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AN OVERVIEW OF ONTOLOGICAL, EPISTEMOLOGICAL, AND AXIOLOGICAL ASPECTS OF THE JUNIOR HIGH SCHOOL CONCEPT OF PRESSURE

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Abstract

Philosophy will be closely associated with the nature, principles, and laws governing all existing reality. This study examines the ontology, epistemology, and axiology aspects of the junior high school concept of pressure. The method used in this study is conducting studies from various books, journals, articles, magazines, and other scientific references related to the research topic. The data collection process in this study was divided into three stages: (1) editing, (2) organizing, and (3) finding. According to the findings of various studies, the ontological aspect of pressure explains what exactly pressure is. What does it accomplish? What kind? While the epistemological aspect of the concept of pressure is related to an explanation of the discussion related to the epistemological aspect of the idea of pressure will be studied regarding (1) the discovery of the idea of pressure, (2) the idea of pressure; (3) the laws that apply to the matter of stress. Meanwhile, the axiological aspect explains how pressure is useful and the laws that govern it in various aspects of human life. Thus, teachers should pay attention to the ontology, epistemology, and axiology aspects of the concept of pressure when teaching it in junior high school.

INTRODUCTION

Philosophy has a lot to do with science. Philosophy is an infinite science because it investigates a specific field of science that is also based on a particular reality. In Indonesian, philosophy is equivalent to the words philosophy (Arabic), philosophy (English), philosophy (Latin), and philosophie (French) (German, Dutch, French). All of these terms derive from the Greek term Philosophia. Philein means "to love" in Greek, while philos means "friend" in Greek.

Furthermore, Sophos means wise, whereas Sophia means wisdom. There are two slightly different etymological meanings of philosophy. To begin, if philosophy refers to the Greek words philein and Sophos, it means "love of the wise" (wise is intended as an adjective). Second, if philosophy is defined by the words philos and Sophia, the meaning is "friend of wisdom" (wisdom as a noun) [1]. Philosophy is known as wisdom because the primary method of studying philosophy is asking questions.

The essence, principles, and laws governing the existing reality will be central to the philosophy concept. One branch of philosophy that addresses the nature of science is the philosophy of science. The philosophy of science includes branches of philosophy concerned with the foundations, methods, assumptions, and scientific implications of the sciences, including natural and social sciences. The study's central question is frequently what constitutes science, the reliability of

scientific theories, and science's ultimate goal. The philosophy of science is closely related to metaphysics, ontology, and epistemology. The philosophy of science seeks to explain problems such as what and how a concept and statement can be called scientific, how the idea was born, how science can explain, estimate, and utilize nature through technology; how to determine the validity of information; formulation and use of the scientific method; various types of reasoning that can be used to reach conclusions; and the implications of scientific methods and models on society and science itself.

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Physics and philosophy must be studied together. Many physics concepts can be explained philosophically, specifically regarding ontology, epistemology, and axiology. One of the concepts covered in junior high school physics is pressure matter. Learning physics about pressure materials is taught in class VIII of the junior high school curriculum. There are facts, concepts, principles, laws, and theories related to pressure in junior high school learning pressure. When a teacher teaches about pressure, students must understand these aspects. The study of philosophy about aspects of ontology, epistemology, and axiology is critical. As a result, aspects of ontology, epistemology, and axiology will be studied in this study on the concept of pressure in junior high schools. The goal of this research is to examine aspects of ontology, epistemology, and axiology related to the idea of pressure in junior high schools.

When a teacher teaches about pressure, students must understand these aspects. Studying philosophy about aspects of ontology, epistemology, and axiology is essential. As a result, this study of pressure in junior high schools will investigate these aspects. This study aims to look at the ontology, epistemology, and axiology of the concept of pressure in junior high schools.

METHODS OF RESEARCH

In this form of study, the research method used is qualitative, and the approach used is descriptive, with a literature review type of study conducted from various books and other scientific works related to the topics raised, specifically a review of aspects of ontology and axiology in learning the physics of pressure matter. Literature studies are a technique for gathering data for research from books, journals, articles, magazines, and references to other scientific papers on research topics. Figure 1 depicts this study's three data collection stages [7].

