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Application of Water Rocket Learning Media to Understand Newton's Third Law: A Case Study at an Islamic Junior High School in Serang, Indonesia

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Rizky Sewu Wulan[1*], Nasywa Maida Rahma [2], Upi Lukmansyah[3], Tiaroh Tiaroh[4]

[1,2]Department of Science Education, Faculty of Teacher Training and Education, Universitas Sultan Ageng Tirtayasa, Serang, Indonesia

[3,4]MTs Al-Khairiyah Kepandean Ciruas, Serang, Indonesia
Correspondence Email: *2281230050@untirta.ac.id

Abstract

Third Newton's Law has been considered difficult by many students to comprehend due to its abstractness and needs concrete visualization to make comprehension easier. Hence, innovative learning tools which can connect theories with everyday happenings are required. Water Rockets can be used as a learning tool which can show the concept of action and reaction. For these reasons, this research is aimed to utilize water rockets as a learning tool to assist students to comprehend Third Law of Motion of Newton concerning action and reaction. This research was carried out at an Islamic junior high school in Serang, Indonesia using a case study approach. The participants of this research were seventh grade students who carried out water rocket activities in science class. The activity was carried out in three stages, namely material delivery, water rocket demonstration, and discussion and evaluation to measure students' understanding of Newton's Third Law. The results showed that the use of water rocket media was able to improve students' understanding of Newton's Third Law based on the evaluation results conducted by the informants. The students involved in this activity were very enthusiastic, making the learning process more interactive.

Keywords: Water Rocket, Newton's Third Law, Learning Media, Science Education, Case Study

INTRODUCTION

Education is one of the main factors in developing high-quality and competitive human resources. Education is a learning process that every human being (student) undergoes to understand, comprehend, mature, and think more critically. Thus, the purpose of education is to facilitate students in exploring and developing their potential, both physically, emotionally, intellectually, socially, and spiritually (Bigger, 2013; Suryani, 2024; Aithal, 2025). One of the subjects that plays a major role in developing these abilities is science learning. Science learning not only serves as a means to understand scientific concepts, but also as a vehicle for training scientific process skills, scientific attitudes, and the ability to apply knowledge contextually.

The reality in the field shows that science learning at the Madrasah Tsanawiyah (MTs) level still faces various challenges. Many students consider science to be a difficult and abstract subject. This is in line with the opinion of Fatimah & Bramastia (2021), who state that the abstract nature of science often makes it difficult for students to understand concepts, especially if students have never experienced or felt them directly. In addition, the learning process is still dominated by lectures and written assignments, where teachers tend to explain scientific material and concepts using the lecture method. According to Pratiwi & Supardi

(2024), the lecture method is widely used because it is effective in conveying information in a short time. However, this method tends to be passive and does not directly involve students in the learning process. Based on this, it means that learning is still teacher-centered (Panjaitan & Supardi, 2024). This condition certainly makes students less actively involved in the learning process and makes it difficult for them to relate concepts to real phenomena in their environment.

One of the topics that often causes difficulties for students in learning is Newton's Third Law of Action and Reaction, because it requires conceptual thinking skills to understand the relationship between two forces working in opposite directions. To overcome this, teachers need to innovate in designing interesting and contextual learning media so that students can visualize the concept in a real way. The use of learning media will facilitate teachers in the learning process. Moto (2019) argues that teachers should use learning media in the teaching and learning process to achieve learning objectives and as an effort to increase students' willingness to learn and improve their motivation to learn. In addition, according to research by Asnawir & Usman (2002), the function of learning media is to make it easier for students to understand abstract concepts, assist teachers in teaching, and provide a more realistic experience.

One of the learning media that can be used in applying Newton's Third Law is a water rocket. A water rocket is a simple rocket model that utilizes basic physics principles. A plastic bottle filled with water and pressurized with air will launch upward due to the thrust force. The movement of a water rocket is influenced by various forces, such as thrust, gravity, aerodynamics, and friction (Agus et al,. 2024; Fischer et al., 2020). The working principle of a water rocket is based on the concepts of pressure and force. The pressurized air within the bottle exerts force which pushes the water out of the rocket. The force exerted by the water creates a force which makes the rocket shoot up into the sky. This is a very obvious case of Newton’s law of action-reaction (Basuki et al. 2016). Students are able to see through water rocket launches how the downward force of the water creates a force that makes the rocket fly up.

A number of studies in the past have revealed the usefulness of simple experimental media in increasing the effectiveness of science learning. According to Budiman et al. (2016), the utilization of teaching aid for practical activities influences the understanding and creativity of the students. In a research by Mardiansyah et al., (2023), it was found that water rocket making could help increase the collaboration skills of students as they need to

collaborate to create and launch the rockets. Moreover, according to Mubarrok et al. (2025), interactive media of learning may positively influence critical thinking skills of students.

Based on all these different problems, the application of the water rocket in science learning is considered as a relevant and potential alternative that could help the students to better comprehend the concept of Newton's third law. Not only does it provide more realistic and interesting way of learning, but it also allows students to actively participate in the scientific experiment. That is why this research is significant in terms of investigating how far the application of the water rocket can enhance the quality of science learning.

