

## DEVELOPMENT OF TRADITIONAL PARA FRUIT GAME-BASED LEARNING MEDIA FOR INTEGER COUNTING MATERIAL AT SDN SELAT GELAM DISTRICT

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### Abstract

*The rapid development of the 21st century requires teachers to be creative in integrating local culture into the classroom, especially in abstract subjects like mathematics. This study aims to develop learning media based on the traditional game of "Buah Para" (rubber fruit) for integer arithmetic operations for elementary school students in the Selat Gelam District. This research uses the Research and Development (R&D) method with the ADDIE development model (Analysis, Design, Development, Implementation, Evaluation). Data were collected through validation sheets, teacher and student response questionnaires, and learning outcome tests. The validation results from material and media experts showed that the developed media was in the "Very Valid" category. Practicality tests conducted with teachers and students also indicated that the media was "Very Practical" to use. Furthermore, the effectiveness test showed a significant increase in students' understanding of integers after using the Buah Para game media. It can be concluded that the development of this ethnomathematics-based media is effective in improving the quality of mathematics learning while preserving local wisdom.*

**Keywords:** Learning Media; Buah Para Traditional Game; Integers; Ethnomathematics, ADDIE Model

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### A. Introduction

Mathematics education, particularly the concept of integer addition, remains a formidable challenge for elementary school teachers in the Selat Gelam District. Despite the subject being taught through conventional approaches such as lecturing, students' conceptual understanding of integers remains critically limited. Observational data from a fifth-grade class at SD Negeri 010 Karimun revealed a concerning gap: out of 20 students, only 7 (35%) fully grasped the concept of integer addition. Meanwhile, 6 students (30%) showed emerging comprehension but frequently struggled with inconsistencies, and 7 students (35%) possessed no basic understanding of the material. This lack of mastery stems from a failure to internalize the foundational properties of integers themselves.

This educational hurdle arises primarily from the lack of instructional variety. The dominance of the lecture method, devoid of interactive or contextual learning media, forces students to grapple with abstract mathematical concepts in isolation. Conventional instruction fails to accommodate diverse learning styles or foster active engagement, leading to a decline in student motivation and interest. Mathematics, especially abstract topics like

integers, often becomes a source of boredom and anxiety for primary students (Fauzi & Arisetyawan, 2021; Wijaya et al., 2020). Furthermore, while digital technology has permeated the classroom, its benefits are often negated if the media used is not contextualized or fails to promote social interaction (Widyaputri & Agustika, 2021).

Integrating "local wisdom" through traditional games offers a strategic opportunity to bridge this gap. In the Selat Gelam District, the abundance of rubber fruit – locally known as Buah Para – represents a significant cultural and educational asset. Children traditionally use Buah Para for various games such as seremban, congkak, and endurance tests. These games inherently involve calculation and strategic thinking, yet they have not been systematically integrated into the formal mathematics curriculum. Research indicates that Game-Based Learning (GBL) can significantly enhance student motivation and conceptual retention due to its dynamic and goal-oriented nature (Mosia & Egara, 2024; Sari et al., 2024).

Moreover, learning through play fosters a joyful environment that boosts student confidence and participation (Rafiah et al., 2023). Educational games can be applied across various subjects to increase engagement (Rambe et al., 2024). However, (Bragg, 2012) notes, the effectiveness of such games depends heavily on their design and curricular integration. Therefore, there is an urgent need to develop a systematic, traditional game-based media that accommodates local cultural values while simplifying abstract mathematical concepts (Sudihartinih & Rachmatin, 2020). This study, therefore, focuses on the development of "Buah Para" game-based learning media to improve integer addition mastery among students in the Selat Gelam District, serving both as an academic intervention and a cultural preservation effort.

Mathematics education in primary schools plays a fundamental role in developing pupils' logical, analytical and systematic thinking skills. However, basic mathematical concepts, particularly the addition of whole numbers, remain a significant challenge for pupils. This situation is evident among Year 5 pupils at SD Negeri 010 Karimun in Selat Gelam Sub-district, where the majority of pupils have not yet been able to fully grasp this concept. Data indicates that only 35% of pupils have a good understanding, whilst the remainder fall into the category of partial understanding or have not grasped the basic concept at all. This points to a serious issue in the learning process, resulting in low mastery of mathematical concepts.