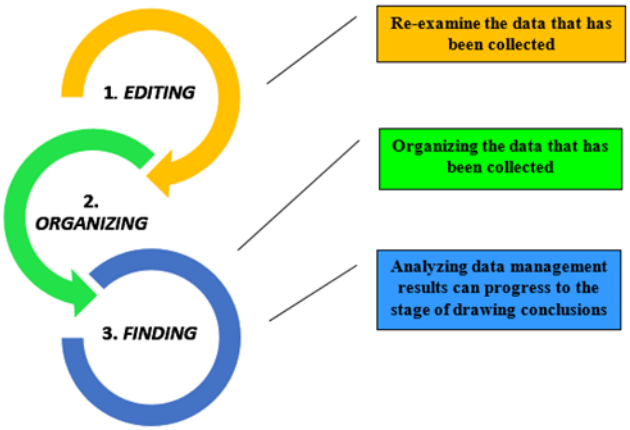

Figure 1. Stages in the Data Collection Process

RESULTS AND DISCUSSION

1. Aspects in Ontology

The Pressure Concept: The first aspect of studying the philosophy of science is the ontological aspect. Ontology is derived from the Greek words Ontos (being) and Logos (logic). So, ontology is the science of existing or the theory of being a being. Ontology is a branch of metaphysics that studies the nature of existence. Ontology investigates as long as something exists. The goal of ontology is to answer the question: within what limits? Ontology is a science that studies what is already there. Ontology is a branch of philosophy that deals with the nature of life and the existence of everything that exists and may exist [8]. The ontological aspect of this section is to determine the concept of pressure. To answer this question, let us define pressure.

Pressure is one of the physical sciences that is frequently studied in school and lectures. Learning about pressure in junior high school is critical because this is the first level at which students learn about physics concepts, including various pressures, pressure functions, pressure calculations, etc. As a result, the question becomes, what exactly is pressure? What exactly does it do? And what are the different kinds? In essence, pressure is a state in which an object is subjected to a force dotted on a specific area. In physics, the magnitude of the force acting on each unit of area is defined as pressure. Pressure can be caused by the force acting on a vertically oriented object. Pressure is related to location, temperature, Volume, and force. The international pressure unit is newtons per square meter (N/m2). Pressure is denoted by the letters P or p in scientific notation.

Furthermore, the Pascal (Pa) unit of pressure is named after the brilliant physicist Blaise Pascal. Pressure can be used to calculate the strength of liquids and gases. Pressure is proportional to Volume and temperature. Pressure magnitude is derived from the principal magnitude, length, and time. Pressure is a vector magnitude that is expressed as a number or value. Pressure can occur in three different types of materials: (1) pressure on solids, (2) pressure on liquids, and (3) pressure on gaseous substances.

One concept in pressure matter is solid pressure. The magnitude of the standard or perpendicular force (F) acting on each unit of surface area (A) is defined as the pressure in solids [9]. From this understanding, it is clear that if a force is applied to an object with a specific surface area, the object is said to be subjected to pressure. With certain limitations, the surface of a solid substance can withstand tangential forces acting on it, implying that it can withstand shear stress. The pressure produced by a liquid is referred to as hydrostatic pressure. The pressure generated by a liquid based on its depth and density is known as hydrostatic pressure. As a result, the magnitude of the pressure value at hydrostatic pressure is strongly influenced by the density of the liquid substance. Gaseous pressure is the third type of pressure. According to the NASA Glenn Research Center, the pressure

of a gaseous substance is the perpendicular force generated by the momentum of a gas molecule when it collides with a plane. Because gas molecules have kinetic energy, they produce pressure.

2. Aspects in Epistemological

The Greek episteme (knowledge) and logos (science) concepts of epistemological pressure, a branch of philosophy, are of paramount importance. It delves into the origin, nature, character, and type of knowledge, making it one of the most frequently debated and discussed topics in Philosophy. For instance, it explores what knowledge is, its definition, its different types, and its relationship to truth and belief [10]. Epistemology, a theory of knowledge, grapples with the nature of science, its assumptions, its fundamentals, and the responsibility for questions about the knowledge that each human being possesses.

