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RESEARCH ARTICLE

CONTENT AND LANGUAGE FEASIBILITY COMPONENT OF PHYSICS TEXTBOOK BASED ON IVM REPRESENTATION TO TRAIN CRITICAL THINKING SKILL OF VOCATIONAL STUDENTS.

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Abstract

Aim: the objective of this article is to describe content feasibility and language feasibility physics textbook based on IVM representation to train critical thinking skill vocational students. IVM representation stands for image, verbal, and mathematical representation which is one of multirepresentation approach variation. This research is a development research. Content feasibility can be seen from the logic validation of three validator to physics textbook based on IVM representation, and supported by empirical validation in the form of improvement of students' critical thinking skill. Language feasibility can be seen from the logic validation from three validator to physical textbook based on IVM representation, and supported by empirical validation in the form of legibility of textbook. Based on the data got, content feasibility covers alignment with Core Competency and Basic Competency, lesson, alignment with student development and society need, knowledge substance, and life skill, insight to advance and work out, and deverse of social value, it is seen from logic validation that has enough category. Empirical validation shows that critical thinking skills for four indicators, namely analysis, inference, interpretation, and evaluation are in high category. Language feasibility that includes readability, conformity with good and correct Indonesian language rules, and language logic has a value of 80.56% and categorized as valid. Empirical validation with legibility test included in the high category, so that the language feasibility physics textbook based on IVM representation is considered feasible.

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Introduction:-

Science education has an important role in improving the quality of education in accordance with the challenges of education in the era of globalization. One of the most important parts of science is physics. According to Druxes (1986: 3) physics is a lesson about natural events that allows research by systematic testing and based on general rules. The essence of physics includes two parts, namely physics as a product and physics as a process. Physics as a product includes a collection of knowledge consisting of facts, concepts, and principles of physics. Physics as a process includes the skills and attitudes possessed by scientists to acquire and develop physics products. These skills are process skills, while the attitudes possessed by scientists are known as scientific attitudes (BSNP, 2006).

Physics learning is not only given to students in the form of facts and concepts, but students are also trained in finding facts and concepts through scientific processes and attitudes. Critical thinking skills become one of the way students find facts and concepts. Critical thinking skills is one form of high-order thinking skills. The results of TIMSS (Trends in Mathematics and Science Study) conducted by IEA (International Association for the Evaluation of Educational Achievement) in 2015 in the field of Physics shows Indonesia received an average value of 397 where this value is below the international average of 500. Based on TIMSS result, it can be said that the critical thinking skill of Indonesian students is still low. This can happen because in the learning process students are less stimulated to improve critical thinking skills.

Critical thinking skills is one of the eight competencies and / or expertise that must be possessed by 21st century human resources, as mentioned by the National Education Standards Agency (BSNP) 2010. BSNP mentioned that one of the eight competencies that must be possessed by human resources the 21st century is a critical thinking and problem-solving skills which includes critical, lateral, and systemic thinking skills, especially in the context of problem-solving. Therefore, critical thinking skills become very important for students so as to compete with human resources around the world.

Critical thinking skills is one of the most indispensable skills in problem solving. A person who thinks critically has a special character that can identified by looking at how a person is addressing a problem. The information or arguments of those characters appear to be in the habit act, argue and exploit its intellect and knowledge. According to Facione (2011), there are six major critical thinking skills involved in the critical thinking process. These skills are interpretation, analysis, evaluation, inference, explanation and self regulation.

The result of open discussion between physics subject teachers in Agricultural Vocational Highschool Tegalampel Bondowoso, there are several reasons why many students who do not have critical thinking skills in solving physics problems provided by the teacher are: (1) lack of trained students to think critical in solving the problems that exist in the learning process, (2) physics subject teachers have not much knowledge of innovative learning media and difficulty finding the right strategy so that students with low ability can actively learn with limited facilities and learning resources, (3)). the level of ability of physics subject teachers has not been much in developing learning media that can train students critical thinking skills and (d) time limitation of physics subject teachers to be able to provide learning media in training critical thinking skills in solving student problems. Therefore required a learning media that can train students' critical thinking skills.

