

Multidimensional Science Education: Overview Of Philosophy Foundations (Ontology, Epistemology, Axiology)

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Abstract. Science is a part of human life that has existed since the beginning of human existence, knowing himself and the natural surroundings. This study aimed to examine Dimensional Science Education based on three philosophical foundations: ontology, epistemology, and axiology. The method used in this article is the literature review method. The library sources used are books and articles that are by this article. The analysis used is content analysis. The study results show that, in essence, science is a science of natural phenomena that is poured into facts, concepts, principles, and laws that are tested for truth through a series of activities in the scientific method. The essence of products and processes cannot be distinguished or separated because they have a bound relationship with one another in conducting scientific observations so that they can form a scientific attitude. Dimensional Science Education is divided into three dimensions, namely Product Dimension (ontology), Process Dimension (epistemology), and Scientific Attitude Dimension (Axiology). These three dimensions are interrelated. It can be interpreted that science learning must include these three dimensions. Therefore, Science education contains not only formulas and theories but a process and scientific attitude to obtain scientific concepts about the universe.

Keywords: science education; multidimensional; philosophy.

INTRODUCTION

Science is a part of human life that has existed since the beginning of human existence, knowing himself and the natural surroundings [1]. Humans act as subjects and objects in science [2]. Science includes humans and their environment, both living and non-living [3]. Humans who have reason and mind will always try to study and carry out activities to discover the phenomena of life around them so that the truth is clear [4, 5, 6]; in line with the times, human life experiences high-speed dynamics, so science also develops. There are many discoveries in various branches of science that we currently encounter and feel, for example, animal husbandry, fisheries, agriculture, clothing, medicine, and many more, so life is now changing from the last time. This will continue as long as there is human life.

Science is defined as the science of the phenomena of the universe [7, 8]. Also, science is the result of human activities in the form of organized knowledge, ideas, and concepts about the natural

surroundings, obtained from experience through a series of scientific processes, including investigation, compilation, and testing of views [9, 10]. Science is a systematic way of discovering the universe; it is a form of effort that makes various experiences into a system of specific logical thinking patterns known as scientific thinking patterns [7]. Science is a natural learning concept and extensively relates to human life [11].

Science education plays a vital role in the educational process and technology development.

Science has the effort to arouse human interest and the ability to develop science and technology and an understanding of the universe, which has many facts that have not been revealed and are still secret. So that the results of their discoveries can be developed into natural science that is new and can be applied in everyday life [12]. Science education has a strategic role in improving the quality of human resources, among others, through providing scientific thinking skills and habits, higher-order thinking skills, and problem-analysis skills in multidimensional life [11, 13].

Because of the role of science education in the educational process, it is essential to examine science education from a philosophical perspective because philosophy is the basic foundation of education, and philosophy is a thought process. Various philosophical thoughts need to be considered. Thus, this literature review research was conducted to examine dimensional science education based on three philosophical foundations: ontology, epistemology, and axiology.

METHOD

The method used in this article is the literature review method. The library sources used are books and articles that are by this article. The analysis used in this article is content analysis: 1) to identify various relevant sources; 2) to find standard semantic units from these sources.

RESULTS AND DISCUSSION

The Nature of Science Education. The term Natural Sciences or IPA is also known as science. The word science comes from the Latin *Scientia*, which means "I know". In English, the word science comes from the word "knowledge". Science then developed into natural science, which in Indonesian is known as natural science (IPA). Science is a science that studies the environment and its contents [14]. So in terms of the term, science is objective knowledge.

1. The nature of science as a collection of knowledge. Science as a collection of learning refers to a broad array of various concepts. Science is considered the accumulation of diverse expertise that has been discovered since ancient times until the discovery of very new knowledge. This knowledge is from facts, theories, and generalizations that explain nature [15, 16].

The nature of science provides an understanding that science does not only include science about nature but includes understanding the process of investigation and acquisition of that knowledge. The essence of Natural Science is as a product, process, and attitude [14]. Science as a product is an accumulation of the efforts of previous science pioneers and generally has been entirely and systematically arranged in the form of a textbook. Science is compiled and obtained through the scientific method. Teaching science is limited to the meaning of "scientific attitude towards the natural surroundings". Through science educa-

tion, it is hoped that students will develop logical, rational, analytical, and critical thinking skills to support the development of science and technology.

2. The Nature of Science as a Search Process. Science as a search process is generally a view that connects the description of science closely related to laboratory activities and equipment [11, 17]. In this category, science is seen as something that has strict discipline, is objective, and is a value-free process.

3. The Nature of Science Education as Value. IPA as a collection of values is closely related to the emphasis on IPA as a process [7]. However, this view emphasizes aspects of the scientific value inherent in science. This includes the importance of honesty, curiosity, and openness.

4. The Nature of Science as a Way to Know the World. The scientific process is influenced by how people understand life and the world around them. Science is considered a way in which humans understand and give meaning to the world around them and a way to know the world and its contents with all its limitations [4].

5. The Nature of Science as Part of Daily Life. People realize that what is used and used to meet the needs of life is strongly influenced by science [18]. The scientific approach strongly influences the use of various technology products due to investigation and knowledge and how people think about everyday situations [19].

Dimensions of Science Education. Based on the nature of science, the dimensions of science education are divided into three dimensions, namely the product dimension (ontology), the process dimension (epistemology), and the scientific attitude dimension (axiology). These three dimensions are interrelated. It can be interpreted that science learning must include these three dimensions.