Epistemology, as a sub-field of philosophy, is concerned with knowledge, precisely what we know and how we know it [11]. Humans obtain this knowledge through reason and the five senses using various methods such as inductive, deductive, positivist, contemplative, and dialectical methods [12]. The following topics will be studied in discussions about epistemological aspects of the concept of pressure: (a) the discovery of the concept of pressure, (b) the concept of pressure, and (c) laws applicable to pressure matter.

The Development of the Pressure Concept Blaise Pascal was a Christian philosopher and mathematician from France. His contribution to physics explained the concepts of pressure and vacuum. Pascal worked in hydrodynamics and hydrostatics, focusing on hydraulic fluid principles. Hydraulic pressure (using hydraulic pressure to multiply force) and syringes were among his inventions. Figure 2 shows more about Blaise Pascal.

Figure 2. Blaise Pascal

Blaise Pascal was born on June 19, 1623 in Clermont-Ferrand, France, to Étienne Pascal and Antoinette Begon. Blaise Pascal is regarded as a mathematical scientist who made significant contributions to the advancement of various fields. For example, when he was only 20, he discovered a fully functional mechanical calculator for the first time. Blaise Pascal had been afflicted with an unusual disease. Pascal's stomach surged suddenly, and he suffered a severe seizure that caused him to struggle in pain. Pascal died at the age of 39 on August 19, 1662. Pascal's Law, Hydraulic Pumps, Syringes, and Digital Calculators are among his many valuable inventions. Pascal's other titles include Philosopher, Mathematician, Author, and Literati. The ideas of Blaise Pascal's discoveries are widely used in everyday life.

1.1 The Pressure Concept

It is necessary to explain the facts, concepts, principles, laws, and theories to students in junior high school when teaching them about the idea of pressure. Facts about pressure in everyday life, for example, geese can efficiently forage in muddy places, such as rice fields, whereas chickens find it difficult; shoes with a broader footing are less likely to get caught in the mud. Furthermore, pressure-related facts such as when the embers of the burner on the hot air balloon are heated, the hot air balloon can fly, whereas the hot air balloon can fall when the heating of the air in the balloon decreases. Pressure is the magnitude of the force acting on each unit of surface area or compressive plane. Pressure is caused by the compressive force acting on the body per unit surface area

perpendicularly. The amount of pressure exerted by one object on another is proportional to the magnitude of the force or impulse exerted.

Furthermore, the size of the pressure generated on an object is affected by the area of the field of the object being pressed. As a result, if the force applied to an object is more significant, so will the pressure generated. In reverse, the greater an object's surface area, the less pressure it generates. Pressure is defined as the distribution of force across the area of a surface. As a result, as the force exerted on an object (F) increases, so does the pressure generated. In contrast, the greater the surface area of an object, the less pressure it generates. The magnitude of the pressure can be expressed mathematically in the following equation.

$$P = \frac{\vec{F}}{A} \qquad (1)$$

P = Pressure (N/m2 or Pa)
F = Force (Newton)
A = Area of field (m2)

It has been explained that pressure can occur in a variety of substances, namely (1) pressure on solids, (2) pressure on liquids, and (3) pressure on gaseous substances. These three concepts of pressure have benefits in everyday life. Figure 3 describes mind mapping the concept of pressure.

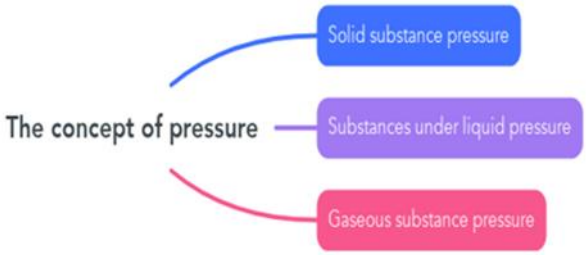

Figure 3. The Concept of Pressure

The following will explain the differences between the three concepts of substance pressure as shown in Table 1 below [9], [13].

