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Simple Engineering-Based Cardboard Game Media to Support Contextual Learning at Al-Ya'lu Elementary School, Malang.

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Abstract

Permainan edukatif telah terbukti dapat digunakan sebagai media pembelajaran yang efektif dalam meningkatkan motivasi dan keterlibatan peserta didik. Program pengabdian masyarakat ini bertujuan untuk memperkuat pembelajaran kontekstual bagi siswa kelas IV dan V di SD Unggulan Al-Ya'lu melalui pengembangan dan penerapan media permainan kardus berbasis rekayasa sederhana. Inisiatif ini dilatarbelakangi oleh kebutuhan sekolah terhadap media pembelajaran yang praktis dan menarik guna menjembatani konsep-konsep sains dasar—seperti gaya, gerak, dan mekanisme sederhana—dengan fenomena nyata di lingkungan sekitar. Pendekatan pemecahan masalah digunakan melalui empat tahapan utama, yaitu persiapan, sosialisasi program, penyuluhan, dan pelatihan praktik. Dalam pelaksanaannya, siswa dilatih untuk merancang dan membuat permainan edukatif berbiaya rendah dari kardus bekas, seperti mesin capit hidrolik dan mesin penjual sederhana. Dampak kegiatan dievaluasi melalui pre-test dan post-test untuk mengukur peningkatan pemahaman konsep siswa. Hasil menunjukkan peningkatan signifikan dari skor rata-rata 64,36 menjadi 87,05, yang mencerminkan peningkatan kemampuan kognitif dan pemahaman terhadap konsep mekanika dasar. Selain itu, kegiatan ini juga mendorong kolaborasi, kreativitas, serta partisipasi aktif siswa. Temuan ini menegaskan bahwa proyek rekayasa sederhana berbiaya rendah dapat menjadi media pembelajaran kontekstual yang efektif serta mendukung strategi pedagogis berkelanjutan di pendidikan dasar.

Keywords:

Cardboard Games; Contextual Learning; Force and Motion; Elementary Education; Simple Mechanisms

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Pengembangan Media Permainan Kardus Berbasis Rekayasa Sederhana untuk Mendukung Pembelajaran Kontekstual di Sekolah Dasar Al-Ya'lu, Malang

Abstrak

Educational games have been widely recognized as effective instructional tools that enhance students' motivation and engagement in learning. This community engagement program aims to strengthen contextual learning for fourth- and fifth-grade students at SD Unggulan Al-Ya'lu through the development and implementation of simple engineering-based cardboard game media. The initiative addresses the school's demand for practical and engaging teaching aids that connect abstract scientific concepts—such as force, motion, and simple mechanisms—with real-world phenomena. A problem-solving approach was employed, consisting of four key phases: preparation, program socialization, counseling, and hands-on training. During the implementation, students were guided to design and construct low-cost educational games made from recycled cardboard, including hydraulic claw machines and simple vending machines. The impact of the program was evaluated through pre-test and post-test assessments to measure students' conceptual understanding. The results indicated a significant improvement in comprehension scores, increasing from an average of 64.36 to 87.05. This outcome reflects enhanced cognitive skills and a deeper understanding of basic mechanical concepts. Furthermore, the activity fostered collaboration, creativity, and active participation. These findings demonstrate that simple, low-cost engineering projects can serve as effective contextual learning media and provide sustainable pedagogical strategies for elementary education.

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INTRODUCTION

Contextual learning allows students to learn in a way that links the knowledge gained with real experiences, thus facilitating a deeper understanding of the subject matter. The use of educational games as learning media has been proven effective in increasing students' motivation and engagement in the learning process (Abidin, 2023; Hanna et al., 2021; Jadmiko & Setiawan, 2024). One type of game worth looking into is cardboard-based games or board games. Research shows that these games not only increase student interest and participation, but also support the development of cognitive and social skills. For example, game-based learning methods have been shown to shift students' attention from traditional learning methods that tend to be boring, to a more interactive and fun learning experience (Sofwan, 2023; Trajkovik et al., 2018). The application of this game can facilitate the exploration of subject matter and provide students with the opportunity to learn through practical experience (Anggraeni et al., 2023; Jadmiko & Setiawan, 2024).

Furthermore, learning through educational games helps students in solving problems and collaborating with their peers. Some studies show that learning that integrates traditional games in the curriculum not only improves academic learning outcomes, but also builds students' self-confidence and interpersonal skills (Dewi & Verawati, 2022; Trajkovik et al., 2018). Research by Dewi and Verawati shows that manipulative play can improve basic motor skills, which is an important component in child development (Dewi & Verawati, 2022). This shows that educational games are not only beneficial in cognitive but also physical and social aspects.

