning outcomes. The improvement was further confirmed by a very small p-value (<0.0001), suggesting that the observed difference was statistically significant and highly unlikely to have occurred by chance. This finding reinforces the validity of the program's learning framework, which emphasizes the integration of physical education, science, and local cultural practices.

Table 1. Descriptive Results on Student Knowledge

	N	$\bar{x}$	t-test	p-value ($\alpha = 0.05$)
Pre - tests	20	5.0	15.48 (>t-tabel)	< 0.0001
Post - tests		7.85		

Students actively engaged in hands-on activities such as measuring heart rates during traditional games like *Ban Laju*, discussing muscle function through *Gasing*, participating in cardio-respiratory activities during *Jalan Sehat*, and learning about nutrition by preparing local foods like *Tabojou*. These activities encouraged a deep conceptual understanding of physiological

systems, healthy habits, and local nutritional values. Students not only acquired theoretical knowledge but also experienced the relevance of these concepts through real-life, culturally familiar situations. This form of experiential and student-centered learning resonates with constructivist learning theories, where meaningful connections between prior knowledge and new information result in better retention and internalization of learning.

Table 2. Cronbach's Alpha Reliability Score

Assessed Aspect	Number of Questionnaire Items	Cronbach's Alpha score (α)	Interpretation (R)	Category
Engagement in Activities	4	0,85	Reliable	Good
Understanding of Science and Health Content	4	0,88	Reliable	Good
Healthy Living Behavior	3	0,82	Reliable	Good
Attitude Toward Local Culture	2	0,75	Reliable	Average
Total Instrumen	**15**	**0,87**	**Reliable**	**Good**

Furthermore, the reliability analysis of the student feedback questionnaire yielded a Cronbach's Alpha value of 0.87 (**Table 2**), indicating high internal consistency. Although certain individual items showed only moderate reliability, the overall instrument proved to be robust and appropriate for assessing student perspectives on the integration of science, physical activity, and local wisdom within the context of health literacy.

Table 3. Expert Characteristics in Content Validation

No	Expert	Education Background	Responsibility
1	Expert 1	Elementary School Principal & Curriculum Evaluator	Student Comprehension & Local Context
2	Expert 2	Associate Professor of Elementary Education	Theoretical Alignment & Indicators
3	Expert 3	Education Practitioner, Physical Education Lecturer	Program Relevance & Language Use

Content validity (**Table 3**) is a critical component in the development of research instruments, particularly in the context of elementary education involving children and school communities. In this study, the content validation process was carried out through expert review involving three professionals from distinct yet complementary backgrounds: a school principal, an academic in elementary education, and a lecturer who is also a physical education practitioner.

The involvement of the school principal as Expert 1 is highly strategic. As a frontline educational practitioner at the elementary level, the principal provides direct insights into

students' comprehension and the local context (Jiménez-Parra & Valero-Valenzuela, 2023). Serving also as a curriculum evaluator, the principal is well-positioned to ensure that each item in the instrument is relevant to children's everyday experiences and supports the implementation of a culturally responsive, thematic curriculum. Expert 2, an associate professor specializing in elementary science education, contributed by ensuring that the structure and content of the questionnaire were theoretically sound and aligned with key indicators of health literacy and the principles of interdisciplinary integration. As highlighted by Chakraborty et al., (2023), the involvement of academic experts is essential in assessing the conceptual coherence and measurement validity of instruments used in elementary education. The participation of this academic strengthened the conceptual validity of the instrument, ensuring that it is both practically applicable and grounded in a solid theoretical framework. The input of Expert 3, a lecturer and physical education practitioner, was pivotal in evaluating the appropriateness of the terminology and the relevance of the questionnaire items to students' physical activity experiences, particularly those related to traditional games such as *Ban Laju*, *Gasing*, and *Tabojou*. Dalawi et al., (2023), in their international study, emphasized that instruments assessing physical activity should use language that resonates with students' lived experiences and accurately reflects the forms of bodily engagement. Thus, the role of this practitioner was vital to ensure that the language and context of the activities measured genuinely reflected students' learning experiences.

