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DEVELOPMENT OF SCIENCE TEACHING MATERIALS USING INQUIRY BASED LEARNING MODEL ENHANCED AUGMENTED REALITY ON ELEMENTS, COMPOUNDS, AND MIXTURES TOPICS TO DEVELOP CRITICAL THINKING SKILLS OF CLASS VII SMP STUDENTS

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Abstract

Material elements, compounds and mixtures are abstract material so that students have difficulty understanding the material. This difficulty is also caused by less attractive learning media. To improve students' critical thinking skills, teaching materials with the help of the media are needed. Media suitable for elements, compounds and mixtures is augmented reality (AR) because it can visualize abstract material. Inquiry based learning is a learning model that is very appropriate for teaching materials using media such as augmented reality (AR). The application of learning using inquiry based learning shows positive results on students' critical thinking skills, especially in science learning. This study aims to produce teaching materials with an inquiry based learning model enriched with augmented reality on elemental material, compounds, and mixtures to develop students' critical thinking skills. Validation test of teaching materials by media expert validators and material experts. Then donevalidation on students. Research and development use the Lee & Owens development model. Research and development are limited to the first three stages, namely assessment / analysis, design and development. The data generated from the validation test and the legibility test state that the teaching materials developed are feasible to be produced.

Keywords: *Inquiry-Based Learning Model, Augmented Reality (AR), Critical Thinking*

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INTRODUCTION

Elements, compounds, and mixtures are chemical science materials that are abstract because they cannot be seen directly (Ikhtiarini & Lutfi, 2012). Learning on elements, compounds, and mixtures needs to be emphasized so that students better understand the material. Understanding the concept is the foundation of higher order thinking skills, namely critical thinking. Critical thinking is the process of compiling an analysis and evaluating the information gathered for observation, so that it can determine action. Critical thinking is needed by students during learning to filter information and have critical and logical thinking in order to be able to work together and get solutions to the problems that have been described (Syahbana, 2012).

Tri Winarto's research results (2012) state that the material elements, compounds, and mixtures are categorized as difficult subject matter so that the average student is not interested in these materials (Tri Winarto, 2012). This condition causes no critical thinking process by students regarding elements, compounds, and mixtures (Snyder & Snyder, 2008). Students' difficulties are exacerbated by learning that only uses pictures so that explanations are not contextual. The teacher does not direct to solve problems (Nurkhasanah et al., 2019).

Research by Krismawati et al (2018) on the analysis of the needs of teaching materials concluded that students need detailed textbooks for the learning process. Another study by Sihombing & Marheni, (2012) regarding the analysis of needs in learning to develop science teaching materials in junior high schools, concluded that the learning process requires contextual textbooks. The results of interviews with teachers of SMP Negeri 8 Malang indicated that learning in class only used textbooks and that the contents of the material in textbooks were also limited. Then the results of interviews with students concluded that students felt difficulties with science material that could not be sensed, for example material elements, compounds, and mixtures. From the research results of Krismawati, et al. (2018) and Sihombing & Maheni (2012) and the results of the interview, it is concluded that the learning process in the classroom really needs teaching materials so that students can focus on the material being taught.

Based on the problems described, teaching materials are needed to develop students' critical thinking processes. Teaching materials are student learning resources independently, which contain material according to competencies for students to learn in the learning process (Efendhi & Susilowibowo, 2013). However, the

teaching materials need to support the media and learning models that have been suggested to improve students' critical thinking.

Several studies have been conducted to overcome the low mastery of concepts or critical thinking on elements, compounds and mixtures. The jigsaw type cooperative learning model (Haryanto, et al. 2015) and the STAD type cooperative learning (Israil, 2019) successfully overcome conceptual mastery or critical thinking on elements, compounds, and mixtures. Learning media for computer-based castle of element games (Ikhtiarini & Lutfi, 2012), information technology and hypertext (Allo, et al. 2010), and e-books based on multiple representations (Marsiyamsih, et al. 2019) successfully overcome the mastery of concepts or critical thinking in matter elements, compounds, and mixtures. From these studies, it appears that teaching materials are rarely used as a medium to improve critical thinking on elements, compounds, and mixtures.

Augmented reality (AR) is a learning instrument that is in accordance with the abstract nature of material elements, compounds, and mixtures that can support the learning process and have a positive impact. By learning using augmented reality (AR) media students become very motivated to learn and can implement concepts in everyday life. Abstract elements, compounds, and mixtures and the ability of augmented reality to be able to present objects in real time require an appropriate learning model, namely inquiry based learning. Inquiry based learning enriched with augmented reality (AR) is learning that starts from an investigation in order to get the facts, concepts, and procedures needed. The application of learning using inquiry based learning shows positive results on students' critical thinking skills, especially in science learning (Uswatun & Rohaeti, 2015).