In addition, research conducted by (Afandi, 2015) explains that educational games such as snakes and ladders can be designed to increase student learning motivation in Social Studies subjects. In the context of this study, the concept of *"simple engineering-based"* refers to the application of basic engineering principles—such as mechanical movement, hydraulic or pneumatic systems, and structural assembly—to create functional learning media using simple tools and recycled materials. Previous studies have shown that hands-on engineering projects can strengthen students' conceptual understanding by connecting abstract scientific principles with tangible applications (Alatas, 2019).

"Cardboard game media" is defined as instructional tools made from recyclable cardboard, designed to simulate simple mechanisms such as levers, pulleys, or fluid systems. This approach is cost-effective, environmentally friendly, and adaptable for various classroom settings, making it suitable for primary education (Sari & Sujana, 2021). Furthermore, *"contextual learning"* emphasizes learning experiences that link classroom instruction with real-life contexts, enabling students to construct meaning through active engagement, exploration, and reflection (Abidin, 2023; Anggraeni et al., 2023). By integrating these three concepts, the implementation of life-based cardboard games in the classroom not only enhances students' motivation but also encourages collaboration, critical thinking, and problem-solving. This creates a more dynamic and meaningful learning environment, where knowledge is not passively received but actively constructed (Hanna et al., 2021).

As such, the development and implementation of educational games, especially life-based games, is crucial in the context of contextualized learning in Elementary schools. These games can be a powerful tool to increase student engagement, facilitate concept understanding, and support their social and emotional development. Through this approach, students will not only gain relevant knowledge but also be able to apply it in their daily lives, which is the main goal of

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Elementary education.

SD Unggulan Al-Ya'lu is a private elementary school in Malang City with a strong emphasis on character education and active learning. Despite this, based on initial observations and interviews with science teachers, the school still faces several challenges in science instruction. Most classroom activities rely on textbooks and teacher-centered explanations, with limited availability of low-cost, hands-on learning media. As a result, students often struggle to connect scientific concepts to real-world applications, leading to reduced engagement and uneven achievement levels across the class.

One of the challenges faced by the partner, SD Unggulan Al-Ya'lu, is that in teaching basic science concepts such as force, motion, and simple mechanisms to grade 4 and 5 students, learning still tends to be theoretical and involves less direct exploration. The school currently relies heavily on teacher-centered instruction and textbook-based explanations, with minimal opportunities for hands-on exploration in the classroom. According to initial observations and interviews with science teachers, many students are less engaged and experience difficulties in linking abstract scientific concepts with real-life applications. This is reflected in the students' average pre-test science scores, which remain below the school's competency target of 64.365 point, indicating a gap between conceptual understanding and expected learning outcomes.

Teachers also reported the lack of affordable teaching aids that can be easily integrated into science lessons. Therefore, introducing training on creating educational cardboard games is considered a relevant and sustainable solution. Through this program, students can actively build simple engineering-based learning tools—such as hydraulic claw machines, buzz wires, and mechanics-based vending machines—using recyclable materials (Sari & Sujana, 2021). Based on this background, the community service aims to make learning about basic science concepts such as force, motion, and simple mechanisms can involve students in a creative and fun learning process.

METHOD

This community service activity was carried out in 9-10 May 2025 at SD Unggulan Al-Ya'lu, Malang City. The method used in this activity was a problem-solving approach, which emphasizes the identification of actual needs and challenges faced by the partner institution as the basis for designing appropriate solutions. This approach is widely recognized as an effective strategy for community engagement programs because it encourages participatory involvement and ensures that the intervention aligns with real problems in the field (Dewi & Verawati, 2022). The implementation steps consisted of four main stages:

1. Preparation of facilities and infrastructure (1-8 May 2025)

The initial stage involved identifying the required tools and materials for making educational cardboard games, including used cardboard, scissors, glue, paint, and other simple tools. The implementation team, consisting of lecturers and students, also prepared prototype products, supporting equipment, and activity logistics. According to educational development theory, proper planning and preparation are essential to ensure the effectiveness and efficiency of learning activities, particularly when involving practical and hands-on learning media (Alatas, 2019; Widiyatmoko & Pamelasari, 2012). This stage aimed to minimize implementation risks and ensure that the workshop ran smoothly in the partner school environment.

