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RECONSTRUCTION OF PRACTICE MODULE ON THE ADSORBENT TOPIC CONTAINED THE NATURE OF SCIENCE (NOS)

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ABSTRACT

The training module is a learning material with interesting illustrations, communicative language, and can be adapted to students' knowledge. Through this module, students can apply their knowledge to life. This study aims to reconstruct the practice module on the topic of adsorbents contained in NOS. The research design of the Educational Reconstruction Model (MER) as the primary reference in making the adsorbent practice module. The participant used was one of the secondary schools in the city of South Tangerang. The results of the calculation of the Content Validity Ratio (CVR) and Content Validity Index (CVI) show that the chemical concepts presented are valid and do not need to be improved. Test results show that from 30 student respondents, the overall percentage data was 89.8%, which means that this module is excellent and suitable as a source of learning in schools. The results of this study can be used as an example of innovating teaching materials.

***Keywords**: reconstruction, a model of educational reconstruction, nature of science, adsorbent*

INTRODUCTION

Based on the results of countries participating in PISA in 2015, Indonesia ranks 62 out of 70 countries. PISA in 2015 reported the average score that must be possessed by 15-year-old students to score a scientific literacy ability was 493, while Indonesia got a score of 403 with this result, meaning that the scientific literacy ability of Indonesian students is currently still at a stage below the [1]. how to use using learning resources in a classroom that is not effective is a cause of this problem [2].

Some previous studies provide an overview related to chemical teaching materials used in schools only focus on discussing chemical concepts in theory [3]. Indeed learning chemistry will be more exciting and easy to understand for students if they can provide an overview of the relationship with daily activities [4]. According to these problems requires innovation through the reconstruction of learning resources so that chemistry learning is more effective and has an impact on students.

Practicum modules created in this study are designed to be applied by students in their lives because science will be far more inherent if applied or utilized. Following the pre-conception analysis of teachers and students, context analysis and adsorbent content, and

analysis of basic competencies, the preparation of practicum modules containing NOS was carried out as an innovative learning resource. Practicum modules are prepared using simple language, so it is expected to facilitate students in receiving new knowledge information. Module topics are chosen by adjusting environmental issues and the availability of natural resources that are around. In this practicum module, students can understand the nature of science that does not have limited to laboratory materials and can use natural resources that exist in daily life[5].

Serious topics of mutual concern and serious issues in environmental issues are water pollution caused by industrial waste and chemicals used in households. The problem of adsorbent is a topic of much discussion because, in addition to containing chemical concepts about colloids and chemical bonds. The issue of adsorbents also provides information to students that water pollution due to industrial heavy metal waste and chemicals can be overcome by using adsorbents [6]. On the topic of adsorbents, students can learn about the true nature and nature of science, called the Nature of Science (NOS).

NOS are aspects that are inherent in scientific knowledge and the development of science. Previous research shows that NOS can show science as knowledge that provides the basis for thinking processes and interactions between science and society, engineering, and technology. NOS aspects are expected to provide a better learning experience for students [7]. The NOS aspect can be designed as a teaching material that is suitable for students' cognitive development [3]. Several chemistry textbooks that indirectly illustrate aspects of NOS make it easy to understand the atomic model of Dalton, Thomson, Rutherford, Bohr, and mechanical waves [8]. Therefore, to synchronize aspects of NOS in learning is very important.

The adsorbent practicum module uses the Model of Educational Reconstruction (MER) reconstruction, the design of this study takes into account the surrounding conditions, especially the issue of learning and current scientific concepts [9]. Usually, researchers use MER, as an effort to provide an approach in the learning process of science [10], as well as steps for scientific inquiry in laboratories [11]. But it is still very rarely found the development of teaching materials with MER research designs. The adsorbent practicum module containing NOS has the opportunity to become a new source of information for students in making adsorbents with surrounding natural resources.

METHODS

This research is based on research and development methods (Research and Development), and which refers to the Model of Educational Reconstruction (MER). The response test in the study was conducted on grade XI students in one of the high schools in South Tangerang City. Data collection techniques in this study used interview guide instruments, content sheets, and adsorbent contexts, module validation sheets, and response questionnaires. Pre-conception interview guidelines are used as reference questions to get information about teaching materials and adsorbent topics through teacher

respondents and students. The adsorbent content and context sheet contains a description of the chemical concepts that are connected to the adsorbent topic both in theory and its application. The validation sheet for the practicum module is used as a criterion for evaluating the module, including module material, module visualization, learning design, module readability, and nature of science aspects [12].

