Development of Chemical Module Based on Science Literacy using the Chemie Im Konteks Stage on Reaction Redox Materials

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Abstract. This research aims to develop e redox reaction module using fireworks context. The method used in this research is the development and validation, adopting stages of the research Chemie Im Konteks. Module product is validated by expert validators. The research instruments are a form to check the integration of content and context, an interview guidelines and module validation format. The result of the research is a module that combines redox reaction content with the context of fireworks. From the validation format, the Content validity Index (CVI) value is 0,919. So that the module produced is very suitable for use in learning.

Keywords: Module, Fireworks, redox reactions.

1 Introduction

The rapid development of science today, either directly or indirectly has affected human life. Science in its activities as science not only demands to be able to understand the universe, but also how science can solve problems and phenomena that exist in everyday life. According to [1] science learning is learning that aims to master applicable and meaningful scientific concepts through learning activities, which in the process emphasizes providing direct, contextual and student centered experience. Chemistry learning can be categorized as one of science learning. For example, in the high school chemistry capytaselecta course, there are several subjects that are relevant to everyday lafe phenomena, such as redox reaction material. Today, the are several redox-related contexts found in chemistry books. Like the corrosion process or apples that turn brown when left in the open. However, from these examples it is necessary to have other contexts that can make the learning process more interesting and memorable [2]. One context that can be raised is fireworks. Fireworks are a well known phenomenon in everyday life. According to [3] in their book ”Chemistry of Pyrotechnics Basic Principles and Theory“, and [4] in their book ”Chemistry of Fireworks“ there are several fireworks phenomena that can be attributed to in chemical content, for example in the constituent components or in the process

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when fireworks are used. There are several components used in the process of making fireworks, such as oxidizing agents and fuels, in which an oxidation-reduction reaction occurs.in other chemical content, there are also some life phenomena that might be taken as context. However, this will be more easily understood by students, when the context is not far from their lives. As in the reasearch conducted by [2] using the context of fireworks with the title ”Using the Chemistry of Fireworks to Engage Students in Learning Basic Chemical Principles: A Lesson in Eco-Friendly Pyrotechnics” conclude that fireworks can it is used for educational purposes, as many aspects of fireworks such as redox reactions, flame colour or combustion theory can be incorporated into the curriculum to illustrate some of the basic principles of chemistry. In compiling the discourse sequence of teaching materials containing scientific literacy content, the following stages of learning were adopted based on the Chemie Im Konteks project in [5] namely the contact, curiosity, elaboration, decisien-making, and nexus stages. Based on the explanation avbove, it is necessary to conduct a research ”Development of Chemistry Module Based on Science Literacy using The Chemie Im Kontext stage on Redox Reaction Material”. The purpose of this research is to produce a valid scientific literacy based chemistry module, so it is hoped that it will be useful for lecturers and students in the learning process.

2 Method

The research method used is development and validations. Includes the Model of Education Reconstruction (MER) [6]. In this study, researchers took components, namely clarification and analysis of scientific content. The structure of the science content is the original text of the three textbooks that have been determined before the basic text is obtained. The population in this study were all Chemistry Education students who took the high school chemistry capytaselecta course. The sample is one class of the population taken by purposive sampling. The validators consisting of chemistry lecturer. Data collection techniques in this study were carried out with module validation formats and student questionnaires. The data was obtained from the validation carried out by the experts. The instrument being validated is the redox reaction module design. The validation results are then calculated using the CVR (Content Validity Ratio) and CVI (Content Validity Index) [7].

3 Result and Discussion

3.1 Indicators and Learning Objectives

Before combining the redox reaction content with the fireworks context, the indicators and learning objectives were formulated. The indicators and learning objectives that are formulated are based on content standards and scientific literacy. KI 2 related to attitude competence consists of KD 1, namely KD 2.3 which includes responsive bahavior in solving problems and making decisions. KI 3 relates to knowledge competence, namely KD 3.9 which contains analyzing the development of the concept of oxidation and reduction reactions and determining the oxidation number of atoms in molecules or ions. In KI 4, the chosen on is KD 4.9 because is is in accordance with the content used, namely the redox reaction. Related to scientific literacy, there are 4 aspects that are used that are interrelated, namely aspects of content, context, competence and attitudes. So overall based on the analysis above, the following indicators and learning objectives are produced:

Table 1. KD 2.3 Demonstrate responsive, proactive and wise bahavior as a manifestation of the ability to solve problems and make decisions

Indicators	Learning Objectives
Show interest in information related to oxidation-reduction reactions using examples from everyday life	Students show interest in information related to oxidation-reduction reactions using fireworks examples
Shows concern for the impact of fireworks	Students show concern for the impact of fireworks
Take the initiative in solving every problem given in learning the material for oxidation-reduction reactions	Students take the initiative in solving every problem given in learning the material for oxidation-reduction reactions through the work of students.

