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ANALYSIS THE SEQUENCE OF LOGICAL MATERIALS WITH DESIGN OF INTEGRATED LEARNING TYPE SEQUENCED IN MATERIALS OF POLLUTION AND CLIMATE CHANGE

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ABSTRACT

Science learning strategy refers to process standards and content that conforms to the nature of science learning as a product and process. The use of content and process standards include the scope of materials and competencies to be achieved. IPA concepts are a unified whole whose teaching cannot be separated so that the design of learning must be designed in an integrated way. While the standard of content concerning the scope of the material on the curriculum is set not in a logical sequence so as to make it difficult for students to organize their cognitive structure in understanding the concept of science. Therefore, it is deemed necessary to attempt to rearrange the organizational structure of the material so that science learning can be presented in an integrated form. The rearrangement of the material structure can be done by applying an integrated IPA study with the sequenced model. The rearrangement of material structures with sequenced models puts the concept of preconditions preceding the main concepts, the basic concepts preceding the application of concepts, and the general concept of preceding specific concepts. The structure of the material in a logical sequence of integrated IPA learning sequenced models fits perfectly with the scientific and conceptual approach. The science lessons with these two approaches are accommodated by guided learning model of guilt and creative problem-solving. The effectiveness of the application of these two learning models is strongly influenced by the method used. Both of these learning models stimulate students' curiosity so that question and answer methods and demonstrations can assist in streamlining the implementation of both learning models.

***KEYWORDS**: IPA Terpadu Model Sequenced, Guided Inquiry, Creative Problem Solving, Question-Answer*

INTRODUCTION

Natural Science (IPA) is concerned with how to find out about nature systematically. Science learning requires not only the mastery of a collection of knowledge in the form of facts, concepts or principles, but also a process of discovery (Kemendikbud, 2016). This is in accordance with the nature of science as a process and product (NRC, 1996: 35). In an effort to achieve both of these objectives, science learning should have clear content standards related to the conceptual framework of learning and learning activities derived from the competence and scope of the material (Kemendikbud, 2016). The last two terms are the competence and scope of the subject matter. Related competence, science learning is directed to understand various natural phenomena, concepts, and principles of IPA that are useful and can be applied in everyday life. As for the scope of the material, science learning in junior high school is a continuation or continuation of the study material in SD / MI covering aspects (1) living creatures and life processes;

(2) the material and its nature; (3) energy and its changes; (4) earth and the universe.

The result of the revision of the 2013 curriculum has stipulated the standard of science learning process implementation of SMP / MTs both concerning the competence to be achieved and the scope of the material to be taught. However, the organization of the scope of the material to be taught is still separated between IPA components consisting of biology, chemistry, IPBA, and physics. This has become one of the problems in the implementation of science learning in SMP / MTs (Rochintaniawati, Widodo, &Widhiyanti, 2012). Though the material IPA is a concept that is integrated with each other. Biological, chemical, and physical content is a united reality (Firman, 2017). Even its integration is not limited to content, but also to aspects of skills, and attitudes.

Science learning should be viewed holistically without fragmentation between parts of it. Isolating these parts would lead to a lack of comprehension of the concept of science. To avoid that impact, an integrated curriculum design is needed so as to make it easier for students to organize their cognitive structures in understanding the science concepts presented by teachers in the learning process. The form of integration is adjusted to the needs analysis by considering the developmental aspects of the learner and the range of material to be taught. Fogarty (1990) has provided a variety of alternative curriculum integration models that can be utilized to rearrange the main curriculum structure in terms of the sequence of material to be taught. One of the integration models that can be utilized is integrated IPA learning in sequential or sequenced models. The main step in designing this integration model is to rearrange the topic and unit of matter and sort, so that among the different topics it corresponds (Firman, 2017). With this model, we can associate the same concepts even though the concept resides in different matters.

METHODOLOGY

This research uses a descriptive qualitative approach by conducting critical analysis on the document in the form of syllabus of SMP / MTs which contains the scope of science material of SMP / MTs. The analysis focused on the logical sequence of the matter by observing the principle of a compilation of sequenced type integrated learning. The analysis begins by grouping the scope of matter into the types of disciplines of biology, chemistry, physics, and Earth Sciences and Space (IPBA). The grouping results will then be sequenced by placing the prerequisite precedes the main concepts, the basic concepts predating the concept application, and the general concept precedes specific concepts. Based on the analysis of the material that has been sorted then formulated methods, models, approaches, and learning strategies in accordance with the material to be selected. In this study, the selected material is material about pollution and climate change.