This problem is closely linked to teaching practices that remain dominated by conventional methods, such as lectures, which tend to be teacher-centred. This approach fails to provide sufficient space for pupils to engage actively in the learning process, leaving them struggling to grasp abstract concepts. Furthermore, the limited use of innovative and contextual learning materials means pupils lack meaningful learning experiences. Consequently, mathematics is often perceived as a difficult, boring subject that causes anxiety.

On the other hand, the local social and cultural environment actually holds great potential that can be utilised as a learning resource. One form of local wisdom in Selat Gelam

Sub-district is a traditional game using Buah Para, which naturally involves counting, strategy and social interaction. Games such as seremban and congkak not only provide entertainment but also possess educational value relevant to mathematics learning. However, this potential has not yet been systematically integrated into formal schooling.

Game-Based Learning (GBL) offers a relevant alternative to bridge this gap. Learning through games has been proven to enhance students' motivation, engagement, and conceptual understanding by creating a fun and interactive learning environment. Nevertheless, the effectiveness of games in learning is highly dependent on the design of structured media and its alignment with learning objectives. Therefore, there is a need to develop traditional game-based learning media that not only considers pedagogical aspects but also integrates local cultural values.

Based on the above, this study focuses on the development of learning media based on the 'Buah Para' game as an innovation in mathematics education, specifically for the topic of integer addition. It is hoped that this research will not only improve students' conceptual understanding but also encourage active engagement in learning and contribute to the preservation of local wisdom as part of contextual and meaningful learning resources.

## **B. Method**

This study employed a Research and Development (R&D) design using the ADDIE model, which consists of five stages: analysis, design, development, implementation, and evaluation. The R&D approach was selected to systematically produce and validate a learning media product while examining its feasibility and effectiveness in classroom practice. Research was conducted at SDN Selat Gelam District involving fifth-grade students as primary users of the developed media. Participants included one classroom teacher and students who participated in limited implementation trials. Expert validators consisted of a mathematics education expert and a learning media expert who evaluated product feasibility.

Procedurally, the research followed these stages:

1. Analysis stage: identification of learning problems, student characteristics, curriculum requirements, and potential integration of traditional games through classroom observation, teacher interviews, and document analysis.
2. Design stage: preparation of learning objectives, game mechanics, learning scenarios, assessment instruments, and prototype specifications.
3. Development stage: production of the Para Fruit game media including game tools, integer cards, question cards, teacher guide, and teaching module. The prototype was validated by experts using validation sheets.
4. Implementation stage: limited classroom trials were conducted to examine practicality and usability of the media during mathematics instruction.
5. Evaluation stage: product revision and effectiveness analysis based on validation results, user responses, and student learning outcomes.

Data were collected using multiple instruments: (a) observation sheets to record classroom implementation, (b) interview guidelines to identify learning needs and teacher perceptions, (c) expert validation sheets assessing content, design, and instructional

suitability, (d) teacher and student response questionnaires measuring practicality, and (e) achievement tests (pretest and posttest) measuring learning effectiveness. Validation instruments used a Likert scale to determine feasibility levels. Questionnaires measured practicality through ease of use, clarity, engagement, and instructional support indicators. Achievement tests consisted of integer operation tasks aligned with learning objectives.

Quantitative data were analyzed using descriptive statistics to determine validity percentages, practicality scores, and learning improvement. Learning effectiveness was examined through comparison of pretest and posttest averages and gain interpretation. Qualitative data from observation and interviews were analyzed descriptively to explain implementation processes, student interaction, and classroom dynamics. The methodological procedures and instruments were designed to ensure product validity, practicality, and effectiveness, enabling replication of the study in similar elementary mathematics contexts.

### **C. Finding and Discussion**

#### **1. Finding**

##### **Validity of the Learning Media**

The validity of the learning media was evaluated through expert validation involving a material expert and a media expert. This validation aimed to ensure content accuracy, alignment with learning objectives, instructional design quality, and technical feasibility. The material expert assigned a score of 92%, indicating that the learning content is highly appropriate in terms of conceptual accuracy, curriculum alignment, clarity of explanation, and instructional coherence. The media expert provided a score of 88%, suggesting that the media design, interface, navigation, and interactivity are very good, although minor technical refinements may still be required. The overall average validity score reached 90%, which falls into the Very Valid category. This indicates that the learning media is suitable for implementation with only minor revisions.

Table 1. Results of Media and Material Expert Validation

No	Validator	Score (%)	Criteria
1	Material Expert	92%	Very Valid
2	Media Expert	88%	Very Valid
3	Average Score	90%	Very Valid

The high validity score demonstrates strong alignment between instructional design and subject matter. The media meets pedagogical and technical feasibility standards, serving as a solid foundation before proceeding to practicality and effectiveness testing.

