

# Implementing Case-Method in Maritime-Related Learning: A Qualitative Descriptive Study in Physics Learning on The Topic of Hydrostatics Pressure

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**Abstract.** The need to develop 21st-century skills requires lecturers to apply appropriate learning to develop skills. This study aims to describe how the implementation of case-method learning for physics lectures on the topic of hydrostatic pressure by integrating the maritime context. This research is a descriptive study. The approach used in this study is a qualitative approach. Data collection was carried out through observation and documentation. Data were analyzed descriptively and presented based on the stages of case-method learning. The implementation of the case method in physics learning on the topic of hydrostatic pressure by linking the maritime context can be done by providing problems that are in accordance with the conditions or events that students often encounter. For instance, we present a problem related to the sinking of the KRI Nanggala 402 ship, a real-life maritime incident involving a steel ship that split into 3 parts. Students discuss in groups to find solutions to problems using appropriate physics concepts and strategies. After going through a series of problem-solving processes, students can understand the essence of the concept of hydrostatic pressure, what events are related to this concept, and how to apply it in solving problems.

## 1 Introduction

Currently, the implementation of learning is focused on developing 21st-century skills. 21st-century skills are essential skills needed in the world of work, where graduates are expected to be able to compete and face challenges in the world of work [1–3]. These skills are important to develop because they are related to students' cognitive competencies as well as interpersonal and intrapersonal competencies [4]. Through the development of 21st-century skills, students are also expected to be able to overcome and find solutions to various problems faced, especially in the world of work. [5]. 21st-century skills that need to be

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developed through learning are critical thinking and problem-solving, communication, creativity, and collaboration [6–8].

As explained, preparing graduates who are able to face various challenges in the world of work and solve problems faced in the world of work is one of the goals of developing 21st-century skills. This shows that critical thinking and problem-solving are skills that must be improved in learning [7,9]. Improving these skills can be done through the application of various learning models [7,10,11]. Among those that can be applied to learning at university is case-method learning [12,13]. Through case method learning, students are able to solve problems better [13]. In addition, the implementation of case-method learning is also one of the main performance indicators of universities in Indonesia [14]. This shows that case-method learning is also a recommended learning implementation in learning at the university level.

In addition to the emphasis on improving 21st-century skills, the implementation of learning also emphasises contextualization. Contextual learning emphasizes learning that links learning materials with things that students encounter in everyday life [15,16]. Several research results also show that the implementation of contextual learning can improve 21st-century skills, including critical thinking and problem-solving skills [5,10,17–19].

Indonesia is one of the largest maritime countries in the world [20,21]. This is because Indonesia's ocean area is much wider than its land area [22–24]. With these conditions, of course, learning will be more meaningful if it is carried out contextually by linking learning with maritime aspects [25]. This can be done by identifying the relationship between learning topics and things related to maritime aspects that students encounter in everyday life [26,27]. This, apart from having a positive impact on improving students' skills in solving various problems related to maritime affairs, can also increase students' concern for marine waste, which is a problem in the archipelago [28] and also in order to increase the attitude of caring for the marine environment among students [29–31].

Among the courses whose topics are closely related to everyday life is physics. Physics is closely related to events and phenomena that occur in everyday life [25,32–35]. For the maritime region itself, physics should be taught by linking learning topics to various real events that occur in everyday life. One topic that is closely related to the maritime context is static fluid material because fluids are related to substances that can flow, one of which is water [36,37]. In order to improve students' 21st-century skills in critical thinking and problem-solving aspects and the existence of policies that direct the implementation of learning in universities to be applied using case method learning, for this reason, research was conducted to find the answer to how to apply case method learning for physics lectures on the topic of hydrostatic pressure by integrating it with the maritime context?

