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STUDENTS' CONCEPT MASTERY WITH THE WEB INQUIRY ENVIRONMENT

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ABSTRACT

Technology has a vital role in the field of education. After the COVID-19 pandemic, the learning system has become more flexible. To keep making arrangements according to the development of the situation in the classroom and to avoid student passivity, an online platform is needed that involves students in conducting investigations. The study aimed to determine the student's ability to understand the concepts in the discussion of Archimedes' Law. The participants involved consisted of 53 grade 7 junior high school students. The method used was descriptive quantitative to investigate students' inquiry abilities and determine their understanding of concepts. The research on concept mastery shows a significant difference in using web inquiry environment after the treatment. Therefore, the web inquiry environment is essential to improve students' concept mastery. Implementing the web inquiry environment is recommended to consider topics with experiments to ensure that all inquiry processes can be carried out efficiently.

PENGUASAAN KONSEP SISWA DENGAN IMPLEMENTASI *WEB INQUIRY ENVIRONMENT*

Kata Kunci:

Penguasaan konsep
Kemampuan inkuiri
Web inquiry environment

ABSTRAK

Keberadaan teknologi memiliki peran penting dalam bidang pendidikan. Setelah pandemi COVID-19, sistem pembelajaran menjadi lebih fleksibel. Untuk membuat pengaturan sesuai dengan perkembangan situasi di kelas dan menghindari kepasifan siswa, diperlukan *platform online* yang melibatkan siswa melakukan penyelidikan. Tujuan dari penelitian untuk mengetahui kemampuan inkuiri siswa dalam memahami Hukum Archimedes. Partisipan yang terlibat terdiri dari 53 siswa kelas 7 SMP. Metode yang digunakan adalah deskriptif kuantitatif untuk mengetahui kemampuan inkuiri siswa dan mengetahui pemahaman konsep siswa. Hasil penelitian menunjukkan perbedaan penguasaan konsep yang signifikan dalam penggunaan *web inquiry environment* setelah perlakuan. Oleh karena itu, *web inquiry environment* sangat penting untuk meningkatkan penguasaan konsep siswa. Penerapan *web inquiry environment* disarankan untuk mempertimbangkan topik yang memiliki eksperimen, hal ini untuk memastikan semua proses *inquiry* dapat dilakukan dengan mudah.

1. INTRODUCTION

The involvement of technology plays a vital role in academic life, especially in the field of science. Technology's critical role is to develop character, improve quality of life, and sharpen people's knowledge. Therefore, students and teachers must be familiar with technology to help support their learning [1]. Technology integration in education increases student interest and innovates teacher-learning practices. The concept of science education, described theoretically, turns out that appropriate learning media is needed to help clarify abstract concepts so students can easily understand them. Technology and science collaboration can support students to learn independently because it makes human work more accessible and saves time more efficiently [2].

After the pandemic caused by the coronavirus, the use of technology demands a more significant role in the learning process. This is because it minimizes direct student interaction activities by staying connected using an online system. Teachers must determine the right strategy to regulate their learning patterns to create a bad interaction effect and low learning investment [3]. Therefore, the strategies that need to be used during online learning by involving students during learning activities make students the dominant subject, allowing students to gain more profound learning abilities and improve the quality of learning [4]. Meanwhile, the weakness of online learning makes most students passive and relies on the teacher, and passive students only see the teacher's explanation. This situation occurs because the interaction between teachers and students is limited by screen devices [5].

The purpose of the science education system is to increase student's ability to obtain information without relying more on input from teachers [6]. To facilitate activities by involving students, an inquiry-based learning method is used. Inquiry-based learning is student-oriented, where the teacher only guides them and collaborates actively to obtain information that supports their investigative activities. The inquiry turned out to be beneficial for students to create a more memorable learning environment [7]. Inquiry learning provides opportunities and encouragement to work systematically through collecting facts and factual evidence, as scientists do [8]. Therefore, inquiry-based learning was chosen as the approach and method, emphasizing student activities during the learning process to collect information directly with direction from the teacher. Mastery of scientific inquiry skills and content knowledge is stressed as a bridge to achieving the practice of the science learning process [9]. Scientific inquiry skills are essential skills for understanding the nature of science through a hands-on approach and techniques for solving problems and assisting students in acquiring 21st-century abilities [10]. Scientific inquiry skills are crucial for understanding the nature of science through a hands-on approach and a technique for solving the problem and assisting students in acquiring 21st-century abilities [11]. However, in one study, many students still did not have good scientific inquiry skills to support mastery of substantive concepts, even in the first grade of high school [12].

