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Student Development: Implementation of Water Rocket Media as a Project-Based Learning Tool to Improve the Literacy of Junior High School Students during the Pandemic

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ABSTRACTS

The current change in learning patterns looks massive at all levels of education due to the Covid-19 pandemic. This research is aimed at empirically testing the effect of water rocket media as a project-based learning tool with the target of increasing the numeracy literacy of grade VIII junior high school students during the Covid-19 pandemic. This analysis involves students, parents, and teachers in junior high schools as the object of research. This study uses a questionnaire method with Pre-test and Post-Test as a data collection tool. Results From the Pre-test and post-test data showed a significant increase in the average value from 19.9 to 45.0%. Thus it can be stated that the application of project based learning affects students' understanding. This study also found that project-based learning has provided a conducive environment for students to be creative and design technological products. Students also become more active, enthusiastic, critical, and creative in learning physics.

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1. INTRODUCTION

In the era of the 21st century, science and technology is developing very rapidly, where everything can be arranged using technology. So that as students, they must understand technological developments and be able to use them wisely in order to balance the development of science and technology (Kristanti *et al.*, 2016). This is also related to students' numeracy literacy power as a supporter of students' knowledge and understanding.

Children's numeracy abilities can be known through the stages of numeracy development, namely informal numeration, numeracy knowledge, and formal numeration (Purpura & Baroody, 2013). At the informal stage of numeration, children are able to number coherently and recognize the quality of objects. Informal numeration occurs in early childhood to early elementary school. Entering the early age of elementary school, students' numeracy skills change to the stage of numeracy knowledge.

Based on research conducted was found that the project-based learning model is quite useful in designing effective learning so that it has the potential to meet the demands of Project-based learning models (project based learning models) assist students in learning, solid and meaningful-use knowledge and skills built through authentic tasks and work, expanding knowledge through the authenticity of curricular activities that are covered by the process of learning to do planning (designing) or open-ended investigations, with results or answers not previously determined by certain perspectives, and building knowledge through real-world experiences and interpersonal cognitive negotiations that take place in a collaborative work atmosphere (Sbaragli & Santi, 2011).

Other studies related to learning science using fun learning are (Astuti, 2016; Arifin & Sunarti, 2017).who conducted research on learning outcomes, motivation, and psychomotor abilities of students. Overall, the results of the research that have been carried out show that the use of media and educational game-based learning can increase students' motivation, learning abilities and learning outcomes. But no one has researched about student development: implementation of water rocket media as a project-based learning tool to improve the literacy of junior high school students during the pandemic.

The purpose of this research aims to find out how the impact of the implementation of water rocket media with the Project based learning model is carried out online. In addition, the purpose of this research is to improve the numeracy literacy of junior high school students during the COVID-19 pandemic, assisted by the synergy of students and parents so that this learning process runs well.

2. THEORETICAL FRAMEWORK

2.1. Project Based Learning

Joyce argues that the learning model is a method used as a guide in planning learning in the classroom to determine learning tools including books, curriculum, and others, thereby helping students achieve their goals (Nurfitriyanti, 2013). This is similarly conveyed by Soekamto the learning model is a conceptual framework that describes a systematic procedure in organizing learning experiences to achieve certain learning goals and functions as a guide for learning designers and teachers in planning teaching and learning activities (Nurfitriyanti, 2013).

One of the learning models that can increase students' creativity in solving problems is the problem based learning model. Said that project based learning can be defined as learning with long-term activities that involve students in designing, creating and displaying products to solve real-world problems Thus the project-based learning model can be used as a learning

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model to develop students' abilities in planning, communicating, solving problems and making the right decisions from the problems at hand .

Characteristics Project Based Learning Model:

(i) There is a problem whose solution is not predetermined
(ii) Learners as process designers to achieve results
(iii) Learners are responsible for obtaining and managing the information collected.
(iv) Conduct continuous evaluation.
(v) Students regularly review what they are doing
(vi) The final result is a product and an evaluation of its quality.
(vii) Classes have an atmosphere that tolerates faults and changes.

The advantages of project-based learning (Project Based Learning) include:

(i) Increase motivation, where students are diligent and try hard in achieving the project and feel that learning in the project is more fun than other curriculum components.
(ii) Improving problem solving skills, from various sources describing project based learning environments makes students more active and successful in solving complex problems.
(iii) Increasing collaboration, the importance of group work on projects requires students to develop and practice communication skills.
(iv) Improving resource management skills, if implemented properly, students will learn and practice in organizing projects, making time allocations and other resources such as equipment to complete assignments.
(v) Improve students' skills in managing learning resources.
(vi) Encourage students to develop and practice communication skills.
(vii) Provide learning experiences that involve complex learners and are designed to develop according to the real world (Nurfitriyanti, 2013).