The results of the analysis in this study will answer the question (1) how the logical sequence of the material in the scope of the material at the level of SMP / MTs (2) how the model, methods, approach, and learning strategy in accordance with the material structure that has been prepared (3) how to create formative assessment corresponding to the question in point 2.

RESULTS AND DISCUSSIONS

Lesson Subject Structure

Model of the IPA science syllabus for junior high school / MTs, the scope of the material can be described in the table below

Table 1: Scope of Science Materials Levels of SMP/ MTs

Scope of Natural Science Material of SMP / MTs Scientific and Occupational, Work, Living Beings and Livelihoods, Energy and Its Changes, Substance and Nature, Earth and the Universe, and Science, Environment, Technology and Society		
Grade VII	**Grade VIII**	**Grade IX**
Magnitude and Measurement	Motion and Style	
Classification	Business and Simple Aircraft	Properties of Materials
Substances and Characteristics	Framework and Muscles	Electricity
Temperature and Heat	Pressure Substances	Magnetism
Energy	Vibration, Waves, and Sound	Environmentally Friendly Technology
Organization of Life	Light	Reproduction
Interaction of Sentient Beings	Structure and Function of Plant Network	Animal and Plant Breeding
Pollution	Digestive system	Inheritance
Climate change	Bloodstream system	Biotechnology
Lithosphere	Respiratory system	Soil
Solar system	Additives and Addictive Substances	

Based on the above table, the organization of the subject matter will then be determined to be grouped into the disciplines of chemistry, biology, physics, and IPBA. This grouping aims to make it easier to sort the material. In this article, the material to be grouped is class VII material.

Table 2: Grouping of Scope of IPA Materials

Disciplines			
Chemistry	**Physics**	**Biology**	**Ipba**
Substance and its characteristics	Magnitude and Measurement Temperature and Heat Energy	Classification Organization of Life Interaction of Sentient Beings Pollution	Climate change Lithosphere Solar system

The clustering method is based on the degree of uniqueness of any material scope. Because the concept of science is a unity and is so related to each other that in determining a concept will be included in the group of disciplines which becomes somewhat difficult (Rochintaniawati, Widodo, &Widhiyanti, 2012). The most likely way to do this is to observe the tendency of a material more dominant in one of the disciplines. For example, environmental pollution material can be incorporated into groups of physics, chemistry, biology, and IPBA. However, after being analyzed, the tendency of environmental pollution material to explain more about the impact of pollution on living creatures, the grouping is incorporated into groups of biological disciplines. Other material groupings also use the same method (Trianto, 2007)

Design of Integrated Plant Unit and Organization of Learning Materials

Organizing the structure of the subject matter is a major step in designing an integrated IPA learning sequence model. The rules in sorting the structure of the material are determined based on the general concept of preceding the specific concept, the precondition concept precedes the main concept, and the basic concept precede the concept application (Rustaman, 2007). In class VII material, the contamination material is eligible to be placed in the first section. The concept of pollution meets the criteria as a prerequisite, general, and basic concepts that precedes the concept application. Students will have difficulty understanding climate change materials when they do not understand the concept of pollution (Inasih, 2014)

The purpose of rearranging the order of the material is not to replace the overall structure of the material in the syllabus that the government has set, but to choose the material at a certain level or class only. In order to be implemented, the material to be sorted cannot be done at different levels or classes so that in this article, the material to be reorganized is the material in class VII.

Learning Strategy

The application of an integrated IPA study of sequential or sequenced models can be done in several disciplines if there is a connection between the objectives of the discipline. Disciplines in science that cover physics, chemistry, biology, and IPBA are disciplines that are interconnected with one another, so it is very possible to make an integrated IPA study with a sequenced model.

The emphasis for integrated IPA learning lies in the logical sequence of the taught material. Logical sequence of matter into consideration in developing learning strategies. Based on the syllabus for science subjects in grade VII / MTs class VII there are two competencies to be achieved to link two different disciplines. The selected material is pollution that is part of a group of biological and climate change disciplines that are part of the discipline group of IPBA. The first competence is competence 3.8 is to analyze the occurrence of environmental pollution and its impact on ecosystem and competence 3.9 that is analyzing climate change and its impact to the ecosystem. See figure 1.