Strategies to achieve goals when students can understand a concept from the material taught. It indicates that the learning process is successful if differences exist before and after students learn the problem topic [13]. The capacity of teachers and students to master a concept is significant because the concept acts as the foundation for many mental activities, including the development of principles and generalizations [14]. Mastery of student concepts refers to the ability to identify and apply the benefits of learning in everyday life. Ibrohim stated that students' mastery of concepts showed low scores because they experienced difficulties during the learning process [15]. Mastery of concepts in the form of cognitive performance is one of the most important ways to

assess science learning performance. The science concept learning method will be effective if students can simplify abstract material and make it easier to understand, perceive, and apply in everyday life [16].

Online learning media is one solution to overcome these problems. Learning Management systems such as Google Classroom and Moodle are also used in several schools. Still, these platforms have not been able to integrate an inquiry-based system because it does not contain steps appropriate to the actions of investigation activities [17], [18]. So the media is still lacking in involving students' thinking processes. A solution to this problem is implementing a web-based inquiry that helps to learn activities involving student activities through the website. Web Inquiry Environment provides opportunities for students to investigate science learning scientifically. Investigations can be carried out through the website. The web inquiry environment offers a framework for students to collaborate on inquiry-based science projects using evidence and resources from online sources. The web-based guided inquiry has proven to be a useful intermediary medium because the content is successfully applied, easy, and liked by students [19]**.** Web-based collaborative concept mapping can effectively support group interaction in a web-based learning environment [20]. So it is expected that students' knowledge integration will increase significantly after implementing web-based inquiry [21].

In contrast to the research that has been done, this research provides inquiry learning that is developed according to the sequence of inquiry activities. Even though there are many interactive learning applications, such as zoom or google meet, these applications have not been able to package actual inquiry learning. This is a novelty in this research because it presents web-based science learning media, which is packaged visually and makes it easy for students to take part in inquiry classes anywhere. Understanding that is packaged virtually focuses on students' scientific inquiry skills in conducting scientific investigations, such as mastering the concept of Archimedes' Law for this research. Therefore, this research can be a reference for online learning, especially in the field of science subjects.

2. METHOD

The purpose of this study was to determine students' scientific inquiry skills and students conceptual mastery of the impact of web-based inquiry. This study used descriptive and experimental methods with a pre-experimental design. In this study, data collection, compilation, analysis, and interpretation were carried out on the application of inhibiting variables or predicting research results. This descriptive study is used to determine the profile of science inquiry skills carried out by students (Figure 1). At the same time, the purpose of the pre-experimental method is to determine the possible causes and effects of the independent and dependent variables. To explain the research chronology, the research program's description must be supported by references so that the explanation can be accepted scientifically.

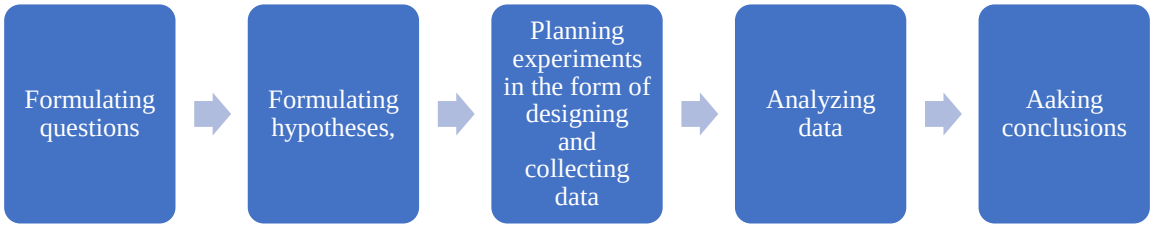

Figure 1. Research steps

This study aimed to determine students' scientific inquiry skills and mastery of Archimedes' law concepts on the impact of the web inquiry environment. This study used descriptive and experimental methods with a pre-experimental design. The design of this research is shown in Table 1

Table 1. Pre-Experimental Pretest-Posttest Design

O_1	X	O_2
Pre-test	Treatment	Post-test

In this study, data interpretation was carried out on the application of inhibiting variables or predictions of research results [22]. The pre-experimental method aims to determine the possible causes and effects of the independent and dependent variables [23]. To explain the research chronology, the research program's description must be supported by references so that the explanation can be accepted scientifically.

3. RESULTS AND DISCUSSION

In science learning, the main thing is student involvement in investigation activities and following procedures to find a concept. Students actively build their knowledge through inquiry activities and participate directly in real-life challenges in inquiry learning activities. The primary goal of science education is to encourage students to think scientifically. Teachers are urged to engage students in inquiry-based activities and process their cognition like scientists when conducting research.