1. Dimensional Science Education as a Product. The dimension of science as a product is an accumulation of scientific findings from previous researchers, which are compiled and then made into a book that is used as a reference where the science is used [20]. The book was produced through unified scientific discoveries. Science textbooks are also called the body of knowledge or the body from which the ability originates. The book contains knowledge sources that can be applied to new scientific discoveries.

The product dimension includes concepts, principles, laws, and theories in science, which are the result of human inventions to understand and explain nature and the various phenomena that occur in it [21]. Science products (concepts, principles, laws, and theories) are not obtained based on facts alone but on data tested through experiments and investigations. Facts are natural phenomena that have been successfully observed but still allow for differences in perception among observers (observers). Facts that are perceived equally by each observer are called data.

We rely on valid data in which a natural phenomenon is abstracted into a concept. In simple terms, there are three ideas: visual images, defined pictures, and relational concepts [22]. Chairs and classrooms are examples of visual concepts. We can understand it simply by seeing its concrete form and not defining it. Energy, field, and temperature are examples of defined images. At the same time, mathematical formulas and sentences are examples of concepts expressing relationships. There are three criteria for an actual natural science product: 1) able to explain phenomena that have been observed or have occurred; 2) able to predict events that will occur; 3) able to be tested with similar experiments.

2. Dimensional Science Education as a Process. The dimension of natural science as a process can be interpreted that how the natural science process is obtained. More clearly, science is a science that requires experimentation to get an answer to the problems at hand. That's where the process takes place. By using the scientific method, natural science is obtained. The scientific method is developed gradually and continuously with the hope that the problems studied in learning can be solved and receive scientific answers (based on science) and evidence that explains that it shows a fact.

The process dimension, the method of acquiring knowledge, is called the scientific method. This method in science is now a combination of the induction and deduction methods. This combined method is a relay activity between deduction and induction, where a researcher initially uses the induction method in connecting observations with hypotheses. Then, this hypothesis is deductively combined with existing knowledge to see its suitability and implications after going through various necessary changes. This hypothesis was then tested through a series of empirically collected data. The scientific method in the

scientific process has a basic framework of procedures that can be described in six steps: 1) being aware of the problem and formulating the problem; 2) observation and collection of relevant data; 3) data classification; 4) the formulation of the hypothesis; 5) hypothesis testing, and 6) generalize. At these stages, some activities are generally carried out by researchers, known as process skills: observing, measuring, predicting, classifying, comparing, concluding, formulating hypotheses, conducting experiments, analyzing data, and communicating research results.

In teaching science, this aspect of the process appears in the form of teaching and learning activities. The presence or absence of this aspect of the process is highly dependent on the teacher. The dimensions of scientific attitude are various beliefs, opinions and values that must be defended by a scientist, particularly when looking for or developing new knowledge. Philosophy can be classified into two major groups. First, a set of attitudes which, when followed, will help the process solution to the problem. And second, a particular set of perspectives is a way of looking at the world and is helpful for future career development.

Learning materials require evidence and authentic experience for students to learn them. Proof and authentic experience in learning are less effective when done with an expository approach, as is often done by teachers. For this reason, an appropriate method is needed to obtain real experience. One method that can be used to acquire a real learning experience for students is the experimental method. It will be able to stimulate students' scientific attitudes through simple experiments themselves and prove the truth of words that they have known but have not understood their meanings. Therefore, the experimental method is one method that is suitable to be carried out in the form of a simple experiment.

3. Dimensional Science Education as Scientific Attitude. The dimension of attitude development is the role of science, which forms students' scientific attitudes. This attitude is undoubtedly expected to be embedded in students. The IPA attitude is meant as a scientific attitude [23]. Scientific perspectives are closely attached to science subjects because science requires a scientific method where the scientific method is used as a medium or tool for inculcating attitudes in science [24].

Scientific attitudes included in science education are a) curiosity about the physical/natural world and how it works; b) recognition that science can help solve individual and global problems; c) an enthusiasm for mastering knowledge and scientific method; d) recognition of the importance of scientific understanding in the present; e) recognizing that IPA is the result and human activity needs.

Author [24] explains the nine attitudes to scientific knowledge that must be developed early on in school students base. The development of this scientific attitude is not through lectures but rather by bringing it up when students are involved in problem-solving activities.

From the overall description of the nature of IPA above, It is clear that science education does not just contain formulas and theories but rather a process and scientific attitude to get scientific concepts about the universe. Science learning as a development medium potential of junior high school students should be based on the characteristics of child psychology. It should provide fun playing and intellectual satisfaction for them in unravelling mysteries, the intricacies and riddles of natural phenomena around them. It should develop the scientific potential contained within him and correct their misconceptions about natural wonders. At the same time, equip-

ping the skills and develop new concepts that must be mastered. In addition, assessment in science teaching must be carried out using a fair assessment system that is proportional, transparent, and comprehensive in every aspect process and student learning outcomes.

CONCLUSIONS

In essence, science is the science of natural phenomena as outlined in the form of facts, concepts, principles, and laws tested for truth and through a series of activities in the scientific method. The essence as products and processes cannot be distinguished or separated because they have a bound relationship with one another in conducting scientific observations so that they can form a scientific attitude. Dimensional Science Education is divided into three dimensions, namely Product Dimension (ontology), Process Dimension (epistemology), and Scientific Attitude Dimension (Axiology). These three dimensions are interrelated. It can be interpreted that science learning must include these three dimensions. Therefore, Science education contains not only formulas and theories but a process and scientific attitude to obtain scientific concepts about the universe.

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