## **2 Methods**

This study aims to describe how the implementation of case-method learning for physics lectures on the topic of hydrostatic pressure by integrating the maritime context. This research is a descriptive study. The approach used in this study is qualitative. Data collection was carried out by observing the implementation of physics learning by applying the case method to the topic of hydrostatic pressure in Biology Education Students at Raja Ali Haji Maritime University and documentation by analyzing videos of the implementation of learning that had been carried out to obtain more in-depth information that might have been missed during observation during the observation of the implementation of learning. Data were analyzed qualitatively by describing information at each stage of the implementation of physics learning on the topic of hydrostatic pressure by applying case-method learning with an outline of learning syntax such as problem-based learning including orientation to problems,

student organizations, guiding individual/group investigations, developing and presenting work, and analyzing and evaluating the problem-solving process [18,38,39].

### 3 Results and Discussions

The results of this study will be described at each stage according to the learning syntax.

#### 3.1 Student Orientation Towards Problems

At this stage, students are given problems related to the topic of hydrostatic pressure to be discussed in groups. There are many ways to orient students to problems, one of which is through learning videos by presenting problems related to lecture topics. In the observed learning, the problem presented was the sinking of the KRI Nanggala Ship, which sank in Bali Waters in April 2021. Where the ship was found at a depth of about 838 m, with the condition of the ship split into 3 parts when it was found [40]. From this problem, 2 main questions can be raised, which will be the subject of discussion solved by students in groups. The questions are:

1. Although the KRI Nanggala 402 Ship was made of steel, why did the submarine break into 3 when it sank at a depth of 839 m?
2. The submarine crew is a crew that is equipped with swimming and diving skills. In the case of the KRI Nanggala 402 Ship, which was damaged at a depth of 839 m, why didn't the crew choose to open the ship's door, then get out and try to swim to the surface using scuba or breathing apparatus for divers?

Through these questions, students will be stimulated to think about solutions to the questions given and how the topic of the lecture relates to the problems presented. This stage is a key stage in the problem-solving process [41]. Because at this stage, it is not just a matter of orienting the problem, but it is hoped that students also understand what is given [10,39,42]. If students can understand the problem well, they can determine problem-solving strategies well, too [43–45].

#### 3.2 Student Organization

Just like in student organizations in general, student grouping is done by paying attention to diversity, such as diversity of cognitive abilities, diversity of students' learning speed levels, and other things [46,47].

#### 3.3 Guiding Individual and Group Investigations

At this stage, students are guided in groups to solve problems by linking the problems to the lecture topics. At the beginning of learning, students have been shown the learning objectives to be achieved. So, of course, the problems given at the beginning of learning have solutions related to the lecture topics.

At this stage, of course, students are required first to understand hydrostatic pressure, where hydrostatic pressure ( $p$ ) is the pressure of a liquid at a certain depth whose magnitude depends on the density of the liquid ( $\rho$ ), the position of the depth ( $h$ ), and the acceleration of gravity ( $g$ ) or which is usually written as  $p = \rho gh$ . By using information from the density of seawater, the depth where the ship was found (838 m), and the magnitude of the acceleration of gravity ( $9,8 \text{ m/s}^2$  or  $10 \text{ m/s}^2$ ). By using the hydrostatic pressure equation, students can find the magnitude of the hydrostatic pressure at that depth ( $p = \rho gh$ ). Then to find the

reason why the submarine made of steel broke into 3, students in groups must trace data on the maximum pressure that the steel-plated material can receive. This data is what students in groups compare with the results of the hydrostatic pressure calculations received by the KRI Nanggala 402 Ship at a depth of 838 m.

In line with the process of finding a solution to the first question, the solution to the second question is, of course, not much different. The reason why the soldiers on the KRI Nanggala did not get out of the ship and swim to the surface is also related to the amount of hydrostatic pressure received at that depth. As comparative data, students in groups trace data on the threshold depth or the maximum depth that can be dived by humans who are diving. In other words, students in groups are asked to find data on the maximum pressure that the human body can receive. This data is also used as a comparison to find the reason why the soldiers on the ship did not dive and swim out of the ship. The steel structure and the human body can also be used as a comparison to answer both problem questions because, as is known, the steel structure is much stronger than the human body structure.