The expert triangulation approach employed in this validation process is widely recommended in educational research methodology (Russell & Gregory, 2023), as it enriches the development process with multiple perspectives and reduces the risk of subjective bias associated with relying on a single expert. Content validity was further strengthened through a pilot test conducted with a small group of respondents outside the main study sample. This practice is in line with the recommendation of (Jones, 2022), who advocates for the combination of expert assessment and empirical testing to prevent miscommunication and ensure readability and comprehension among target respondents. The content validation process in this study demonstrates that the questionnaire has a high degree of accuracy and appropriateness in relation to its intended measurement objectives. This rigorous process ensures not only the reliability and validity of the collected data but also provides a strong foundation for scientifically and measurably assessing the effectiveness of the *Dogomo Makodo* program based on students' perceptions.

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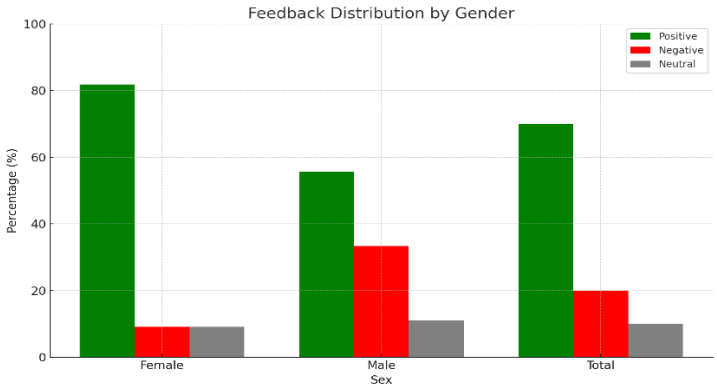
Figure 1. Feedback Distribusion



The questionnaire results (**Figure 1**) also revealed valuable insights into student perceptions. A gender-based response pattern emerged, where 81.8% of female students expressed positive responses toward the program compared to 55.6% of male students. Conversely, 33.3% of boys gave negative responses, significantly higher than the 9.1% negative response rate among girls. Neutral responses were relatively balanced across both groups. These differences suggest that the program's design, which emphasizes collaborative, reflective, and culturally grounded learning, may resonate more strongly with girls. This finding aligns with existing literature on gendered learning preferences, where female students often show greater affinity for structured, relational, and emotionally engaging learning environments.

The data further suggest that incorporating gender-responsive strategies may enhance program inclusivity and effectiveness. For example, the integration of more competitive or technology-supported activities could potentially increase the motivation and engagement of male students. This insight is crucial for refining the program design to better accommodate diverse learner profiles and ensure equitable benefits for all students. It is important to acknowledge, however, that the sample size in this study was relatively small and gender distribution was slightly imbalanced (11 girls vs. 9 boys). While the trends observed provide valuable directions for future development, the findings should be interpreted with caution. To ensure broader generalizability, future studies should consider larger and more gender-balanced samples, possibly across multiple schools and geographic regions with varying cultural characteristics.

In summary, the Dogomo Makodo program significantly improved students' health literacy by bridging cognitive learning with embodied, cultural experiences. It fostered students' abilities to understand and apply health knowledge while nurturing positive attitudes toward physical activity, nutrition, and cultural heritage. The statistically significant learning gains and overwhelmingly positive student feedback validate the program as a viable educational innovation for health promotion in elementary education, particularly in remote and culturally rich regions like North Maluku.

4. DISCUSSIONS

The Dogomo Makodo program significantly improved students' health literacy by bridging cognitive learning with embodied, cultural experiences. It fostered students' abilities to understand and apply health knowledge while nurturing positive attitudes toward physical activity, nutrition, and cultural heritage. The statistically significant learning gains and

overwhelmingly positive student feedback validate the program as a viable educational innovation for health promotion in elementary education, particularly in remote and culturally rich regions like North Maluku.

The findings of this study support the continued development and expansion of the Dogomo Makodo model as a context-sensitive, interdisciplinary, and student-centered approach to health education. This model not only addresses the compartmentalization of subject instruction in the current curriculum but also empowers children to become active agents in cultivating a healthy lifestyle grounded in local wisdom and scientific understanding.