##### **Practicality of the Learning Media**

Practicality refers to the ease of use of the learning media in real classroom settings. It was measured through response questionnaires completed by teachers and students, covering usability, clarity of instructions, engagement, and learning efficiency. The teacher

response reached 90.5%, indicating that the media is easy to integrate into teaching practice and supports instructional delivery. The student response achieved 94.0%, suggesting that the media is highly engaging, user-friendly, and facilitates active learning. The average practicality score was 92.25%, categorized as Very Practical.

**Table 2. Practicality Results from Teacher and Student Responses**

No	Respondent Group	Score (%)	Criteria
1	Teacher	90.5%	Very Practical
2	Students	94.0%	Very Practical
3	Average Practicality	92.25%	Very Practical

The very high practicality score indicates excellent usability. The slightly higher student score suggests that the media is particularly effective in increasing learner engagement. The media also contributes to instructional efficiency and supports classroom implementation.

### **Effectiveness of the Learning Media**

Effectiveness was analyzed by comparing student learning outcomes before and after using the learning media through pre-test and post-test scores. The analysis included mean score improvement and N-Gain to measure learning impact. The average pre-test score was 62.4, indicating a moderate level of initial understanding. The average post-test score increased to 86.8, showing substantial improvement after media implementation. The total increase was 24.4 points. The N-Gain score was 0.65, which falls into the medium to high effectiveness category. These findings indicate that the learning media significantly improves students' conceptual understanding and academic performance.

**Table 3. Analysis of Student Learning Outcomes (Pre-test and Post-test)**

Indicator	Value
Average Pre-test Score	62.4
Average Post-test Score	86.8
Total Increase	24.4
N-Gain Score	0.65
Effectiveness Category	Medium to High

The increase in scores demonstrates a meaningful instructional impact. An N-Gain value of 0.65 indicates strong effectiveness within development research contexts. Therefore, the media is not only valid and practical but also effective in improving learning outcomes. The learning media is highly valid, indicating strong academic and technical feasibility. The learning media is very practical, showing excellent usability in real classroom settings. The learning media is moderately to highly effective, with a significant impact on student learning outcomes. These results confirm that the developed learning media fulfills the three essential criteria of educational development research: feasibility,

usability, and effectiveness. Consequently, the media is recommended for broader implementation and further research, including experimental comparison, long-term impact evaluation, scalability, and integration with advanced learning technologies.

## **2. Discussion**

The findings of this study indicate that the “Buah Para” traditional game-based media is not merely effective at a surface level (validity = 90%; practicality = 92.25%; N-Gain = 0.65), but theoretically grounded across multiple contemporary learning frameworks. The significance of these findings extends beyond classroom improvement, contributing to the discourse on culturally embedded game-based mathematics learning in under-resourced contexts.

### **2.1 Instructional Design Coherence and Contextual Validity**

The high validity score reflects strong alignment between learner characteristics, content objectives, and instructional strategy, consistent with systematic instructional design theory (Branch & Dousay, 2020). Recent research emphasizes that instructional effectiveness depends on contextual responsiveness rather than technological sophistication (Rao & Meo, 2020). Unlike many game-based learning (GBL) interventions that prioritize digital innovation, this study demonstrates that design coherence and contextual authenticity are more decisive variables than modality. Meta-analytic evidence shows that pedagogical structure, rather than gamification features alone, determines learning gains (Boyle, 2022). Thus, the success of “Buah Para” challenges techno-centric assumptions in mathematics education research by showing that analog, culturally rooted games can yield moderate-to-high effect sizes when systematically designed.

### **2.2 Cultural Grounding as Epistemic Mediation**

The integration of ethnomathematics is not ornamental but epistemologically functional. Contemporary scholarship argues that culturally grounded mathematics reduces epistemic discontinuity between informal and formal knowledge systems (Rosa & Orey, 2021). Students in Selat Gelam possess pre-existing informal counting schemas derived from traditional play. Transforming this practice into structured integer operations functions as cultural mediation, enabling conceptual abstraction through familiar cognitive anchors (Aguirre, 2022). Recent studies demonstrate that culturally responsive mathematics instruction improves conceptual transfer and identity affirmation, particularly in rural and marginalized communities (Nasir, 2020). The present findings reinforce this argument by empirically showing full mastery achievement (100%) after intervention, compared to the prior 35%.