Table 1. Differences in the Concepts of Solids, Liquids and Gaseous Substances

No.	Component	Pressure of Solids	Fluid Pressure	Gas Pressure
1.	Understanding	The pressure of a solid is the force acting on a unit area of compression.	Liquid pressure is also known as hydrostatic pressure. Hydrostatic pressure is the pressure generated by a liquid based on its depth and density	The gas pressure is the perpendicular force exerted by the momentum of the gas molecules when they collide with a plane
2.	Principle	If a solid substance is given a force from above it will automatically cause pressure. The larger the area of the pressure field, the smaller the pressure will be	Pressure in liquids is affected by depth. The deeper, the pressure of the liquid will be greater. Hydrostatic pressure has the following properties: a. The deeper the location of a point	➢ Pressure gas is produced because the gas molecules have kinetic energy. ➢ Air pressure in each place will vary depending on the altitude of the place. ➢ Pressure gas is generated because the gas

No.	Component	Pressure of Solids	Fluid Pressure	Gas Pressure
			or object from the surface of the liquid, the greater the pressure. b. Hydrostatic pressure in all directions has the same size. c. Hydrostatic pressure depends on depth, the density of the liquid, and the acceleration due to gravity. d. Hydrostatic pressure does not depend on the shape of the container.	molecules have kinetic energy. The kinetic energy moves the molecule, generates momentum, causing it to crash into the container and bounce off. The greater the kinetic energy of the gas molecules, the greater the pressure generated.
3.	Equality	Mathematically, the equation of pressure on a solid is: $\vec{P} = \frac{\vec{F}}{A}$ Information: $\vec{P}$ = Solids pressure (Pa) $\vec{F}$ = Working force (N) A = Surface area (m^2)	Mathematically, the equation for hydrostatic pressure is: $\overrightarrow{P_h} = \rho . g . h$ Information: $\overrightarrow{P_h}$ = Hydrostatic pressure (Pa) ρ = Mass Type of substance (kg/m^3) g = Acceleration of gravity (m/s^2) h = Altitude (m)	Mathematically, the equation of gas pressure is: $\vec{P}xV = Konstan$ $\overrightarrow{P_1}\, x\, V_1 = \overrightarrow{P_2}\, x\, V_2$ Information: $\overrightarrow{P_1}$ = Gas pressure at state 1 (N/m^2) V_1 = Volume of gas at state 1 (m^3) $\overrightarrow{P_2}$ = Gas pressure at state condition 2 (N/m^2) V_2 = Volume of gas at state 2 (m^3) **Notes:** The unit of pressure for gases is expressed in atmospheres (atm). Generally, 1 atm = 105 Pa or 1 atm = 76 cmHg

1.2 Laws Concerning Anxiety

There are several laws associated with the concept of pressure when discussing it, namely:

1.2.1 Pascal's Principle

Pascal's law states that pressure exerted on a liquid in a closed space will be transmitted with the same magnitude in all directions [9], [14]. Pascal's law is primarily concerned with pressure on liquids. Blaise Pascal (1623-1662), a French scientist and philosopher, was the first to discover Pascal's

law. Pascal's law was found through water experiments in which he discovered that water comes out more quickly and farther through a hole in a container with an open-top surface than a container with a closed-top surface. As a result, Pascal deduced that pressure exerted on a liquid in a closed space is equally transmitted in all directions. Pascal's law is illustrated in Figure 4 below [15].

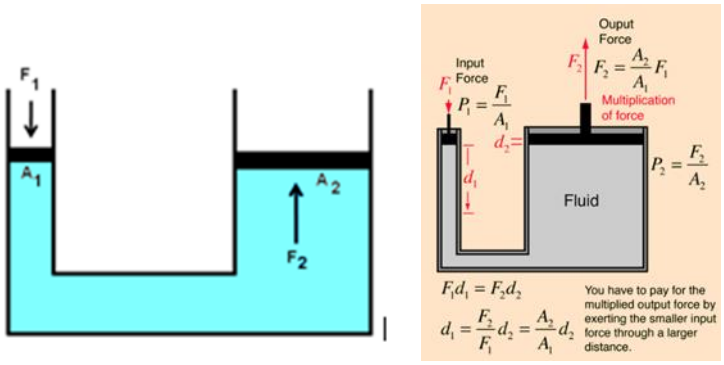

Figure 4. Pascal's Law Concept

According to Figure 4, the pressure on piston 1 is the same as the pressure on piston 2. Pascal's pressure can be expressed mathematically as follows:

$$P_1 = P_2 \qquad (2)$$

$$\frac{\overrightarrow{F_1}}{A_1} = \frac{\overrightarrow{F_2}}{A_2} \qquad (3)$$

Information:
P1 = pressure on piston 1 (N/m2)
P2 = pressure on piston 2 (N/m2)
F1 = force acting on piston 1 (N)
F2 = force acting on piston 2 (N)
A1 = Surface area of plane 1 (m2)
A2 = Surface area of plane 2 (m2)

The force received by the object (on piston 2) can be calculated using Pascal's law by multiplying the surface area of plane 2 by the result of dividing the force on plane one by the surface area on plane 1. This is because the pressure exerted on the liquid in a closed space by piston 1 is equal to the pressure received by piston 2.