In an inquiry-based learning environment, students observe the natural world, ask questions about their observations, and search for evidence to answer these questions. This process is an educational approach in which inquiry is treated as a primary tool for education and learning. Within this process, students are expected to use and develop their inquiry skills, such as making observations, asking questions, hypothesizing, designing research, developing results based on evidence, and establishing communications. Inquiry-based learning is a significant approach to the enhancement of inquiry skills. This approach involves important tasks such as researching, solving problems, and developing a project. The students cooperate to acquire inquiry skills, solve a problem, and enhance their learning capacities.

Scientific inquiry is a set of technical procedures. Inquiry learning refers to engaging students with scientific processes like orientation, developing a hypothesis, designing and implementing experiments to test the hypothesis, gathering and analyzing data, and reaching conclusions to help them build their knowledge and to use it to predict and explain the events in the natural world. Scientific inquiry skills, also known as science process skills, are a collection of abilities that apply to various science fields and represent scientists' behavior. Science inquiry skills are categorized into basic and integrated science inquiry skills. In science teaching and learning, learners acquire science inquiry skills through participation in practical investigations, which allow them to carry out activities that test hypotheses for observed phenomena.

The involvement of students in science learning is the main thing to build knowledge in inquiry activities. In addition, the role of the teacher contributes to the process of student cognition so that their investigation activities are by the procedure [24]. Based on the implementation using a web inquiry environment, students develop their inquiry skills, such as making observations, asking questions, making hypotheses, designing research, developing evidence-based results, and building communication. Students perform cooperative teamwork to acquire inquiry skills, solve problems, and

increase their learning capacity [25]. It builds their knowledge and uses it to predict and explain natural events [26].

Learning strategies affect the idea of mastery of concepts. The right strategy can help students hold on to concepts for long-term memory [27]. Therefore, further research by applying the Web Inquiry Environment to students' conceptual mastery is analyzed to find out the differences before and after treatment using Web Inquiry Learning. An objective test was used with 26 multiple-choice questions to analyze the data. There are 53 samples of 7th-grade students: 33 females and 20 males. The data collected from the objective tests were statistically analyzed using the IBM SPSS Ver.25 to investigate the significant difference between the pre-test and post-test scores. The difference in the value of the pre-test and post-test data is shown in Figure 2.

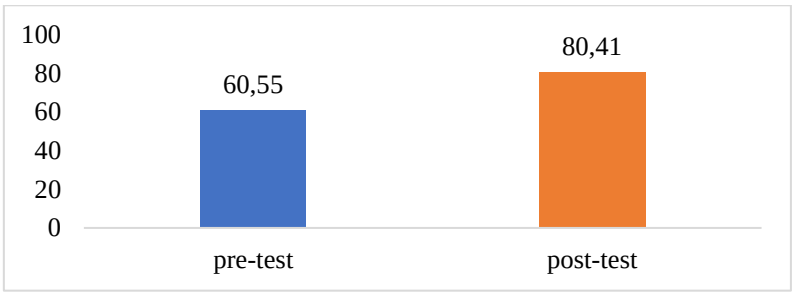

Figure 2. The Average Score for Pre-Test and Post-Test of Students' Concept Mastery

As presented in the figure, there is a significant difference in scores in the pre-test and post-test. For the pre-test score, the average gained by the students is 60.55, and the average score for the post-test is 80.41. The difference points between the pre-test and post-test are 19.86. To analyze the data more deeply, the data was tested using SPSS, and the analysis data consisted of descriptive statistical analysis, normality test, paired sample t-test, and homogeneity. The recapitulation of the objective test in conceptual mastery is shown in Table 2.

Table 2. The Summary of the Concept Mastery Objective Test

Component	Pre-test	Post-test
Participant	53	53
Average Score	60.55	80.41
Standard deviation	19.94	16.58
Maximum Score	24	36
Minimum Score	82	100
Normality Test	0,20	0,08
Homogeneity Test	0,16	
Paired Sample T-Test	Sig. *(2-tailed)* = 0,00 There is a significant Difference H_o is rejected, and H_1 accepted	

The sample for the pre-test and post-test was the same individual, consisting of 29 students. As presented in the table above, the students' concept mastery from the objective test was normally distributed. The score of normality data for the pre-test is 0.20, and the post-test is 0.08. The data is normally distributed because of the sig. value is higher than 0,05.

Further analysis used in this research is the homogeneity test. As shown in the table, the data were homogenous if the sig value is higher than 0.05. The normal data analysis and homogenous are used as a prerequisite for paired sample t-test. From the

analysis, the prerequisite for paired sample t-test was fulfilled. Therefore, paired sample t-test was used to determine the significant difference. The score gained for paired sample t-test is 0.00. Therefore, H_0 was rejected, and H_1 was proven accepted, which means there is a significant difference in students' concept mastery using web-based inquiry on the topic of coordination and response after being given treatment.