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2. Program socialization (9 May 2025)

The second stage was program socialization to the school, teachers, and students to ensure a shared understanding of the objectives, benefits, and technical implementation. The socialization was carried out orally and in writing through official letters, direct meetings, and group briefings. Effective socialization is a critical element of community engagement, as it builds commitment and shared ownership of the program, thereby increasing its sustainability (Abidin, 2023; Trajkovik et al., 2018).

3. Provide counseling (9-10 May 2025)

The core activity was providing counseling on the basic concepts of mechanics, force, and motion using an educational game-based approach. The material was delivered interactively, supported by live demonstrations of cardboard game-making by facilitators. Students then worked collaboratively in groups to design and build their own educational game prototypes with the guidance of accompanying students and teachers. According to constructivist learning theory, active participation and hands-on practice allow learners to construct their own knowledge, leading to better conceptual understanding and long-term retention (Bi, 2021).

4. Monitoring and evaluation (9-10 May 2025)

The final stage was monitoring and evaluation, conducted to measure students' engagement, comprehension of the material, and the quality of the products created. This process involved direct observation, question-and-answer sessions, and feedback collection from teachers and students. Monitoring and evaluation are integral components of sustainable community service programs, ensuring accountability, identifying areas for improvement, and validating the effectiveness of the intervention (Hanna et al., 2021; Nurfadhillah et al., 2021). The findings from this stage were used to assess the knowledge and technology transfer process, as well as to provide a foundation for program continuity and scaling.

RESULT AND DISCUSSION

Community service activities in the form of filling material about processing cardboard waste, force and motion, and simple mechanisms. This sub-activity was filled by three presenters who came from Malang State University Lecturers. The theme carried out in this activity is "Development and Formation of Simple Mechanism Analysis Processes Through Used Cardboard-Based Games" to 4th and 5th grade students. The main objective of this service activity is to improve cognitive development and the ability to analyze the mechanism of a machine or prototype tool through games made of used cardboard. (Figure 1). Games such as Excavators, Pinch Machines, and vending machines that function as simple fluid props not only provide entertainment, but also contain important values that are beneficial for the development of mindsets, analysis processes, and understanding in children (Alatas, 2019; Prihatiningtyas & Putra, 2018).

In the socialization process, the material presented how to process simple cardboard waste using the recycle method. After that, the material continued with material about simple physical laws about force and motion which is the initial material for grade 4 elementary students, and finally the material was closed with an explanation of simple mechanisms. In the simple mechanism sub-material, elementary students are invited to recognize the working concepts of various kinds of simple machines with working concepts using electricity, pneumatic and hydraulic. One of the efforts to provide fun learning facilities for elementary school students is to

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use a variety of games made with cardboard file waste as shown in Figure 1.

Figure 1. Cardboard Game Created by Students
Source: Process by author

The picture shows several types of games made from cardboard waste. The socialization of making educational games made from student cardboard took place at SD Al Ya'lu Malang City. This activity is divided into two stages, namely the socialization of educational game tools and the practice of making games for students. The socialization of educational game tools was carried out using the demonstration method and discussion with participants (Figure 2). The cardboard game development process can be described in several clear steps. First, the teacher introduces the concept of mechanical systems through simple demonstrations. Second, students are grouped into teams of 4–5 people and provided with basic materials such as used cardboard, glue, cutters, plastic syringes, hoses, and paint. Third, students learn about step-by-step build models such as a hydraulic claw machine, buzz wire, or simple vending machine. The hydraulic system is assembled by connecting syringes with clear hoses filled with colored water to visually demonstrate force transfer.

In the demonstration activity, students and teachers were introduced to cardboard games as an educational game tool that is useful for training the ability to understand concepts and simple mechanisms related to physics subjects. The cardboard game is a game tool designed like machines, and various mechanisms related to physics. Besides being able to train children's understanding of physics, this game tool can also train the ability to assemble to form structures and mechanisms of tools that have been designed (Prihatiningtyas & Putra, 2018). Understanding a mechanism is one of the aspects that must be considered in the development of elementary school students and is a benchmark to prove that children grow and develop well (Yuliana et al., 2023). In order for the ability to think and analyze to develop properly, children must be given good opportunities by parents, teachers/schools, and the environment, as well as the right opportunities for optimal development through play activities, moving freely and making things with their games (Heldanita, 2019).