To implement that, a comprehensive (comprehensive) plan is needed in the learning activities to achieve the learning objectives called learning strategies. Learning strategy includes components such as models, approaches, methods, learning media, as well as student settings and formative assessment. The model, approach, and the method chosen depend on the learning objectives and learning materials (Firman, 2017) so that the first step in designing an integrated IPA learning is to determine the learning objectives to be accomplished with accompanying indicators. Because the integrated IPA learning used sequenced model, then the following will be elaborated each competency (Wisudawati&Sulistyowati, 2013)

Table 3: Structure of the Order of IPA Materials

	Physics	Chemistry	Biology	IPBA
Sequence of Initial Material	1. Quantities and measurements		2. Classification	
		3. Substances and its characteristic		
	1 Temperature and Heat			
	1. Energy		6. Organization of live	
			1. Interaction of Living Beings with the Environment	
			2. Pollutions	
				3 Climate change
				2. Lithosphere
				2. Solar system

Table 3 Contd.,

	Physics	Chemistry	Biology	IPBA
Sequence of Material After re-ordering	1. Quantities and measurements	2. Substances and its characteristic	3. Organization of live	
			4. Classification	
	5. Temperature and heat			
	6. Energy		7. Interaction of Living Beings with the Environment	
				8. Lithosphere
				9. Solar system
			10. Pollutions	11. Climate change

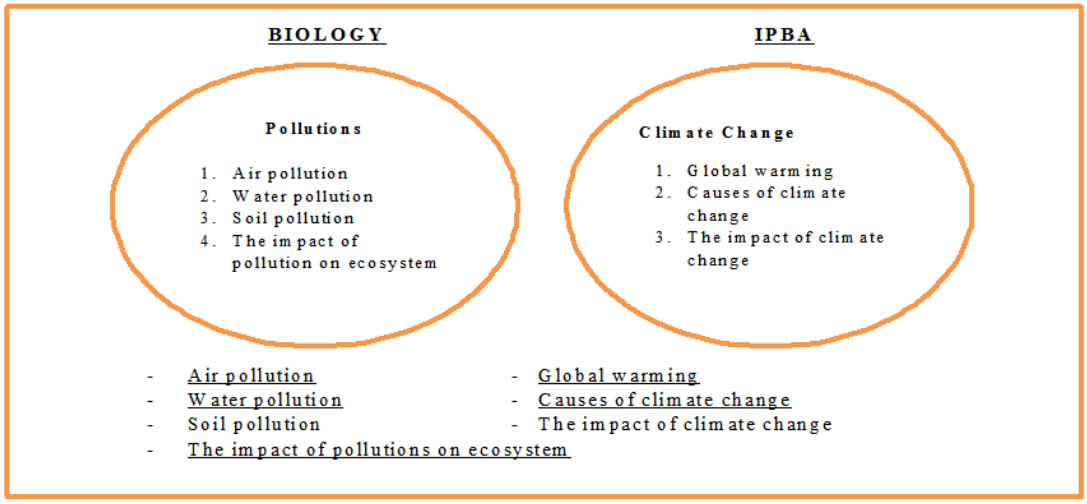

Figure 1: Integrated Science Learning Model Sequenced

Learning Approach

The learning approach provides direction to the whole learning process so that students succeed in learning, the learning materials and achieving the learning objectives (Firman, 2017). The teaching approach is a point of view based on certain basic principles (philosophical, psychological, didactic and ecological) that embodies, inspires, strengthens and underlies certain learning methods (Kemendikbud, 2016). The selection of approaches to be used will depend on conformity with the learning objectives, subject matter, and selected learning model.

The reason for the selection of a scientific learning approach to climate change materials is to involve an active student (student-centered) in the learning process. 5M activities that include observing, questioning, gathering data, associating, and communicating can make the learning process of students meaningful (NRC, 1996:35). While the reason for the selection of a conceptual approach to contamination material is that the pollution phenomenon is so close to the daily lives of the students that they may encounter the phenomenon either directly or indirectly (via newspaper, TV program, internet). In addition, this approach is more flexible because it can be implemented in the

class, lab, and neighborhood settings. According to Firman (2017), this approach is also capable of improving students' higher-order thinking skills because students are asked to integrate some concepts or principles.