The response questionnaire was used as an instrument evaluation module consisting of 26 questions. Data analysis techniques of the results of this study used an average percentage, Guttman scale, interpretation of scores, and calculation of the content validity ratio (CVR) and content validity index (CVI). Calculate the average percentage using the number of answers according to the rubric compared to the overall data [13]. The Gutmann scale uses a score of 1 for yes answers, and a score of 0 for no answers. The interpretation of scores to determine criteria is very poor to very good. CVR calculation, score three if the statement is considered important, score two if the statement is deemed appropriate but not important, and score one if the statement is not appropriate and not important. In contrast, the CVI calculation is obtained from the average CVR value. The formula can calculate CVR:

$$CVR = \frac{n_e - \frac{N}{2}}{\frac{N}{2}} \quad \text{.....(1)}$$

Where, ne is the number of experts who say yes (important), and N is the total response. CVI is the average of the CVR value for the statement item that is answered "yes (important). The formula can calculate CVI.

$$CVI = \frac{CVR}{jumlah\ butir\ soal} \quad \text{.....(2)}$$

The results of the calculation of CVR and CVI are in the form of a 0-1 ratio [14].

RESULTS AND DISCUSSION

The results of this study are divided into several main sections, including analysis of pre-conception of students and teachers, analysis of chemical concepts about adsorbents, as well as the creation of practical modules and student response tests.

1. Pre-conception Analysis of Students and Teachers

The pre-conception analysis is to try to analyze the opinions of students and teachers about a science concept [15]. The pre-conception review is also to find out the learning difficulties encountered by students. Based on the results of the pre-conception analysis conducted to students and teachers, both agreed that the chemical teaching materials currently used in schools were not yet relevant to aspects of daily life, and focused on discussing their chemical theories and problems. Contextual teaching materials can have a positive impact on student achievement and motivation to learn chemistry because learning is more interesting and enjoyable because it relates to everyday life [16].

Learners and teachers say the same thing about them never using practicum modules as a source of learning in schools. Based on this, it can determine that the practicum module can be used as an innovative learning resource in learning in schools. The results of the analysis of

respondents 'opinions about adsorbents and aspects of NOS indicate that students' and teachers' understanding of adsorbents and NOS is still low, so the understanding of these two things needs to be increased again.

2. Analysis of Chemical Concepts Regarding Adsorbent

Adsorbents are related to chemical materials in schools and have not been discussed. The context of the adsorbent includes the principle of water purification, graphite compounds in the structure of the adsorbent, activated carbon content, activated carbon characteristics, the principle of the process of absorption of activated carbon, and cellulose as a source of activated carbon. The context of the adsorbent involves four chemical contents, including the nature of colloidal adsorption, carbon compounds, van der Waals forces, polar covalent bonds, and carbo-hydrates. A description of the chemical concepts related to the topic of adsorbents is presented in Table 1.

Chemical concepts related to the topic of adsorbents are the primary reference in making the context and content of the adsorbent practicum modules to fit the high school learning in schools. Six validators then validate the content and context. Based on validated, the calculation of CVR values of 0.67-1.00. Value means that all content and context presented are declared valid because the CVR value is by the CVR calculation requirements for six validators who have a minimum value of 0.523 [14]. The resulting CVI value is 0.85, which means that the content and context statement has been approved and is worth showing. This is because the CVI values obtained have exceeded 0.78 and are included in the first category, so it does not need to be repaired [17-18].

3. Making Practicum Module

According to the results of the experts' validation, the main basic competencies that discuss colloids. Use this competency because the topic of adsorbents contains a lot of colloid concepts in terms of particle size, system type, colloidal properties, manufacturing principles, and their usefulness in daily life. Meanwhile, in addition to this module, the discussion about changes in chemical bonds that occur in adsorbents [19].

The selection of topics that are suitable for aspects of NOS will be a new knowledge for students. Displays aspects of NOS as a whole in the module sections both in the introductory discourse, the process of making adsorbents, practice exercises, and a thorough discussion of the topic being studied. The addition of NOS in the module is adjusted to the basic competencies and learning indicators related to the adsorbent topic. The suitability is then poured into the module so that the module has aspects of socio-cultural integration, tentative, empirical, theory, creativity, subjectivity, and observations, and conclusions [20].