Based on the above problems, the development of science teaching materials with an integrated inquiry-based learning model of augmented reality on the topic of elements, compounds and mixtures was carried out to develop the critical thinking of seventh grade junior high school students.

METHOD

The method used is the Lee and Owens development method. This method is suitable for multimedia-based development (Lee & Owens, 2004). Research and development is limited to the first three stages due to time and cost limitations. The three stages are assessment / analysis, design and development. Retrieval of research data was carried out by testing the validation of teaching materials by media expert validators and material experts from one of the lecturers of FMIPA State University of Malang and a science teacher at SMPN 3 Singosari. The next stage was a readability test by students. The material, media, and readability validation test instrument used a Likert scale with 4 ratings, namely strongly agree, agree, disagree, and strongly disagree. The instrument for testing the validation of the concept of truth uses the Guttman scale with a rating of 1 for true and 0 for false. The assessment questionnaire was conducted online via google form. The statement of the material validation test questionnaire contains basic competencies (KD) and the steps of inquiry based learning. The concept validation questionnaire contains the truth of the concept of elements, compounds, and mixtures. The validation test questionnaire contains the presentation of the cover design, content design, animation on the material, and 3D markers. The student readability test questionnaire contains the readability of teaching materials, and the readability of the augmented reality application. The data from the questionnaire were in the form of quantitative and qualitative data. Qualitative data from the results of suggestions and comments on the questionnaire. Quantitative data from the media validation test, material and readability are calculated using the following formula.

$$P = \frac{\sum x}{n} \text{ x } 100\%$$

Description

P = the total score of the assessment results by each validator

$\sum$ x = the total score of each parameter item result of the validator

n = the maximum score of the validation results

With the average analysis score interpretation criteria written in Table 1.

Table 1. Interpretation of the Mean Analysis Score

Percentage (%)	Criteria
0-20	Very weak / unworthy / invalid
21-40	Weak/ Less worthy/ Less valid
41-60	Pretty weak/ Pretty worthy/ pretty valid
61-80	Strong/ eligible/ valid
81-100	Very good / very worthy / very valid

(Riduwan, 2012)

The steps of inquiry based learning on teaching materials and activities that students must do are described in Figure 1.