One of the learning media that can support learning and can practice critical thinking skills is textbook. The textbook is a book that is used in a particular field of study, which is a standard book compiled by experts in the field for instructional purposes and objectives, complemented by harmonized and understandable teaching tools by the wearers in the schools and colleges so as to support a teaching program (Suharjono, 2008: 83). Mahardika (2012: 23) mentions that the textbook as a teaching material is a book that contains a science of the results of analysis of the curriculum in written form. A good textbook by Situmorang (2013) should be able to motivate learners by making use of interesting things such as pictures, illustrations, case examples, having sufficient material to support teaching, and can be used to support problem-solving activities.

Textbooks that can train students' critical thinking skills should use the right approach. One approach that can be used is the multirepresentation approach because in physics learning, students are required to possess different representations (experiments, graphs, conceptual, formulas, diagrams) (Mahardika, 2013). IVM representation is one variation of multirepresentation approach . The representations in question include image representation, verbal representation, and mathematical representation. The advantage of this IVM Representation is to put the image representation at the beginning of most of the material in textbooks , followed by verbal and mathematical representations. Representation of the image at the beginning of the discussion of the material will attract and arouse students' curiosity to know the content of the material presented. A great curiosity will lead the students to read the verbal and mathematical representations presented after the image representation. Hanna et al (2016) mentions that the media images used in the learning process other than aim to attract attention and encourage students also function to facilitate communication that is difficult to imagine by students to a concept or material, so that the learning process is effective.

One important aspect to be considered in developing a teaching material, including textbooks is the content feasibility aspect. Content feasibility component may include alignment with Core Competency and Basic

Competency, alignment with the child's development and needs of the people, the substance of science and life skills, insight to both developed and developing, and also diversity social values. Content feasibility important in order for the concept of physics can be well understood. In addition, to create a teaching material interesting, efficient, and easy to understand, in the development of physics textbooks with IVM - representation based is important to pay attention to the language feasibility of the textbook. Components of language feasibility including readability, conformity with good and proper Indonesian language rules, and language logic

Based on the description, then the formulation of the problem in this study is how the level of content feasibility and the language feasibility of physics textbook with IVM representation to train critical thinking skills of vocational students .

Method:-

This paper is based on a study of development, which is developing a physics textbook based on IVM representation to train critical thinking skills of vocational students. The design of this development research refers to the 4-D development model. Data collection techniques used in this study were tests, questionnaires, observations, interviews, and documentation. Content feasibility can be seen from the logic validation of three validator to physics textbook based on IVM representation, and supported by empirical validation in the form of improvement of students' critical thinking skill. Language feasibility can be seen from the logic validation from three validator to physical textbook based on IVM representation, and supported by empirical validation in the form of legibility of textbook. The test site is at Agricultural Vocational Highschool Tegalampel Bondowoso. Subjects in this research are students of class XI A ATPH first semester of the school year 2017/2018.

Result and Discussion:-

This study is a part of the development research that aims to obtain a physics textbook based on IVM representation that is able to train critical thinking skills of vocational students . Description of physics textbook based on IVM representation to training critical thinking skills consists of three chapters: vibration, waves, and sound , static electricity and dynamic electricity , and magnetism. Cover page contains the title of physics textbooks for vocational high school, ladder education intended for the use of physics textbooks based on IVM representation , and the author of textbooks . The page for each chapters contain the title of the learning material, chapter 1 (vibrations, waves, and sounds), chapter 2 (static electricity and dynamic electricity), and chapter 3 (magnetism). The introduction contains briefly the contents of the textbook and Core Competency and Basic Competency each material. The table of contents includes content of physics textbook based on IVM representation and their pages. Learning materials include learning objectives, concept maps, prerequisites, ability checks, explanations of material concepts learned, let's practice critical thinking, sample questions, exercise questions, summaries, and test learning outcomes. Bibliography contains literature sources used in the preparation of physics textbook based on IVM representation.