Learning Model

In addition to choosing a learning approach, other factors that also affect the effectiveness of the learning process is the accuracy of choosing a model of learning. Not exactly in choosing a learning model will cause the desired competencies cannot be achieved by learners. Because basically, the learning model is a plan or pattern used as a guide in planning the learning in the classroom (Trianto, 2007, pp. 51). Application of learning model is expected to help students to get ideas, information, skills, ways of thinking and expressing ideas so that the achievement of learning goals (Joyce & Well, 1992: 1-4).

The reason for the selection of the model of mercury learning on climate change materials is that for a scientific approach, the use of a model in line with that approach is one of the guided inquiry model. Blanchard et al. (2010) revealed that the guided inquiry learning model provides enough time and opportunity for students to interact, reflect, and take initiative in learning activities. The phases of the guided inquiry model are in line with the student's activities on the scientific approach (Dewi, Sadia, &Riatiati, 2013). Guided selection of inquiry is used taking into account the development of the learner. For junior high school students, the application of inquiry model still needs guidance and direction by the teacher. As for the material of pollution, the selected model of learning is the model of creative problem-solving. The reason for choosing the model is because the creative problem-solving model demands a deep understanding of the concepts taught and their ability to integrate existing concepts to find solutions to the problems raised (Surif, Ibrahim, &Mockhtar, 2012; Inasih, 2014). This is reflected in the stages in the creative problem-solving learning model. The selection of creative problem-solving model is in line with the selected conceptual approach.

Learning Method

Learning method or teaching method is a means of teacher facilitate student learning a subject matter. This learning method includes a series of interrelated actions by teachers and students (teaching and learning interaction). According to Firman (2017), the role of learning methods in teaching and learning process is to implement an instructional design that includes models and approaches to achieving learning objectives. As a means of achieving goals, a learning method will have its own characteristics for the materials to be provided. Therefore, the use of learning methods should be tailored to the material to be taught

The learning materials selected in this article are about climate change and pollution. The methods chosen to teach both materials are question and answer methods and demonstrations. Selection of this method always adjusts to the approach and selected learning model (Joyce & Well, 1992: 1-4). Due to the material of climate change, the scientific approach and the model used are guided inquiry model, then the choice of method should pay attention to the characteristics of both. The question and answer method corresponds to the questioning activity of the scientific approach and is in line with the phases of the hypothesis formulation of the guided inquiry model (Rustaman, 2007). Likewise, the conceptual approach to pollution material is very much in line with the question and answer method to explore and explore the specific answers given by the students and the stages in the creative problem-solving model are also very relevant to the question and answer method to stimulate the students to come up with ideas that are solutive to the given problem. Usefulness in reviewing the material and fostering the courage of students to express their opinions orally is also the reason

for the selection of question and answer method. The selection of demonstration methods is because both materials, initiate the learning process by presenting the images and videos for students to observe. Especially for climate change materials that use miniature greenhouse while the number of tools is limited so that for the effectiveness of learning used demonstration methods. The following sequence of sequenced learning models (Trianto, 2007)

Formatif Assessment

According to Rustaman (2007), the assessment procedure is tailored to the learning objectives and depends on the learning model used. Because of performance-based learning objectives, the formative assessment used is a performance assessment. When students perform demonstrations, teachers observe student activities and provide an assessment of the performance performed. Assessment of student performance is done by filling out the performance appraisal rubric (Stiggins, 1994). The instrument used is LKS and giving a test with multiple choice format and open-ended. In LKS there are several skills to be measured. The measured skills of climate change materials are the ability to collect and interpret data, formulate hypotheses, and develop conclusions. For multiple-choice and open-ended questions, the criteria for each item are designed to measure students' cognitive abilities at the level of understanding and analysis because the two models used involve high-level thinking. After students have taken a series of tests or measurements, a good assessment result of the rubric on the performance and scores of the multiple-choice and open-ended test is performed. In the rubric, there is a value criterion so that students will appear who have not achieved the learning objectives. Likewise, scores obtained by students on the open-ended test and multiple choice can be used as data to diagnose students' difficulties in understanding learning materials. Further enrichment will be carried out for learning purposes that have not reached the target.

CONCLUSIONS

World of science education. The real form of the effort is the presence of integrated IPA learning articles in sequential or sequenced models in the middle of the reader. However, this article has not been tested in terms of its effectiveness, so it is necessary to test the application in learning. The result of the trial will be input and become the evaluation material for subsequent improvement. Efforts to present an effective integrated learning model of IPA have been conducted by activists in the

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