One of the most salient outcomes of implementing the *Dogomo Makodo* program was the significant increase in students' knowledge of health literacy. The comparison between pre-test and post-test scores revealed a marked cognitive improvement in students' understanding of bodily functions, nutritional balance, and hygienic and healthy lifestyle practices. This enhancement reflects not only the success of knowledge transmission but also students' capacity to apply scientific concepts in their daily lives. A particularly important finding pertains to the high level of student engagement in learning activities, which directly contributed to increased health literacy knowledge. In this context, *engagement* is understood not merely as physical participation but as a multidimensional construct encompassing cognitive, emotional, and social involvement throughout the learning process.

The learning activities designed within the *Dogomo Makodo* program—such as the traditional game *Ban Laju*, pulse-monitoring during *Jalan Sehat* (healthy walks), simple respiratory experiments, and cooking nutritious local meals like *Tabojou*—succeeded in creating a learning environment that was joyful, meaningful, and contextually relevant. Through active movement and direct experiential involvement, students were better able to grasp scientific concepts such as heart function, the importance of nutrition, and the mechanisms of bodily systems.

These findings align with constructivist learning theory and experiential learning approaches, which assert that knowledge is most effectively acquired through direct experience, reflection, and real-life connection (Tan, 2024). Based on observation and interviews, students displayed high enthusiasm during the activities, were able to recall information more clearly, and even explain the learned concepts to their peers or teachers in their own words. This suggests that active engagement facilitates deeper internalization and conceptual understanding.

Furthermore, high engagement levels also enhanced students' focus, curiosity, and healthy peer interaction (Ji-Ping Jiang Jin-Yan Hu & Yin, 2023). Students became more confident in asking questions, engaging in discussions (Zeyer & Kyburz-Graber, 2024), and expressing their thoughts on health topics—behaviors that were previously rare in conventional classroom settings. This contributed to the formation of a collaborative learning environment that strengthened collective understanding of healthy lifestyle practices. Quantitatively, the pre- and post-test results demonstrated a statistically significant increase in knowledge scores, indicating that participation in well-designed learning activities not only boosts learning motivation but also directly supports cognitive outcomes. These findings reinforce earlier research by Edmore Nhamo1, (2024) and Peacock et al., (2021), who argued that physical activities paired with scientific reflection enhance both conceptual understanding in science and health literacy

concurrently.

Participatory activities also enabled students to draw meaningful connections between lived experiences and scientific knowledge (Jean-Philippe Ayotte-Beaudet Abdelkrim Hasni & Paquette, 2024). For instance, when students placed their hands on their chest to feel their heartbeat after running, then compared their pulse rates before and after the activity, they not only understood the concept of increased cardiac workload but also began to recognize the importance of exercise for cardiovascular health. Notably, in the remote and multicultural context of Morotai, the use of local cultural media in learning activities significantly increased relevance and meaning-making for students (Afrianto & Yusuf, 2024). When learning experiences incorporated local values and daily life contexts—such as playing *Gasing* (a traditional spinning game) or consuming healthy indigenous food—students felt more connected to the subject matter (Demaio, 2021). This cultivated a sense of cultural pride while simultaneously raising awareness of individual and community health (Musi et al., 2022).

Thus, engagement in activities within the *Dogomo Makodo* program did more than increase health knowledge—it also shaped students' character, self-awareness, and social competence. Learning transformed from a mere process of information transfer into a transformative experience, influencing how children think and act in maintaining their well-being.

Moving forward, the success of this engagement model highlights the critical importance of instructional design that integrates physical movement, scientific inquiry, and local culture. Teachers should be supported and encouraged to design holistic learning experiences that actively involve students, provide ample opportunities for participation, and link classroom learning to the students' real-world environments. Another critical finding of this study is the substantial enhancement of students' understanding of science and health-related content as a result of the Dogomo Makodo instructional model. Unlike conventional learning approaches that often isolate science and physical education into separate disciplines (Taher et al., 2023; Nyberg & Larsson, 2024), the Dogomo Makodo program integrates these subjects through experiential and culturally relevant activities that provide deeper cognitive access to health-related concepts.