The empirical aspect is part of the research related to the topic in the module-socio-cultural issues associated with the use of raw materials for adsorbents that can be connected to daily life. The theoretical aspects are contained in various discourses and enrichment topics related to adsorbents. Other aspects, such as creativity, subjectivity, observation, and conclusions can be seen from the experimental activities carried out by students, both in terms of practicing, analyzing,

connecting, and making conclusions. Through this experiment, students can understand the true nature of science, which is not limited to laboratory materials and can use the natural resources that surround them. The use of practicum methods can also make students more interested in learning and make it easier for them to understand the material presented because it is related to daily life [19]. The module is then validated and adjusted according to expert advice. Practicum modules that have been approved by experts are then tested by students who have previously studied the topic of colloids and chemical bonds.

Table 1. Chemical Concepts on Adsorbent Topics

No.	Content	Context	the relationship between Content and Context towards Adsorbents
1.	Colloidal Adsorption Properties	Water purification principle	Colloidal Adsorption Properties Water purification principle Purifying water can be done by using a colloidal particle called an adsorbent. This purification process involves the colloidal adsorption properties, which is the process of absorption of ions or other substances by the surface of colloidal particles.
2.	Carbon Compound	Graphite	Graphite is a carbon compound that has properties as activated carbon. Graphite forms a circumference of six in a plane that has an open structure, so it has a large surface, which is around 1,000m2 / gram and can adsorb some ions, molecules, or other substances both in liquid and gas form.
		Activated Carbon Content	activated carbon contains carbon atoms and small amounts of oxygen and hydrogen, which are chemically bound in the form of various functional groups such as carbonyl (CO), carboxyl (COO), and phenol (C_5H_6OH) groups. Activated carbon also contains mineral components that will become more concentrated during the activation process. The chemicals used in the activation process can cause changes in the chemical properties of activated carbon produced.
		Activated Carbon Characteristics	Characteristics of activated carbon in the form of black solid, hygroscopic, insoluble in water, acids, bases, or organic solvents, tasteless, odorless, and not damaged by an increase in temperature or pH during the activation process.
3.	The van der Waals force and the nonpolar Kovalen Bond	The principle of the process of absorption of activated carbon	Carbon in the form of graphite, all hexagonal layers are held together by a weak van der Waals force so that if the adsorbent interacts with ions or molecules of other substances. This interaction provides an attractive force between the material and the adsorbent. This happens because the surface area of the adsorbent experiences an imbalance of forces, so it can create attractions, or molecules of other substances until the force balance is reached. Activated carbon consists of flat plates whose C atoms are covalent and are nonpolar composed of two single bonds and one double bond so that the series of bonds is horizontally hexagonal in layers.
4.	Carbohydrate	Cellulose as a source of activated carbon	The activated carbon in this experiment uses raw material for corncob waste, which contains carbon elements and the element that is stored as a cellulose compound. Cellulose is the main carbohydrate compound comprised in the cell wall of green plants that is useful as an absorber because the OH group it has can interact with the components to be absorbed.

4. Student ResponseTest

The assessment of practicum modules is divided into several indicators, including aspects of learning design, module materials, module readability, module visualization, and aspects of NOS. The results give the highest data in the material aspect of 94.3%, and the lowest percentage obtained in the module readability aspect of 86.7% in Table 2.

Table 2. Students' responses to the Practicum Module

No.	Indicator	Score	Criteria
1.	*Content*	94.3	Very good
2.	Visualization	88.0	Very good
3.	Learning Design	90.0	Very good
4.	Readability Module	86.7	Very good
5.	*Nature of science (NOS)*	90.0	Very good

According to the results of interviews with students, the material aspect has a high percentage because the topic discussed in the material is a knowledge that is very relevant to everyday life and by theory and references. Students think these modules will provide benefits for daily life while the readability aspect of the module gets the lowest percentage because there are quite a lot of theories presented. The topic of adsorbents and NOS elements contained in the module is also new for students, so it is quite difficult for students to understand the contents of the module in detail.

Based on the analysis of students' questionnaire responses, an overall aspect average of 89.8% was obtained, which means that the adsorbent practicum module containing NOS is very good and suitable for use as a source of teaching materials in schools [14]. This is because aspects of NOS are relevant to the daily lives of students [21].

CONCLUSION

The reconstruction of the adsorbent practicum module refers to the MER research design, which consists of 3 main parts, including pre-conception analysis of students and teachers, concept analysis of adsorbents, preparation of practicum modules, and student responses. Based on the data obtained from the assessment of students' responses to the adsorbent practicum module, the overall aspect average is 89.8%, which means that the module is very good to be used as a source of learning at school. Through this research, students can find out the extent to which their increased understanding of the nature of science and its benefits for life

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