After the service process is carried out, a test is carried out to determine the results of the socialization and service to determine the effectiveness of the service, where the results of the pre-test and post-test are shown in Figure 3. In this service, an initial test (pretest) and a final test (post test) are carried out. In the pretest, the average understanding of grade 4 students was

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64.36 while after the post-test the score rose to 87.05. In the pretest activity, some of them forgot about the material taught even though they had previously received the material in the previous few weeks. After learning by using simple teaching aids, students' learning outcomes increased. With the use of appropriate methods and the use of practical media in the teaching and learning process can generate enthusiasm for learning and a pleasant learning atmosphere so that the information conveyed by the lecturer can be easily accepted and acquired into long-term memory (Nurfadhillah et al., 2021). This is in line with Pavio's theory of dual coding theory that information presented visually and verbally is remembered better than information that is only presented in one way (Bi, 2021).

Figure 2. Making Process Cardboard Game Created By Students
Source: Process by author

Practical experience in the manufacturing process is widely recognized as a key determinant of improved student learning outcomes because hands-on engagement helps strengthen memory retention, attention, and intrinsic motivation toward the learning material. The use of tangible learning media enables students to connect theoretical knowledge with real-world applications, making abstract concepts more concrete and meaningful. This aligns with the findings of (Abdullah et al., 2011), which highlight that appropriate teaching aids effectively stimulate both cognitive and sensory domains, encouraging students to actively process information through visual and auditory channels.

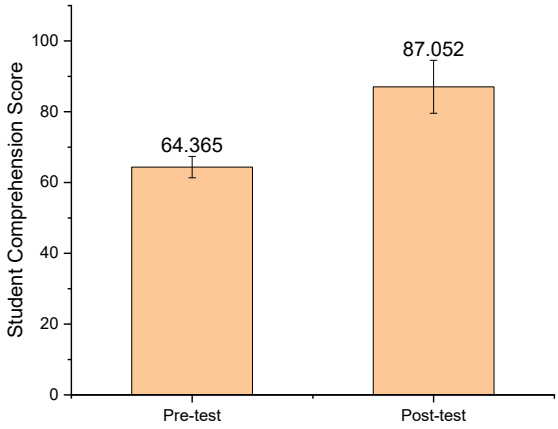

Figure 3. Comparation of student comprehension score before and after
Source: Process by author

More importantly, the use of simple engineering-based teaching aids creates an active learning environment that promotes higher-order thinking skills. By directly interacting with

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physical models, students engage in cognitive processes such as observation, analysis, and problem-solving rather than passively receiving information. This interpretation is consistent with constructivist learning theory, which emphasizes that knowledge is best constructed through active experience and reflection rather than through one-way instruction. As (Widiyatmoko & Pamelasari, 2012) explain, the integration of multiple sensory pathways—hearing, seeing, touching, and reasoning—amplifies conceptual understanding and supports long-term memory retention.

The increased post-test scores demonstrate not only the effectiveness of the cardboard game media in improving basic science comprehension but also its potential to enhance cognitive flexibility and student engagement. These findings suggest that the learning process is not merely about information transfer but about facilitating deeper cognitive processing, enabling students to internalize abstract scientific concepts through hands-on exploration and contextual experiences.

CONCLUSION

Based on the results of community service activities implemented in Al Ya'lu Malang City, it can be concluded that: (1) this used cardboard-based game tool is a learning tool for grade 4 elementary school students who are able to train children's thinking and analyzing; (2) this used cardboard-based game tool can add a variety of games with basic science concepts such as force, motion, and simple mechanisms can involve students in a creative and fun learning process; and (3) this used cardboard-based game tool can increase the understanding of grade 4 elementary school students. The sustainability of this activity is expected that teachers can increase creativity in maximizing cardboard games, not only games with the forms that have been presented, but also can develop games in other forms.

This community service activity contributes to the field of elementary science education by demonstrating how low-cost, simple engineering-based cardboard game media can be effectively integrated into contextual learning. The program not only strengthens students' conceptual understanding and engagement but also provides teachers with practical, sustainable strategies for classroom innovation. However, this activity also faced several limitations. The implementation was conducted within a limited time frame and involved a single partner school, which may restrict the generalizability of the findings. In addition, the evaluation primarily focused on short-term learning outcomes, without assessing long-term retention or broader cognitive impacts. Future studies are encouraged to expand the implementation to multiple schools, include larger sample sizes, and apply longitudinal assessment methods. Such efforts will help refine the approach and provide stronger evidence of its effectiveness and scalability.

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