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Kembara Ethno-Puzzle Walasuji: A Concrete Mathematics Learning Innovation for Developing Geometry Understanding in Middle Childhood

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Abstract: Geometry learning in elementary schools still faces significant challenges, as shown by students' low achievement in understanding three-dimensional shapes, symmetry, and nets. The lack of concrete learning media and the dominance of conventional approaches cause difficulties in connecting abstract concepts with real-life experiences. This situation highlights the need for innovative learning aligned with the concrete operational stage of students' development. This study aims to develop the Kembara Ethno-Puzzle Walasuji as a valid, practical, and effective medium to improve geometry comprehension and critical thinking skills through the integration of ethnomathematics based on Bugis cultural motifs. The research employed a Research and Development (R&D) approach using the 4D model (Define, Design, Develop, Disseminate). Trials were conducted with fourth-grade students at SD Negeri 277 Palattae and SD Inpres 10/73 Palattae, Bone Regency. Research instruments included expert validation sheets, practicality questionnaires, pre-tests, post-tests, and classroom observations. Data analysis involved validity, practicality, effectiveness tests, N-Gain, and effect size to measure learning outcomes. Findings indicated that the medium was rated highly valid by experts, practical by teachers and students, and effective in enhancing geometry understanding with moderate to high improvement. The impact of the Ethno-Puzzle Walasuji lies not only in strengthening mathematical skills but also in preserving Bugis cultural heritage, thereby fostering contextual, meaningful, joyful, and sustainable learning.

Keywords: Ethnomathematics, Educational Puzzle, Walasuji, Geometry, Middle Childhood, Concrete Learning.

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A. INTRODUCTION

Mathematics is one of the subjects that plays an important role in shaping logical, analytical, and systematic thinking skills (Siahaan, 2020, 8) (Rahmaini, 2024, 8). However, mathematics learning among middle childhood students is often faced with the challenge of limited conceptual understanding, especially in geometry (Fauzan, 2020, 4). This is caused by the lack of connection between the material taught and the real-life experiences and cultural context familiar to the students (Islamy, 2025, 2) (Novianto, 2024, 2**)**. The abstract nature of the learning approach tends to make it difficult for students to fully grasp the concepts of two-dimensional and three-dimensional shapes (Fathoni, 2024, 1) (Hafizah, 2023, 4).

According to Piaget's theory, the cognitive development stage of middle childhood students is in the concrete operational phase, where understanding is more optimally achieved through manipulative activities and direct experiences (Putri, 2024, 1). Therefore, appropriate

learning media are needed to match these developmental characteristics while also presenting contexts that are familiar to students (Adha, 2024, 5) (Al Aluf, 2024, 4).

Ethno-Puzzle Walasuji emerges as an innovative learning medium based on local culture, designed to strengthen the concrete understanding of geometry concepts. The Walasuji motif, a symbol of unity and protection in Bugis culture, is used as the main element in an interactive educational puzzle. By integrating ethnomathematics into the learning process, students are encouraged not only to understand the forms and structures of geometric figures but also to appreciate the cultural values embedded within them. Through the Kembara Ethno-Puzzle Walasuji, geometry learning can become more contextual, meaningful, and enjoyable, thereby fostering greater engagement and understanding among students.

B. METHOD

The implementation of *Kembara Ethno-Puzzle Walasuji* in mathematics learning showed positive responses from middle childhood students. The medium successfully captured students' attention and increased active participation in the learning process, particularly when they were asked to assemble geometric shapes based on Walasuji patterns. The puzzle assembly activity not only strengthened their understanding of two- and three-dimensional figures but also fostered curiosity and appreciation for local cultural values.

During the implementation stage, students found it easier to identify differences between various geometric forms because they were directly involved in manipulating the media. The active use of hands in assembling the puzzle pieces supported the development of spatial skills and logical thinking abilities. This process aligns with the cognitive characteristics of students in the concrete operational stage, which requires experiential, hands-on learning. Furthermore, the cultural values embedded in the Walasuji motif provided a contextual dimension to learning. Students not only learned about shapes and their properties but also understood the symbolic meanings within the patterns, such as protection, strength, and order. This integration reinforced the idea that mathematics is inseparable from daily life and the culture in which students grow.

Overall, the Ethno-Puzzle Walasuji demonstrated its effectiveness as a learning medium that connects cognitive, affective, and cultural aspects into one unified experience. Learning activities became more meaningful because students were not merely completing tasks but also engaging in critical and reflective thinking about what they learned. This serves as an important foundation for building deep and contextual understanding of geometry.

C. RESULTS AND DISCUSSION

1. Results

The implementation of the Kembara Ethno-Puzzle Walasuji in the classroom demonstrated positive outcomes for students in the concrete operational stage. Students were highly engaged and motivated to participate in the learning process. The puzzle-based design, combined with local cultural elements of the Walasuji motif, captured students' interest and made mathematical concepts particularly geometry more tangible and easier to understand.

The results of the pre-test and post-test indicated a significant improvement in students' understanding. On average, students' scores increased, showing a deeper comprehension of geometric concepts such as shapes, angles, and spatial reasoning. Additionally, observational data revealed that students displayed more confidence in solving problems, improved collaboration during group activities, and demonstrated higher enthusiasm when interacting with the learning media.

2. Discussion

The positive impact of the Kembara Ethno-Puzzle Walasuji is closely related to its design, which integrates cultural values into mathematics learning. This ethnomathematics-based approach not only contextualizes learning within students' daily lives but also strengthens their appreciation for local wisdom. From a pedagogical perspective, the use of puzzle media supported the development of critical thinking, problem-solving skills, and collaboration. Students engaged in active exploration while arranging puzzle pieces, which encouraged them to connect abstract concepts with concrete experiences. This aligns with Piaget's theory that children at the concrete operational stage learn best through hands-on activities and real-life contexts.

Furthermore, the combination of cultural motifs with mathematical content enriched the learning experience, making mathematics more meaningful and less intimidating. Students did not merely memorize formulas but experienced mathematics as part of their cultural identity. This shows that learning media rooted in local culture has the potential to both improve academic achievement and preserve cultural heritage simultaneously.

Table 1. Distribution of Students by School and Category

No	School Name	Number of Students	Category
1	SD Negeri 277 Palattae (Experiment)	22 students	High
2	SD Inpres 12/79 Palattae (Trial)	22 students	Medium
3	SD Inpres 10/73 Palattae (Control)	18 students	Low

D. CONCLUSIONS AND SUGGESTIONS

The results show that the Kembara Ethno-Puzzle Walasuji effectively enhances students' understanding of geometry at the concrete operational stage. Students in the experimental school, who engaged more intensively with the puzzle media, demonstrated better spatial reasoning, problem-solving skills, and collaborative learning compared to those in the control school who only experienced conventional instruction. The integration of ethnomathematics through the Walasuji motif not only contextualized the learning process but also enriched students' appreciation of cultural heritage. This aligns with Piaget's theory that children at the concrete operational stage require hands-on, manipulative, and experiential activities to construct abstract concepts more effectively. From a pedagogical standpoint, the use of the Ethno-Puzzle Walasuji supported active learning, critical thinking, and cultural awareness simultaneously.

By embedding cultural values such as protection, unity, and order into the puzzle design, students were able to see mathematics not merely as abstract symbols but as a discipline

closely tied to their cultural identity and daily life. Thus, the findings reinforce the argument that culturally based educational media can serve as a bridge between cognitive development and cultural preservation, making mathematics learning more meaningful, contextual, and sustainable.

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