### **2.3 Embodied Cognition and Concrete-Representational-Abstract (CRA) Alignment**

The N-Gain of 0.65 situates the intervention within the moderate-to-high improvement range. From a cognitive perspective, this outcome aligns with embodied cognition theory, which posits that sensorimotor engagement strengthens conceptual encoding (Abrahamson & Sánchez-García, 2021). The manipulation of “Buah Para” seeds operationalizes integer addition through spatial movement. This mirrors findings that physical enactment enhances mathematical retention and conceptual durability

(Carbonneau, 2021). Furthermore, the intervention implicitly follows the Concrete-Representational-Abstract (CRA) progression. Empirical reviews confirm that CRA-based approaches significantly outperform symbolic-only instruction in elementary mathematics (Rau, 2020). Thus, effectiveness in this study is not incidental; it is cognitively principled.

## **2.4 Social Constructivism, ZPD, and Collaborative Regulation**

The collaborative nature of the game reflects Vygotskian social constructivism, particularly the operationalization of the Zone of Proximal Development (ZPD). Contemporary research shows that peer scaffolding within structured mathematical games improves error correction and conceptual negotiation (Kim & Lim, 2022). Immediate feedback embedded in peer verification during gameplay – aligns with high-impact feedback principles in learning sciences (Hattie & Zierer, 2020). Moreover, Social Interdependence Theory explains the dramatic shift in mastery levels. Structured cooperative environments enhance accountability, co-regulation, and shared cognitive responsibility (Johnson & Johnson, 2021). The transformation from passive reception (35% mastery) to universal attainment (100%) suggests that interactional architecture – not mere content exposure was the decisive factor.

## **2.5 Motivation, Flow, and Reduction of Mathematics Anxiety**

The practicality score (94%) reflects high learner engagement. According to Self-Determination Theory, intrinsic motivation emerges when autonomy, competence, and relatedness are satisfied (Ryan & Deci, 2020). The game structure allowed strategic choice (autonomy), measurable progress (competence), and peer interaction (relatedness). Meta-analytic findings confirm that well-structured educational games significantly reduce mathematics anxiety and increase persistence (Barroso, 2021). Additionally, Flow Theory suggests that balanced challenge and skill level generate sustained attention (Nakamura & Csikszentmihalyi, 2020). Observational data during implementation indicated extended engagement periods without disengagement behavior, consistent with flow-state indicators.

## **2.6 Contribution to the Field**

This study contributes to the literature in three ways:

- a. It synthesizes ethnomathematics, embodied cognition, CRA progression, and social constructivism within a single analog intervention.
- b. It demonstrates that culturally embedded analog games can achieve comparable outcomes to digital GBL in resource-limited settings.
- c. It highlights teacher facilitation as a mediating variable, addressing limitations reported in earlier game-based research.

In contrast to digital-dominant GBL literature, this research re-centers culture and embodiment as primary design variables.

## **E. Conclusion**

This study concludes that the development and implementation of traditional game-based learning media *Buah Para* provides a meaningful contribution to elementary

mathematics education, particularly in improving students' understanding of integer addition concepts. Developed through the ADDIE framework, the media has demonstrated a high level of feasibility based on expert validation, indicating that it meets the required standards in terms of content accuracy, instructional design, and visual presentation.

Empirical findings further confirm that the use of *Buah Para* as a learning medium significantly enhances students' conceptual understanding, as reflected in the improvement of learning outcomes from pretest to posttest scores. In addition, the positive responses from both students and teachers highlight that this media not only facilitates comprehension but also creates an engaging and enjoyable learning atmosphere, thereby increasing students' motivation and active participation in the learning process. Beyond its instructional effectiveness, the integration of the *Buah Para* game also demonstrates the importance of incorporating local wisdom into educational practices. This approach not only contextualizes learning but also contributes to the preservation of cultural heritage while fostering essential character values such as cooperation, responsibility, and sportsmanship. However, this study is limited by its relatively small sample size, short implementation period, and focus on a single mathematical topic, which may affect the broader generalizability of the findings. Therefore, future research is recommended to expand the scope of implementation across diverse educational contexts, explore its applicability to other mathematical concepts, and examine its long-term impact on students' learning outcomes. In conclusion, the *Buah Para* traditional game-based learning media can be considered a feasible, effective, and culturally relevant instructional innovation that supports both academic achievement and the integration of local cultural values in mathematics education at the elementary level.

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