Table 2. KD 3.9 Analyze the development of the concept of oxidation-reduction reactions and determine the oxidation number of atoms in molecules or ions

Indicators	Learning Objectives
Explain the relationship between the components that make up fireworks with the concept of an oxidation-reduction reaction	Students are able to explain how the relationship between the components of fireworks with the concept of oxidation-reduction reactions
Explain the characteristics and functions of the components that make up fireworks (oxidizing agents, fuels, binders and coloring agents) based on scientific phenomena.	Students are able to explain the characteristics and functions of oxidizing agents in fireworks
	Students are able to give examples of oxidizing agents in fireworks and their properties
	Students are able to explain the characteristics and functions of fuel in fireworks
	Students are able to explain the characteristics and functions of binders in fireworks
	Students are able to explain the characteristics and functions of coloring agents in fireworks
Explain the concept of an oxidation-reduction reaction based on the release and attachment of oxygen	Students are able to relate the concept of oxidation-reduction reactions based on the release and binding of oxygen with yhe use of fireworks components
Explain the concept of an oxidation-reduction reaction based on the loss and gain of electrons	Students are able to relate the concept of oxidation-reduction reactions based on the release and binding of electrons with the use of fireworks components
Distinguish between oxidation-reduction equations based on scientific phenomena related to the loss and gain of oxygen with the loss and gain of electrons	Students are able to group examples of oxidation-reduction equations based on the release and binding of oxygen and the release and binding of electrons from the use of fireworks components

Explain the concept of oxidation number	Students are able to explain the concept of oxidation number
Determine the oxidation number of an atom in a molecule or ion based on knowledge of the applicable rules	Students are able to determine the oxidation number of atoms in molecules of fireworks components based on applicable rules
Distinguish between oxidation-reduction equations based on scientific phenomena related to the loss and gain of electrons and changes in oxidation state	Students are able to distinguish the concept of oxidation-reduction reactions from reaction equations based on the release and binding of oxygen, the reelase and binding of electrons and changes in oxidation state from the use of fireworks components.

Table 3. KD 4.9 Conduct, conclude and present the experimental results of oxidation-reduction reactions

Indicators	Learning Objectives
Conducting an oxidation-reduction reaction experiment based on the experimental procedure	Students are able to conduct oxidation-reduction reactions experiments according to the given experimental procedures.
Concluding the results of the oxidation-reduction reaction experiments based on scientific evidence	Students are able to conclude the results of oxidation-reduction reactions based on observations
Presenting the experimental results of oxidation-rduction reactions based on assumptions, evidence and reasons according to the observations	Students are able to present the experimental results of oxidation-reduction reactions based on assumptions, evidence and reasons according to the observations

3.2 Module Design based on the Chemie Im Konteks Stages

Contact Phase. At the contact stage, students are invited by the teacher to get to know the learning context used, which is related to fireworks, especially the constituent components that cause certain effects from fireworks. Through the introduction of the context of fireworks, it is hoped that students will have a great curiosity, because basically these contexts are often encountered in their daily life, so that fireworks are not only used as entertainment but also can provide benefits for them in terms of science, knowledge especially chemistry.

Elaboration Phase. At this stage, exploration, formation and consolidation of concepts are carried out until the questions at the curiosity stage can be answered. Through this stage the various abilities of students will be explored more deeply, both aspects of knowledge, process skills as well as attitudes and values. The development of the text at this stage is based on indicators and learning objectives on the cognitive and attitude aspects that have been determined.

Decision Making Phase. The decision making stage is obtained after analyzing and evaluating the existing problems. This stage emphasizes the answers to the questions contained in the curiosity stage. Students are invited to explore their answer regarding how the components that make up fireworks relate to the concepts of oxidations-reduction reactions.

Nexus Phase. In the nexus stage, there are two phases, namely decontextualization and recontextualization. The presentation of the composition of the text discourse that has been describes in the textbook is summarized for the process of extracting the essence (decontextualization). Furtheremore, concept development is carried out with a wider learning context (recontextualization), meaning that tha same problem, which is related to redox reactions, is given in a different context which requires the same concept of knowledge to be solved. This concept development stage is important so that students understand that the concepts that have been learned can be used as a basis for solving other problems so that a meaningful learning process is expected.

3.3 Validator's Assessment

The assessment process is based on five points, (1) the accuracy of the content of the material (content and context), (2) the suitability of the content and the context, (3) the suitability of the material with the curriculum (learning objectives), (4) the accuracy of the illustrations/symbols/experiment and (5) eligibility for use by students. The results of the expert's assessment were calculated using the CVI (Content Validity Index) formula. The CVI assessment is based on 2 categories, namely based on learning objectives and based on the stages of decontexttualization and recontextualization. Both assessment can be seen in Table 4, Table 5 and Table 6.

Table 4. Assessment of textbook CVI base on learning objectives

Point	(1)	(2)	(3)	(4)	(5)
CVR	0,852	0,802	0,874	0,866	0,872
CVI			0,857		

Table 5. The CVI assessment of textbook is based on the stages of decontexttualization and recontextualization

Point	(1)	(2)	(3)	(4)	(5)
CVR	0,928	1	1	1	1
CVI			0,982		

Table 6. The CVI

Point	(1)	(2)
CVI	0,857	0,982
CVI	0,919	

Based on the CVI value obtained, interpreting that the resulting module is suitable for use in learning.

4 Conclussion

Based on the results and analysis of research data, the authors can make the following conclussions: (1) it was found that in making a mapping as a combination of redox reaction content with the context of fireworks starting from the formulation of indicators and learning objectives, as well as making basic texts developed through the Model of Educational Reconstruction (MER). (2) The CVR values of the developed textbooks were 0,857 and 0,982, so that the value of the CVI of the textbook is 0,919, interpreting that the resulting module is suitable for use in learning.

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