Through contextualized inquiry-based activities—such as measuring breathing patterns after traditional physical games or discussing nutritional values of local foods—students were encouraged to connect theoretical knowledge with observable bodily responses. This form of scientific embodiment, where the body becomes a tool for learning, significantly aided the internalization of abstract concepts (Angel Ezquerra Federico Agen & Ezquerra-Romano, 2023) like the respiratory process, energy conversion, muscle coordination, and circulatory function. Students who had previously memorized information from textbooks without understanding were now able to explain how the lungs expand during deep breathing, how the heart rate increases with exertion, and how different foods contribute to body strength and immune resilience. Interviews with students and teachers revealed that students demonstrated clearer conceptual comprehension and used more scientific language to describe their health-related experiences, compared to baseline observations before the intervention.

These outcomes support Fitriani et al., (2023) and Murwati et al., (2022), who argue that science learning becomes more effective when connected to embodied experience and culturally relevant contexts. The multisensory, action-based approach allowed for concept acquisition through movement, observation, and reflection, engaging various learning modalities—visual, kinesthetic, auditory—which are particularly effective in the elementary education setting

(Pratiwi et al., 2024). Moreover, the integration of health and science content supported students in recognizing the cause-effect relationships between lifestyle choices and physiological responses (Skarstein & Ugelstad, 2020). For example, during one lesson, students observed that skipping breakfast led to fatigue during physical activity. They then discussed, with teacher facilitation, the biological explanation behind this observation, linking it to blood sugar levels and energy availability. These real-time, reflective conversations enabled students to co-construct understanding with peers (Gillies, 2023) and educators, reinforcing health literacy as a living, dynamic process.

The use of culturally familiar media—such as explaining the digestion process through the preparation and consumption of *Tabojou*—also played a critical role in anchoring scientific content in students' everyday realities. By seeing science in action within their homes and communities, students developed a stronger motivation to learn, as the relevance of scientific concepts became tangible and immediate.In this way, the Dogomo Makodo model bridges the gap between scientific abstraction and daily life, making science accessible and meaningful to young learners in remote and underserved areas. It also reflects the principles of constructive alignment, wherein learning activities, assessments, and objectives are cohesively linked to maximize student understanding. The positive outcomes in students' comprehension of health and science content further affirm the importance of interdisciplinary, context-based teaching in promoting deep learning (Onde et al., 2020). This approach not only enhances retention and conceptual clarity but also cultivates critical thinking and problem-solving skills, which are essential for lifelong health decision-making (Kurniawan et al., 2023).

Going forward, the Dogomo Makodo framework offers a replicable strategy for science education reform in rural and multicultural contexts. It emphasizes that when students are given opportunities to explore scientific principles through relevant, embodied, and community-rooted experiences, their engagement and understanding significantly increase. This makes the case for revising standard curricula to support interdisciplinary health education that mirrors students' lived realities and cultural assets. One of the most transformative impacts of the Dogomo Makodo program was its influence on students' healthy living behavior, bridging the gap between health knowledge and its application in everyday life. Contrary to studies that Wiedermann et al., (2024) conventional health education often remains theoretical, Dogomo Makodo empowers students to practice what they learn, integrating healthy habits into their routines.

Students began to exhibit practical health behaviors such as washing hands after outdoor activities, being aware of hydration needs after physical exertion, and choosing more balanced meals at home. These behavioral shifts were observed not only during the structured learning sessions but also in informal school environments, indicating that the program had a lasting impact on students' health consciousness. For example, students could articulate why they needed to eat nutritious foods like local sago-based *Tabojou*, citing its protein and energy benefits, and were more attentive to avoiding sugary drinks after learning about the effects of excessive sugar on the body. Furthermore, students monitored their pulse during and after activities like *Ban Laju*, demonstrating an awareness of cardiovascular health.