Data of logic validation from physics text book of grade XI vocational high school odd semester is obtained from validation of content feasibility and language feasibility of textbook by three validators who are experts in the field of physics learning. The validation result of the content feasibility and the language feasibility of physics textbook grade XI vocational high school odd semester can be seen in Table 1 .

Table 1:- The validation result of the feasibility of physics textbook based on IVM representatio

No	Assessment	Rating Result			Average	Criteria
		Validator 1	Validator 2	Validator 3		
1	content feasibility	75%	75%	85%	78,33%	Quite valid
2	language feasibility	75%	75%	91,67%	80,56%	Valid
Overall Value		75%	75%	88,34%	79,45%	Quite valid

The content feasibility assessment includes alignment with Core Competency and Basic Competency subjects, alignment with the development of children and the needs of society, the substance of science and life skills, insights to move forward and develop, and diversity of social values. Language feasibility assessment includes readability, conformity with language rules Indonesia is good and right, and the logic of language. The data result of that assessment obtained in the form of quantitative and qualitative data. Quantitative data in the form of assessment questionnaire, while the qualitative data includes responses, suggestions, criticisms, and conclusions in

general against physics textbook on IVM representation of the validator. Data quantitatively analyzed by calculating the value of the questionnaire then obtained degree category content feasibility and language feasibility of physics textbooks based on IVM representation.

Data of development test result obtained by doing development test in grade XI A Agricultural Vocational Highschool Tegalampel Bondowoso to improve student's critical thinking skill. Development test carried out in 3 cycles. Implementation of learning for three cycles using physics textbook grade XI vocational student odd semester based on IVM representation assessed by three observer that is teacher at Agricultural Vocational Highschool Tegalampel Bondowoso. The result of observation of the implementation of learning can be seen in Table 2.

Tabel 2:- Implementation of Learning

No	Cycle	Average Value	Category
1	Cycle 1	82,50	Good
2	Cycle 2	80,83	Good
3	Cycle 3	82,50	Good

The data of students' critical thinking skill is used to find out the improvement of critical thinking skill of students in cycle 1, cycle 2, and cycle 3, as data supporting the content feasibility physics textbook based on IVM representation. Value of students' critical thinking skills (pre-test and post-test) in each cycle can be seen in Table 3

Table 3:- Values of pre-test and post-test of students on cycle 1, cycle 2, and cycle 3

No	Critical thinking skill indicator	Average Value					
		cycle 1		cycle 2		cycle 3	
		Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
1	Analysis	4,84	15,24	5,54	15,51	5,17	15,93
2	Inference	3,97	14,83	4,98	16,79	6,23	15,98
3	Interpretation	5,21	16,39	4,83	16,63	8,30	30,93
4	evaluation	10,19	29,75	12,39	28,61	6,19	16,79

Furthermore, the mean value of students' critical thinking skills is used to determine the improvement of students' critical thinking skills using physics textbooks based on IVM representation through N-gain as shown in Table 4 .

Tabel 4:- N-gain each cycle

No	Critical thinking skill indicator	N-gain					
		Cycle 1	Category	Cycle 1	Category	Cycle 1	Category
1	Analysis	0,6869	Medium	0,6895	Medium	0,7256	High
2	Inference	0,6775	Medium	0,7889	High	0,7081	High
3	Interpretation	0,7559	High	0,7779	High	0,7139	High
4	evaluation	0,6562	Medium	0,5875	Medium	0,7676	High

The readability test of physics textbook is done through the cloze test. The cloze in the form of a sentence that removed its parts (word). The readability test is performed to measure feasibility language physics textbook based on IVM representation . Results of readability tests on each cycle can be seen in Table 5 .