1.2.2 Archimedes's Principle

Archimedes' law states that "an object wholly or partially immersed in a fluid receives an upward buoyant force equal to the weight of the fluid displaced by the object" [13]. Archimedes' law explains the relationship between gravity and upward lift when an object is placed in water. As a result, there is an upward lifting force (buoyant force).

This principle can be used to calculate the volume and, thus, the density of an irregularly shaped object by measuring its mass in air and effective mass when submerged in water (density = 1 gram per cubic centimeter). Underwater, the effective mass is equal to the actual mass minus the mass of the fluid displaced. The difference in natural and effective mass thus displaces the mass of water. It allows the volume of an irregularly shaped object (such as the king's crown in the Archimedes story) to be calculated. The average density of the object is calculated by dividing the mass by the volume. Archimedes discovered that the density of the king's ostensibly gold crown was significantly less than that of gold, implying that it was either hollow or filled with a less dense substance. Objects immersed in a liquid will lose weight. As a result, lifting objects in water feels lighter than lifting them on land.

Archimedes' law's central concept is related to plunging, patches, and floating. Figure 5 depicts the differences in buoyancy between sinking, floating, and floating concepts.

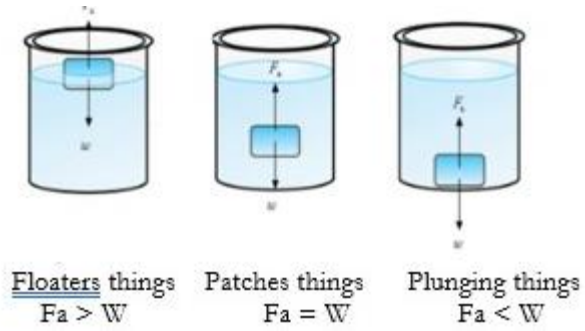

Figure 5. Buoyancy Differences between Plunging, Patches, and Floating Concepts

Mathematically, the equation of Archimedes' law [9] can be written as follows:

$$\boldsymbol{F_a = \rho . g . V} \qquad (4)$$

Information:
Fa= Floating force (N)
$\boldsymbol{\rho}$ = Mass Type of substance (kg/m^3)
g = Acceleration of gravity (m/s^2)
V = Volume (m^3)
W = Gravity (m/s^2)

3. Aspects in Axiological

Axiology is derived from the Greek words axion (value) and logos (theory), and it means "value theory"[16]. According to [17], axiology is a value theory based on usefulness and knowledge gained. According to the Indonesian dictionary, axiology is the application of science to human life and the study of values, particularly ethics [18]. Axiology is a branch of science philosophy that discusses the goals of science and how humans use their knowledge. So, the nature of the benefits contained in knowledge is the nature that axiology wishes to achieve. The object of axiological study is related to the problem of science's applicable value because science must be adapted to cultural and moral values so that society can feel the valuable value of knowledge. Axiology is a value theory that considers good and evil (good and bad), true and false (right and wrong), and procedures and objectives (mean and end). It is explained in junior high school about the benefits of pressure on living things and various areas of life. There are so many science concepts developed from everyday life [19]. In physics, the axiology for solid pressure explains that the magnitude of the acting force and the surface area influence the magnitude of the pressure value in the equation above. The pressure equation above shows that the pressure value is equal to the value of the division of the force acting and the surface area. To increase the value of the pressure, we increase the force applied to the object while decreasing the surface area of the compressive field.