2.2. Water Rocket

A water rocket is one of the models that can be used as teaching aids / learning media in schools in introducing the forms and events of space rocket launches that cannot be seen directly by students at school. A water rocket is one of the props that can attract the attention of students, in which there are many aspects of science that have not been known by students so students are interested in learning it. Water rocket props can be made from used items such as used plastic bottles, nozzles from motorcycle hubcaps, mica plastic, and bicycle pumps that are easy for us to get where the items are designed in such a way as to form water rockets. The design of water rocket props carried out by students with teacher guidance is very good for developing cognitive, affective, psychomotor, and creative thinking skills. The basic principle of using water rockets is to issue a volume of water from the rocket nozzle which also means the air pressure difference as an energy supply in water rocket launches (Fatimah *et al.,* 2016). The making of the water rocket needs deep analysis to produce the farthest distance. This depends on the variable used as the assumption in the experiment. The more variables used, the more complex it will be in analysing the data, but it will produce more varied findings.

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Figure 1 show the general design of the water rocket**.** A water rocket is a type of rocket that uses water as its fuel. Pressure vehicles that function as rocket engines are usually made of plastic bottles used for soft drinks. The water is forced out by compressed air, usually compressed air.

The term "aqua jet" has been used in parts of Europe, but is more commonly known as "water rocket" and in some places they are also referred to as "bottle rocket" (which can be confusing as this term traditionally refers to a firework elsewhere).

Water rocket engines are most commonly used to propel model rockets, but have also been used in model boats, cars, and rocket-assisted gliders.

The water rocket operates as follows:

(i) Compressed air is added which creates a bubble that floats on top of the water and then compresses the volume of air at the top of the bottle.
(ii) The bottle is removed from the pump.
(iii) Air is pushed out of the nozzle by compressed air.
(iv) The bottle moves away from the water because it follows Newton's third law.

Water and gas are used in combination, providing a means of storing incompressible potential energy, and water increases the mass fraction and provides greater momentum when ejected from the rocket nozzle. Sometimes additives are combined with water to improve performance in various ways. For example: salt can be added to increase the density of the mass so that the specific impulse increases. Soap is also sometimes used to create dense foam in rockets which lowers the reaction mass density but increases the duration of thrust (Fatimah *et al.,* 2016).

3. METHODS

3.1. Research Design

Data retrieval using a questionnaire via Google form. The research method applied in this research is a field experiment. This method is a research study in real situations by manipulating one or more independent variables in the one group Pre-test post-test design as many as 10 questions with multiple choice, namely experiments carried out in only one group without a comparison group.

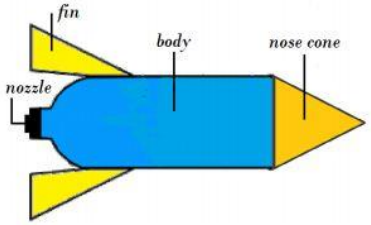

Figure 1. General design of the water rocket.

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The Equation [1] to calculate the score is:

$$\frac{N}{n} X\ 100\ \% \quad (1)$$

The letter N in the equation is the number of students who answered correctly and the letter n is the total number of students.

The first thing we did was to determine the field conditions and the state of the subject, after that we made concepts and learning models as well as the right tools to be applied to students, when we got the right ones, we immediately gave 10 pre-test questions to 24 After obtaining the results, we applied the concept to students and provided the methods that had been prepared, then we gave a final test or post-test so that the impact of the method that had been given could be seen.

This model uses an initial test (Pre-test) so that the magnitude of the effect of the experiment can be known with certainty under carefully controlled conditions. Paired sample test or one group pre-test post-test design is a different test of two paired samples. Paired samples are the same subject and same test (Post-test). The structured concept can be seen in **Figure 2**.

4. RESULTS AND DISCUSSION

4.1. Demographic Characteristics of the Participants

From the data obtained from the teacher concerned, students' understanding related to physics and mathematics subjects decreased, as seen from the students' scores obtained. Project-based learning which was applied to 24 students of class viii of junior high school 4 Pangalengan, Indonesia with a gender ratio of 14 students and 10 students turned out to be very influential on students' understanding of basic concepts of science.