The three principles of Archimedes' Law, learning buoyancy requires students to have accurate concepts about mass, volume, and density to fully develop and calculate formula values. These terms are interrelated and dependent on each other [28]. Buoyancy is the upward force acting on an object in a fluid and determines whether the object will rise, sink or remain static [29]. Buoyancy is defined as a dimension to understanding why objects float and sink. Part of the principle of Archimedes' law, this virtual-based investigation is analogous to placing a weight into a boat and seeing how deep the boat sinks into a tank of liquid. The boat's depth and the amount of fluid displaced can be measured. The boat's dimensions and the liquid's density can be adjusted. Next, students see how much weight the boat can hold before sinking deeper. The research activities shown are shown in Figure 2 that students must follow the teacher's direction to set the Width (Width), Length (length) to 5.0 cm, and Height (height) to 10.0 cm, then change the Liquid density sequentially to 0, 5 g/mL, 1.0 g/mL, 2.0 g/mL. Based on the results of the investigation skills carried out by the experimental student examples, they were able to collect and interpret data appropriately to avoid errors due to their low ability in data analysis [30].

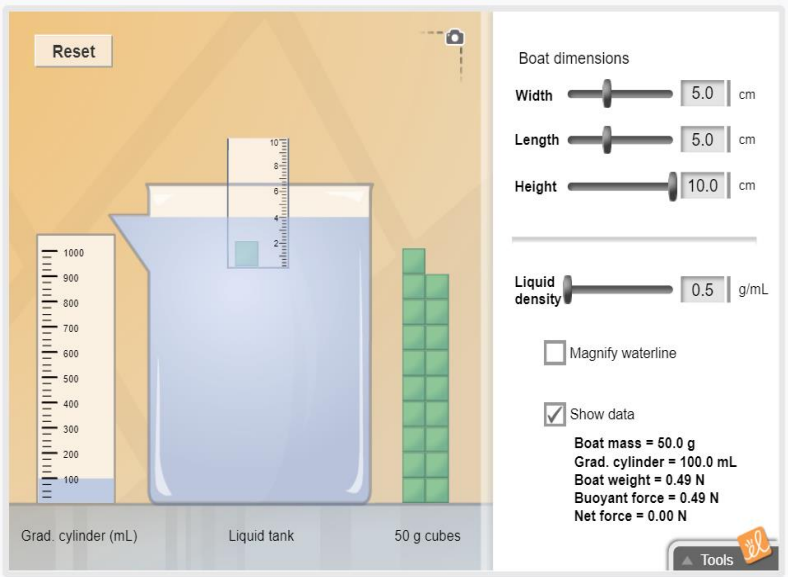

Figure 3. Virtual Lab Theme of Archimedes' Law

Students can find a virtual lab-based investigation for the theme of Archimedes' legal principles to explore conducting investigations on the link https://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=603. The two measurable variables can be observed in the virtual lab visualization if given a mass of 5.0 g; for that, students must understand the provisions of the investigation so that the ability to analyze the theme of Archimedes' Law principles can be successful. Examples of data and scientific evidence that students have successfully collected through Table 3.

Table 3. Obtained Results of Student Investigations

Boat Mass	Liquid Density	Depth (cm)	The Volume of Fluid Displaced (mL)
50 g	0.5 g/mL	4 cm	100 mL
50 g	1.0 g/mL	2 cm	50 mL
50 g	2.0 g/mL	1 cm	25 mL

Table 3 identifies if the density of the liquid is small, the depth and volume of the fluid displaced are greater, and if the density of the liquid is large, the fluid displaced will be smaller. The density of a substance is affected by the pressure experienced by the substance. In line with these results, that web-based science learning provides students with the ease of learning and expands student activity space to enrich their learning experience. In practice, the teacher's direction to explain is the key to students' success in understanding the learning material. Teacher approaches directly impact students' knowledge integration gains, particularly when implementing web-based inquiry teaching strategies. The capacity of teachers to empower scientific thinking skills is an advantage of guided inquiry. The teacher provides direction, instruction, and planning during implementation. So that students are better able to develop a thorough understanding [31]. Using strategies that emphasize investigative activities to find answers to the questions posed by experiments to prove answers and conclude experimental results makes students more exploratory [25].

4. CONCLUSION

The research results on students' science inquiry skills by implementing a Web Inquiry Environment show a high interpretation on average. This study shows that the use of technology for inquiring supports students in acquiring science inquiry skills. The research on concept mastery shows a significant difference in using Web Inquiry Environment after the treatment. Therefore, the Web Inquiry Environment is essential to improve students' concept mastery. Further research to develop this Web Inquiry Environment can consider adding some features, such as slots for uploading the worksheet and column chat. This is used to simplify the instruction, so the students and the teacher can only focus on the Web Inquiry Environment for doing the whole activity without using any other platform such as google classroom.

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