The concept of pressure has a practical application in human life. The following is an example of how pressure (solid, liquid, and gas) can be helpful in everyday life. When we walk on muddy ground in boots, we apply substance pressure. We will be able to walk more efficiently in mud if we wear boots rather than other types of shoes. Not only that but there are numerous other examples of pressure being used in everyday life, such as (1) an ax blade with a sharp edge to make splitting wood easier; (2) the base of the snowshoes is more comprehensive to make walking on slippery snow easier; (3) special car tires for heavy muddy terrain are made large so that they do not slip easily when driving through muddy terrain; (4) nails and knives have sharp edges to make them easier to use; (5) it will be easier to slice vegetables and meat if we use a knife with a sharp tip (small surface area). (6) the broad, webbed feet of ducks and geese make it easier for them to walk on mud and swim in water; (7) the fish's wide fins allow them to move in the water because the movement of the wide fins provides

thrust. Matter pressure is also found in living things, such as (1) water transport in plants, (2) nutrient transport in plants, (3) blood pressure in the human respiratory system, and (4) gas pressure in the human breathing process.

The laws governing the concept of pressure have axiological significance as well. The following is an axiological example of applicable laws concerning pressure. In thermodynamics, Pascal's law's axiology is analogous to a hydraulic jack's. To replace a punctured car tire, use a hydraulic jack. A slight suction will press the liquid in the reservoir when the hydraulic jack is pressed. The liquid will flow towards the large suction cup, causing the object to rise. In biology, the axiology of Pascal's law is linked to blood pressure, specifically blood pressure in the human circulatory system. Pascal's law states that pressure exerted on a liquid in a closed space will be transmitted equally in all directions by the liquid. This is the same as blood vessel pressure, which is pressure in a closed space. When the heart beats, the blood pressure rises. The impulse then causes blood to flow through veins. Blood pressure is caused by blood flow in the blood vessels pushing against the blood vessel walls. The blood vessels must be completely filled with blood to keep the air pressure stable.

The working principle of hydraulic brakes demonstrates the axiology of Pascal's law in technology. Hydraulic brakes work by limiting the movement of the discs in contact with the tires. This is accomplished by clamping or pushing the disc out. The friction force between the clamp and the disc stops the vehicle. The small piston is pressed by the driver's feet. The liquid in the pipes experiences increased pressure. The pressure increase is transmitted to all parts of the liquid. The added pressure is applied to the large piston opposite the brake disc. The force exerted on the brake disc becomes enormous because this piston is much larger than the piston at the driver's feet. As a result, the small force generated by the feet produces a significant force on the brakes, which can cause the vehicle to stop. The axiology of Pascal's law in everyday life can be seen in the example of a car lift in a car repair shop or a car wash. The hydraulic pump operates on force and cross-sectional area principles, with two distinct troops and a large and small cross-sectional area. Furthermore, the hydraulic pump contains a liquid or fluid that connects the cross-sectional areas, commonly called suction. If a force is applied to the small suction cup and there is liquid in the pump, such as lubricant, the force is transmitted or forwarded to the large suction cup, and the load (in this case, the car) is lifted.

Archimedes' law is the second law that applies to pressure. Archimedes' law's axiology can be found in everyday life. Archimedes' law exists to provide benefits and make human life more manageable. Submarine and ship technology, shipyard (ship repair facilities), air balloons, hydrometers (devices for measuring the density of liquids), and pontoon bridges (bridges over floating empty drums) are some of the benefits of Archimedes' law for human life [20]. We know that Archimedes' law is not only a contextual theory but also has many applicative values, providing compelling evidence that Archimedes' statement is a law and part of science that has been empirically proven [21].

CONCLUSION

Based on the findings of a review of sources relevant to the topic of this study, it is possible to conclude that studies on ontology, epistemology, and axiology require further examination to comprehend the concept of pressure in learning at the junior high school level. The study of the philosophy of science is highly beneficial in better understanding the nature of science, particularly the concept of pressure. As a result, research on the concept of pressure is also required. The idea of pressure will be a valuable information tool for a junior high school teacher to explain the usefulness of pressure in various fields, particularly applications of pressure that aid in facilitating human work. By teaching students about pressure, we can make it easier to convey information and influence the development and progress of human civilization. The limitation of this research is that it only examines the ontology, epistemology and axiology aspects of pressure material; a similar study is needed on various other materials in physics learning.

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