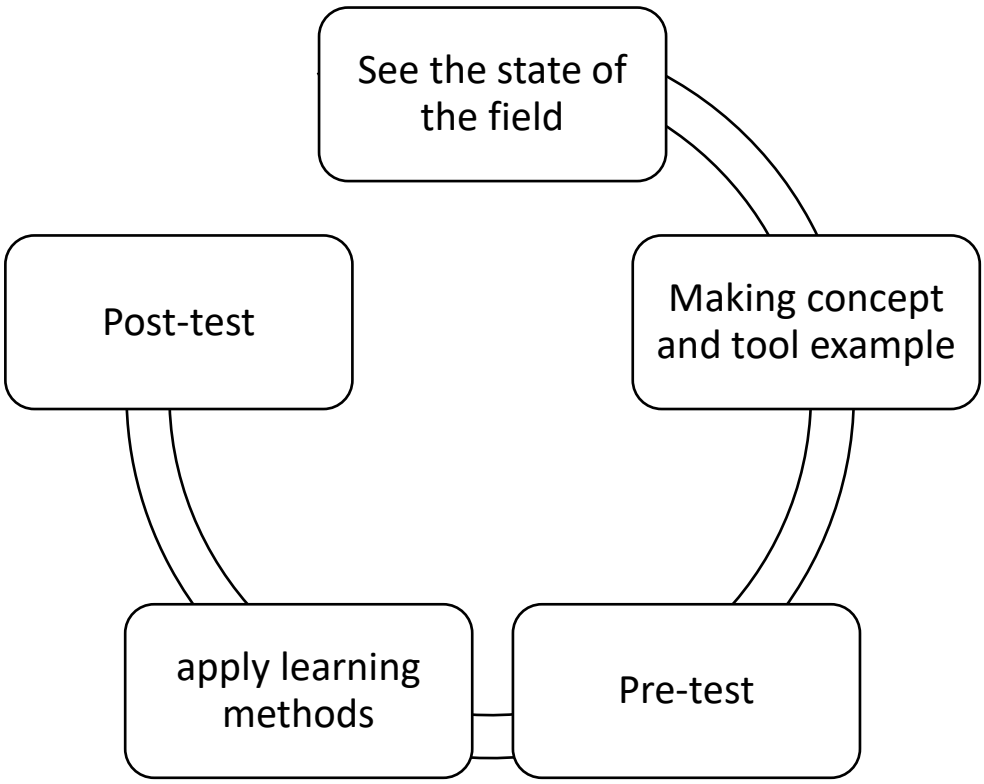

Figure 2. Research concept.

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4.2. Phenomena in the learning process

From the demographic data, it appears that there are quite serious problems in students' understanding, we get information that students find it difficult to study online, there are also other problems with these students, namely the problem of communicating, in this case students are very difficult to be invited to communicate directly, it can be seen from the discussions given, these students do not want to answer when given direct questions, as well as when students The student is given the opportunity to ask questions. There is also confusion from the teacher concerned to determine the right learning method, and in this study the teacher acts as an observer, and parents as student partners. and therefore we try to apply the method that has been described with the following steps:

(i) In the first stage, we introduced ourselves and gave Pre-test questions to be filled in by the 24 students.
(ii) Next, we provide understanding materials related to water rockets using video media that are shared directly online and also given via Whatsapp groups.
(iii) After that, we gave assignments to students to make their own water rocket designs, in collaboration with their parents.
(iv) The next step is that students are asked to present the designs they have made.
(v) And finally, we gave a final test or post-test to see the impact of the learning method given to students.

4.3. Pre-test and Post-test Result

After the learning method and pre-test post-test were applied, data were obtained as can be seen in **Table 1**, in that table there were 10 pre-test and 10 post-test questions that had been given to students. In the table, percentage figures are used as an illustration of the data obtained:

Table 1. Pre-test and post-test result.

No	Question	Pre-test	Post-test	Gain
1	Do you know Water Rocket?	33.3%	83.3%	50.0%
2	Do you know the parts of a Water Rocket?	12.5%	75.0%	62.5%
3	Do you know how to make a Water Rocket?	16.6%	62.5%	45.9%
4	Do you know how to launch a Water Rocket?	41.6%	70.8%	29.2%
5	Do you know the shapes of the Water Rocket wings?	45.8%	95.8%	50.0%
6	Do you know the theories applied to Water Rockets?	4.1%	58.3%	54.1%
7	Do you know the factors that affect the launch speed of a Water Rocket?	8.3%	58.3%	50.0%
8	Have you ever built and launched a Water Rocket?	20.8%	20.8%	0.0%
9	Do you know the parts of the Water Rocket launcher?	12.0%	66.6%	54.1%
10	Do you know how to make a Water Rocket Launcher?	4.1%	58.3%	54.1%

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4.3. Discussion

The results of the data show:

(i) For question number 1, there was an increase of 50.0% after the introduction of the Water Rocket material was given.
(ii) There was a significant increase of 62.5% after the material for the rocket parts was given.
(iii) There is an increase of 45.9% after watching the practice of making water rockets.
(iv) There was an increase of 29.2% after students watched the practice of launching a Water Rocket.
(v) Students' understanding of the parts of the Water Rocket increased by 50% after the material was given.
(vi) There was an increase of 50.0% in question number 6 after being given an understanding of the theories on the Water Rocket.
(vii) There is an increase of 50.0% after the material factors affecting the speed of the rocket are given.
(viii) There is no improvement in question number 8 because students do not make and launch water rockets.
(ix) There was an increase of 54.1% after the material about the rocket launcher was given.
(x) There was an increase of 54.1% after students watched how to make a Rocket launcher.

From the results of these data, the method provided can be said to be effective because there is a significant increase in students' understanding and learning motivation after the learning method is applied, according to research conducted by (Astuti, 2016; Arifin & Sunarti, 2017).

5. CONCLUSION

From the research, the project-based learning model is quite influential to improve students' understanding and literacy. It can be seen from the average Pre-test and post-test scores that there was a significant increase from 19.9 to 45.0%.

The analysis shows that before the implementation of project based learning, the average test scores of students increased quite drastically. This shows that the given method is effective to provide the given understanding.

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