This behavioral embodiment of knowledge aligns with Budiarti & Putri, (2022) dan Israwaty et al., (2023), who highlight that experiential, project-based learning fosters not just cognitive mastery but behavioral change. By giving students agency in health-related activities and encouraging personal reflection, Dogomo Makodo moved beyond the traditional input-output

model of education and instead fostered transformative learning—learning that changes thinking, feeling, and acting. The combination of science, movement, and reflection created a holistic model of health education (Zeyer & Kyburz-Graber, 2024). Students were no longer passive recipients of information but became active health agents—not only improving their own habits but also influencing peers and family members. Teachers reported that some students shared what they learned at home, reminding siblings or parents about the importance of handwashing, rest, and nutrition. This evidence points to a sustainable impact on lifestyle choices, particularly critical in rural areas where access to formal health services may be limited. Dogomo Makodo thus serves as both an educational and preventive health intervention, leveraging the school environment to instill healthy behaviors at a formative stage of life.

The Dogomo Makodo model also had a profound effect on students' attitudes toward their local culture, which is often marginalized in conventional curricula. By integrating traditional games, foods, and health practices into the learning process, the program reaffirmed the cultural identity of students while simultaneously building their health literacy. Students expressed a sense of pride and excitement when engaging in activities rooted in their local traditions. The inclusion of *Ban Laju*, *Gasing*, and *Tabojou* preparation did not merely serve as pedagogical tools—they became cultural bridges that linked scientific concepts with ancestral wisdom. This alignment created a sense of ownership and belonging, essential for sustained learning.

Interviews and reflective writings showed that students began to view their culture as a valuable source of knowledge. One student noted, "I didn't know our traditional food was that healthy. Now I want to eat it more often instead of instant noodles." This illustrates a shift in cultural attitudes, from passive inheritance to active appreciation. Such outcomes resonate with Hermansya; & Panggung, (2022) and Khoiri et al., (2023), who emphasize that culturally relevant pedagogy enhances motivation, engagement, and identity development. In Dogomo Makodo, the affirmation of local culture not only enriched the curriculum but also promoted intergenerational learning—as students discussed traditional health practices with parents and elders, thereby strengthening community ties.

This approach is particularly important in multicultural and remote areas like Morotai, where diverse ethnic backgrounds coexist and local knowledge systems are still alive but under threat. Dogomo Makodo did not impose external health norms but validated and integrated indigenous knowledge systems, creating a reciprocal flow between science and culture. By respecting and elevating local culture, the program addressed one of the core challenges in rural education: the disconnect between school content and students' lived experiences. When students see their language, games, and food reflected in their learning, they become more invested in education and more confident in their identity (Purwasih & Wilujeng, 2023).

Dogomo Makodo not only advanced students' understanding of health but also nurtured a cultural attitude that values tradition, reinforces identity, and aligns with scientific literacy. This fusion of cultural affirmation and academic rigor stands as a model for inclusive and sustainable education in rural and indigenous settings (Atmojo et al., 2021; Murwati et al., 2022). While the Dogomo Makodo program has demonstrated strong evidence of success in enhancing health literacy, several challenges must be addressed to ensure its long-term sustainability and wider replication across elementary schools in Morotai and similar rural regions.

One of the primary challenges is the limited capacity and training of teachers in designing

and facilitating interdisciplinary, experiential, and culturally grounded learning. Many educators are accustomed to conventional teaching methods, and the shift to an integrated model like Dogomo Makodo requires not only pedagogical retraining but also a shift in mindset. Without structured and continuous professional development, the model risks being diluted or inconsistently implemented. Another challenge lies in the logistical constraints of remote and resource-limited schools. Schools in Morotai often face a shortage of basic materials, limited internet access, and constrained school hours, which can affect the consistent execution of activity-based learning. The integration of local culture also requires community collaboration, which, while beneficial, adds layers of complexity in coordination and engagement that may burden already stretched school staff.