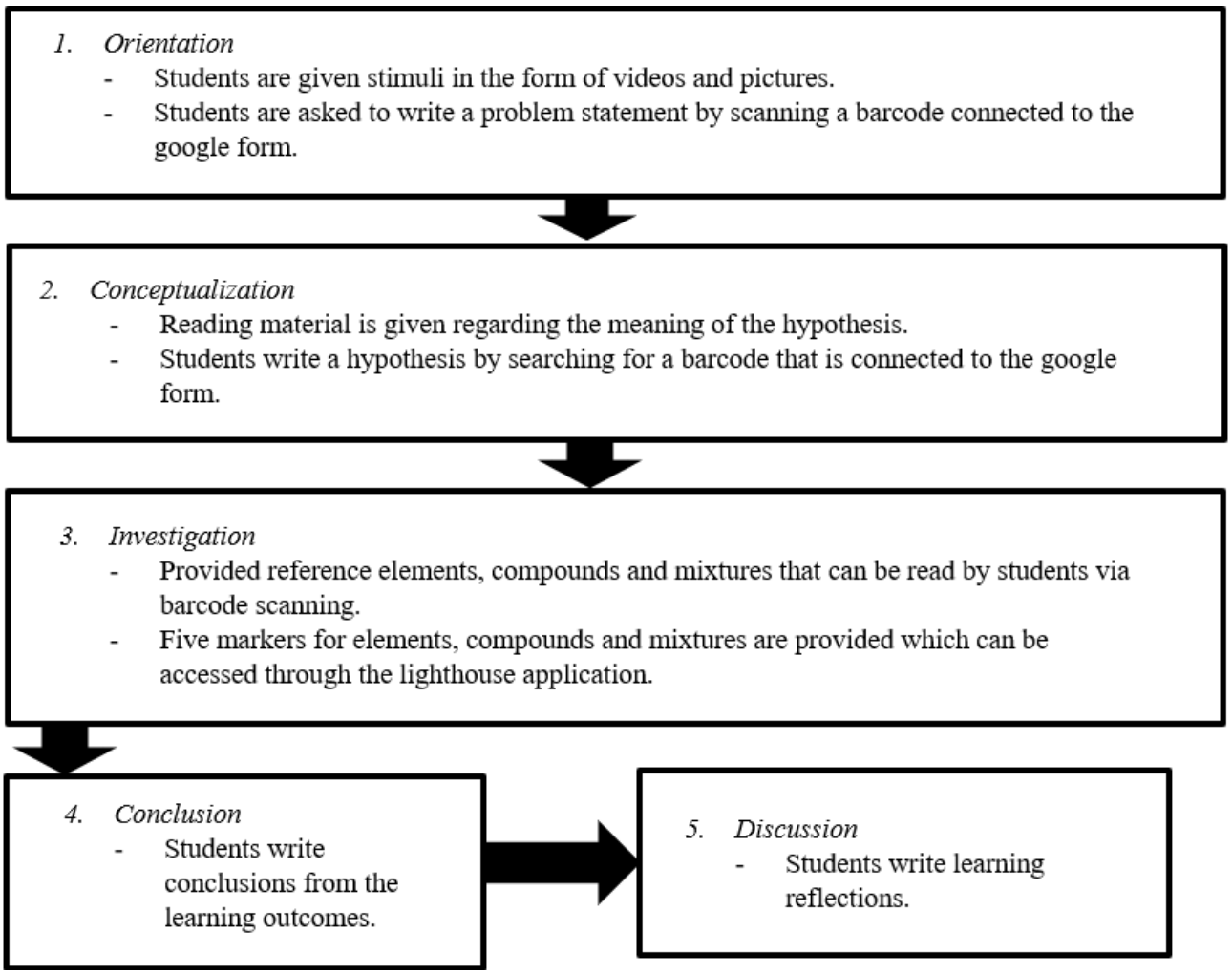

Figure 1. Syntax of the Inquiry Based Learning Model enriched with Augmented Reality material elements, compounds, and mixtures

RESULTS AND DISCUSSION

The data from the validation test results and the readability test questionnaire were processed to determine the validity of the teaching materials that had been developed. The results of processing the validation test data and readibility test questionnaires are shown in Table 1.

Table 1. Results of Validation Test Data Processing and Readability Test Questionnaires

Data analysis	Score	Criteria
Material Validation Test	77	Worthy
Validation test for the correctness of the concept	100	Very worthy
Media Validation Test	84	Very worthy
Readability Test Questionnaire	90,4	Very worthy

From the results of Table 1, it is found that research data and product development of teaching materials produce book products that must be tested for validity and feasibility by validating. The first validation that is done is material validation. Material validation aims to determine the correctness and appropriateness of the contents of the material in the teaching materials being developed. The results of the validation by material experts as a whole obtained a score of 77 with worthy criteria. Furthermore, the conceptual truth test was carried out and obtained a score of 100 with very worthy criteria for use in learning material elements, compounds, and mixtures. Then media validation is carried out by media experts which

aims to determine the feasibility of the media that has been developed to be fit for production. The results of the validation of the developed media got a score of 84 with very worthy criteria for use.

The readability test was carried out by 10 students of junior high school / madrasah tsanawiyah who had received subject matter topic elements, compounds and mixtures. The results of the overall student readability test were very worthy with a score of 90.4. One of the students' comments regarding the teaching materials being developed is that they feel like the teaching materials that are developed because of their easy use and the packaging is very interesting so they do not get bored to learn. Based on the results of the validation test and the readability test questionnaire, it was found that inquiry based learning was enriched with augmented reality on the subject matter of the topic elements, compounds, and mixtures which could improve students' critical thinking (Uswatun & Rohaeti, 2015) The results of the validity of the teaching materials that have been developed show very feasible results with an average score of 87.8.

Teaching materials with an integrated augmented reality inquiry-based learning model make it easier for students to understand abstract concepts because the teaching materials display the concepts of elements, compounds, and mixtures in the form of augmented reality three-dimensional animation to develop students' critical thinking. In addition to the three-dimensional animated display, these concepts are presented in text form or in the form of student worksheets. The results of developing science teaching materials with an integrated inquiry based learning model of augmented reality can develop students 'critical thinking in accordance with the results of research by Duran & Dökme (2016) which explains that inquiry based learning is able to develop students' critical thinking, especially in science subject matter.

Teaching materials developed in the form of student books and teacher books. The difference between the two is in the teacher's book that can access the google form from the results of student discussions. Then the features in the Mersusuar application or augmented reality application are the Ar menu to see animated elements, compounds, and mixtures, and a quiz to test students' learning abilities shown in Figure 2.

Figure 2. Augmented Reality application features

CONCLUSION

Based on the above problems, to develop critical thinking skills students can use teaching materials with an inquiry based learning model enriched with augmented reality on the topic of elements, compounds and mixtures. The results of the development of teaching materials show that it is valid and feasible to produce from the results of the validation test by lecturers and teachers. The overall validation result is 87.8 with very feasible criteria. Students also feel happy with the teaching materials developed because they are interesting and not boring.

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