After students are able to understand the problem well, this stage is also important in the process of finding a solution to the problem. At this stage, students hone their critical thinking skills to determine the right strategy to solve the problem [48–50]. In determining the appropriate strategy to solve a problem, students must also understand the physics concepts that underlie the problem [43,44,51,52]. Not only understanding physical concepts, students must also be supported by good mathematical skills to be able to find solutions to problems [53–56]. In this case, students must be able to do the calculations correctly in determining the hydrostatic pressure experienced by the KRI Nanggala 402 Ship at a depth of 838 m. The results of this calculation will be compared with data on the maximum pressure that can be received by steel and the human body.

### **3.4 Developing and Presenting Work**

At this stage. Students in groups are asked to make a short report of the results of the discussion containing the problems solved and the solutions to the problems associated with the appropriate physics concepts. The results of the discussion of solving this problem are also conveyed through a discussion forum until a question and answer space is opened between students because the problems presented are related to the maritime context, so in some answers, students include aspects of their experiences because the majority of students live in island areas that are familiar with the sea. Among the experiences included in expressing answers is the activity of diving in the sea, where students also experience discomfort in their bodies, especially in their ears, when diving deeper into the sea. The experiences conveyed by students can be explained well through the concept of hydrostatic pressure. This experience is also related to the reason for the discovery of the KRI Nanggala 402 Ship condition being split into 3 parts at a depth of 838 m. Through presentations, questions and answers, and the process of exchanging ideas, students increasingly understand the essence of the concept of hydrostatic pressure and how close the concept is to events that occur in everyday life because students who are dominated by island communities often do activities at sea.

### **3.5 Analyzing and Evaluating the Problem-Solving Process**

This stage is carried out in order to evaluate the problem-solving process carried out by students in groups. The evaluation carried out includes an evaluation of the understanding of the concept of hydrostatic pressure expressed. In addition, an evaluation is also carried out on the application of the hydrostatic pressure equation to determine the amount of hydrostatic pressure received by the submarine. In addition, data and information regarding the

maximum pressure that can be received by steel and the human body and how it compares to the hydrostatic pressure received by the KRI Nanggala 402 Ship are also evaluated. This is done to provide a deep understanding of the students' heads regarding the concept of hydrostatic pressure, examples of events related to hydrostatic pressure and how to solve problems related to hydrostatic pressure. At the end of this session, students are given the task of seeing how physics and biology are related. Students are asked to analyze and identify the cell structure and body structure of marine biota that live in the deep sea and marine biota that live in shallow seas. This is, of course, different because the hydrostatic pressure received by biota in the deep sea is greater than that of biota in shallow seas. The difference in hydrostatic pressure experienced by marine biota at different sea depths, of course, causes differences in the body structure of the biota due to the body's adaptation process to the hydrostatic pressure received by marine biota at these depths.

The problem-solving evaluation process is one of the stages that must be carried out every time a problem is solved. A good problem solver will evaluate the problem-solving process that is carried out [33,45,57,58]. This is done to maintain the accuracy and precision of the solutions provided, which are produced through a problem-solving process based on appropriate physics concepts and strategies [5]. In addition, providing enrichment related to the topics studied after the problem-solving process can also provide students with a deeper understanding [59,60].

## 4 Conclusions

The implementation of the case method in physics learning on the topic of hydrostatic pressure by linking it to the maritime context can be done by providing problems that are in accordance with the conditions or events that students often encounter in everyday life so that students can feel the meaning of the learning that is carried out. For the topic of hydrostatic pressure, the problems given include the sinking of a submarine made of steel that was found in a broken condition at a certain depth in the sea. Through this problem, students discuss finding the answer or cause of the submarine breaking into 3 parts even though it is made of steel and why the humans inside did not choose to save themselves by swimming using diving equipment when the submarine sank. Through this problem-solving process, students are guided to apply the concept of hydrostatic pressure to find answers and trace data on the maximum pressure that can be received by steel and the human body. By comparing the data obtained and the results of the calculation of the hydrostatic pressure received by the ship at the depth of its submerged position, students will be able to draw conclusions about the cause of the ship breaking into 3 parts and the humans inside it are better off waiting for help in the head than getting out of the ship and swimming towards the surface even though there are swimming aids.

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