Gender-responsive design also presents a future challenge (Rekoert, 2023). The gendered responses observed in this study suggest the need for differentiated learning strategies that can engage both boys and girls effectively. If unaddressed, such disparities could limit the inclusivity and equity goals of the program. Despite these challenges, the opportunities for expansion of Dogomo Makodo are significant and promising. First, the program aligns strongly with Indonesia's Merdeka Belajar (Freedom to Learn) policy framework, which encourages flexible, student-centered, and locally relevant curricula. This alignment opens doors for the institutionalization of Dogomo Makodo within district or provincial education plans.

Second, the program's integration of health, science, and cultural education offers a model that is replicable not only in Morotai but also in other remote island communities across Indonesia that face similar educational and health challenges. Its context-sensitive framework allows for adaptation based on local games, foods, and cultural practices, making it a scalable yet customizable approach. To move toward wider replication, it is crucial to develop modular teaching materials, detailed activity guides, and video-based tutorials that can help teachers replicate Dogomo Makodo even without direct training from the original facilitators. Partnerships with teacher education institutions and local health offices could also be leveraged to mainstream health literacy education through preservice training and community-based outreach.

The incorporation of digital storytelling or gamification elements, particularly for male students who showed lower engagement levels, represents another avenue for future growth. These innovations can modernize the model while maintaining its cultural roots. Finally, monitoring and evaluation systems should be built into future implementations to ensure fidelity, document best practices, and measure long-term impacts on student health behaviors and academic outcomes. Collaboration with local government and community stakeholders will be key to embedding the program into school governance and local development agendas.

In summary, Dogomo Makodo stands not only as a successful educational intervention but also as a catalyst for systemic change in rural health literacy promotion. By addressing pedagogical, logistical, and gender-based challenges, and capitalizing on the opportunities for policy integration, teacher empowerment, and digital innovation, the model holds the potential to evolve into a district-wide health education framework that is sustainable, inclusive, and culturally affirming. Its future depends on strategic collaboration, investment in educator capacity, and a shared vision that health and education must go hand-in-hand—especially in shaping the next generation of healthy, informed citizens in Morotai and beyond.

5. CONCLUSIONS

The Dogomo Makodo program has proven to be an effective and innovative approach in enhancing health literacy among primary school students through the integration of science, physical activity, and local culture. By positioning students as active participants in experiential and contextual learning, the program successfully strengthened students' understanding of key health concepts, such as organ function, balanced nutrition, and hygiene practices. The significant improvement in knowledge scores, coupled with positive student feedback and meaningful engagement, highlights the strength of this student-centered, culturally grounded model. The implementation of Dogomo Makodo not only contributed to cognitive gains but also fostered healthy behaviors and positive attitudes toward traditional values and physical activity. The incorporation of culturally familiar activities — such as *Ban Laju*, *Gasing*, *Tabojou*, and *Jalan Sehat* — created a learning environment that was both relevant and motivational. Moreover, the program demonstrated its alignment with national curriculum goals, particularly the holistic development principles of Merdeka Belajar. The mixed-methods design employed in this study allowed for a comprehensive evaluation of the program's impact, capturing both quantitative improvements and qualitative richness from students' lived experiences. However, differences in student response based on gender suggest the need for a more differentiated and inclusive pedagogical approach that accommodates diverse learning preferences. Given the program's positive outcomes and cultural relevance, Dogomo Makodo holds strong potential for replication and scaling, particularly in rural, remote, and culturally rich areas. Future research should expand the scope of implementation across different regions and student populations to examine the program's adaptability and long-term impact. Longitudinal studies are especially recommended to investigate how early health literacy interventions influence students' behaviors, decision-making, and lifestyle choices over time. In addition, further exploration is needed on the development of gender-responsive instructional strategies within integrated health education, as well as on the role of family and community engagement in sustaining learning outcomes. Cross-disciplinary collaboration among educators, public health experts, and cultural practitioners will be key to enriching and contextualizing future iterations of this model. Dogomo Makodo exemplifies how education rooted in cultural identity and active learning can meaningfully address contemporary health challenges among children. Its success offers a pathway toward more inclusive, contextual, and impactful health education in primary schools — one that equips students not only with knowledge, but also with the values and habits essential for lifelong well-being.

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