METHOD

Qualitative methodology and case study design are employed in this research study. Based on Sugiono (2009), qualitative research is a kind of research that is performed to investigate natural conditions. The term 'qualitative' is derived from the fact that data obtained and analyzed are text or verbal data, not numeric data. The scope of this study covers a detailed description of the use of water rocket learning medium in assisting the students' understanding of Newton's Third Law of Action and Reaction in science learning.

The study took place at an Islamic junior high school in Serang, Indonesia. The study participants were 27 seventh graders that were actively engaged in the process of practicing with water rocket as part of science class studying the topic of force and motion. There were three main stages of conducting the research. The first one was delivering the material where the resource person presented the basic information about Newton's law and gave examples of its implementation in everyday life. The second stage was a water rocket demonstration, where students conducted experiments to launch water rockets using simple materials such as plastic bottles, water, and air pumps. At this stage, students directly observed the process of action and reaction forces that caused the rockets to launch upward. The third stage was discussion and evaluation. In this stage, students and the resource person discuss the results of their observations and draw conclusions about the working principles of water rockets. The evaluation process is carried out through a question-and-answer session and a summary of the material, in which the resource person asks several students to explain the application of Newton's Third Law to determine the extent to which their understanding has improved after the activity. In addition, students are also given reflective questions as feedback to find out their experiences and feelings after participating in learning using water rockets as a medium.

RESULTS AND DISCUSSION

A water rocket is a toy that uses the principle of air pressure. In a water rocket, a plastic bottle acts as a pressure chamber containing water and air. When air is pumped into the

bottle, the pressure inside the bottle increases. When the launcher cap is released, the water is pushed out downward with a certain force (action), and as a result, the rocket is pushed upward with an equal but opposite force (reaction). This upward thrust is what causes the rocket to launch. The greater the air pressure applied, the stronger the action force produced, so that the reaction that propels the rocket upward is also greater. Water rockets work based on Newton's Third Law of Action and Reaction. Newton's Third Law states that "For every action there is always an equal and opposite reaction, or it can be said that the reciprocal action between two objects is always equal in magnitude and opposite in direction" (Suryanto & Bakhri, 2021).

This study shows that the use of water rocket learning media has a positive impact on improving students' understanding of Newton's Third Law and their enthusiasm for learning science. The activity was carried out in three main stages, namely material delivery, water rocket demonstration, and discussion and evaluation.

1. Material Delivery

In this stage, the researcher acted as a teacher/facilitator, delivering the concepts of Newton's First, Second, and Third Laws using everyday examples such as the pushing force when rowing a boat and the movement of a released balloon. At this stage, most students were still passive. Although the students seemed attentive, most of them still had difficulty understanding the material, one of which was the discussion of Newton's Third Law, namely the relationship between two forces working in opposite directions. However, the students began to show interest when the teacher explained that this principle would be tested through a water rocket experiment.

2. Water Rocket Demonstration

The water rocket demonstration stage was the most interesting activity for the students. According to Rahmadona & Nana (2021) and Loiser & Endne (2022), demonstration is a form of learning method in the teaching process. Demonstration makes it easier to convey events and concepts of knowledge, talking demonstratively to show how to do the activity. This activity was carried out outside the classroom, specifically on the school field. When the rocket was launched on the field, the students looked very enthusiastic, even conducting several retests to improve the launch results. The students enthusiastically observed the physical phenomena that occurred. They could see firsthand that the water coming out of the bottle produced an upward thrust that made the rocket launch, in accordance with the principle of action and reaction. This enthusiasm showed high emotional and cognitive involvement in the learning process.

3. Discussion and Evaluation

The discussion and evaluation stage is an important part of the leaning activity, because it is at this stage that students are guided to reflect on their learning experiences and relate them to the theoretical concepts they have learned. In line with the statement by Rahmaeni et al., (2025) and Safrudin (2025) that evaluation is not only used to measure student achievement but also as a tool for educators to reflect on designing, implementing, and improving learning strategies so that the overall quality of education can be improved.

After the practical activity, the resource person invited the students to discuss their observations. In the discussion session, the students were encouraged to ask questions and discuss the theory and practice that had been carried out. The resource person then invited the students to summarize the results of the activity. The evaluation results showed that there was an increase in the students' understanding, as indicated by their correct answers when the resource person asked them to summarize the activity. Students were able to understand the concept of action-reaction through the use of water rocket learning media. Most students were able to explain that the force of water coming out of the rocket was the action, and the upward thrust was the reaction. In addition, students were given reflective questions about their experiences during learning. The majority of students said that this activity was fun and exciting.

CONCLUSION

Based on the results of the research, it can be concluded that the application of water rockets successfully improved students' understanding of the concepts of action and reaction as described in Newton's Third Law. Through a series of activities, namely material delivery, field demonstrations, discussions, and evaluations, students showed a high interest in learning during the activities. The enthusiasm and active involvement of students during the activities showed that contextual experiment-based learning was able to create a more interactive, interesting, and meaningful learning atmosphere. In terms of feedback, students also provided positive reflections, with the majority of students saying that the activities were exciting and enjoyable. Thus, the impact of using water rockets was clearly achieved in terms of learning motivation and learning interaction.

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