Tabel 5:- Result Of Readability Test Each Cycle

No	Cycle	Value of readability	Category
1	cycle 1	81,84	High
2	cycle 2	87,11	High
3	cycle 3	88,94	High

Discussion:-

Discussion of research results discusses the development of physics textbook based on IVM representations that have been described previously. The results of this study is a product of the content feasibility and the language feasibility of physics textbook based on IVM representation. The quality of physics textbook based on IVM representation is declared valid categorized physics textbook that has been through the stage of experts validation (logic). The average feasibility assessment result of validator is 79 , 45 % , so it can be used for development test in class.

Development phase of physics textbook based on IVM representation consists of expert validation (logic) and development test. Expert validation process is done before the researcher do the development test. During the validation process, made some revisions to the components of the textbook in accordance with the suggestions and criticisms validator. The validation process is done because there are still shortcomings or errors that need to be corrected in the textbook developed in order to obtain a physics textbook based on IVM representation with a valid category. The validator provides suggestions for improving several sentence arrangements, improving the order of representational representations in textbooks improving the selection of images on the book's cover with images corresponding to the conceptual material in textbooks , learning objectives and questions must be in accordance with Core Competencies and Basic Competencies in the 2013 curriculum, as well as adding critical thinking exercises to textbooks. Based on expert validation, it is concluded that physics textbooks based on IVM representation can be used with small revisions.

The development test was conducted on the students of grade XI A ATPH Agricultural Vocational Highschool Tegalampel Bondowoso in the odd semester of academic year 2017-2018, using one-group pretest-posttest design , that is research design using one group of respondents then conducted data retrieval in the form of test score before treatment (pre-test), and after treatment (post-test). Development tests are conducted with three cycles or three meetings. The first cycle learning material is vibration, the second cycle is the wave, and the third cycle is the sound. Each lesson is observed the implementation of learning by three observers, namely teachers at Agricultural Vocational Highschool Tegalampel Bondowoso.

Assessment from expert validation indicates the content feasibility component that includes alignment with Core Competency and Basic Competency, alignment with child development and community needs, scientific substance and life skills , insight to progress and develop, and diversity of social values. Expert validation assessment results for the content feasibility component has a value of 78 , 33 % and categorized quite valid. While the test results development is demonstrated through the improvement of students' critical thinking skills that are analyzed through N-gain in each cycle. Once analyzed, the N-gain analysis thinking skills in the first cycle of 0,6869 so that the category is medium, N-gain inference skills of 0,6 775 so that the medium category, N-gain interpretation thinking skill of 0,7559 so that the high category, and N-gain evaluation thinking skills of 0.6 861 so that the medium category. Physics textbooks based on IVM representation are considered feasible if N-gain is in the high category . N-gain thinking skill analysis on cycle 2 is 0,6895 so that it is medium category, N-gain inference thinking skills by 0,7889 so that the high category, N-gain the skills to think the interpretation of 0,7779 so that the high category, and N-gain skills evaluation of 0,5875 so that the medium category. In the third cycle, the N-gain analytical thinking skills at 0,7256 so high category, N-gain of inference thinking skill is 0, 7081 so that the categorization is high, N-gain of interpretation thinking skill is 0,7139 so categorized high, and N-gain thinking skill evaluation is 0, 7676 so categorized high . Based on the value of N-gain that shows the high category on the four indicators of critical thinking skills , it can be concluded that the physics textbook can improve students' critical thinking skills , so it is not need to be tested again in the next cycle. Improving critical thinking skills from the first cycle to the third cycle can be achieved because each end of the cycle is always done a reflection to improve the next cycle. In addition, students have also started to get used to the critical thinking exercises given in textbooks.

Components of language feasibility covering legibility, conformity with good and correct Indonesian language rules, and language logic has a value of 80.56% and categorized as valid. Development tests were also conducted to assess the degree of readability of physics textbooks based on IVM representation. The readability test of the first cycle earns an average of 81,84 and is included in the high category. The readability test of the second cycle earns an average of 87,11 and is included in the high category. The readability test of the third cycle is higher than the cycle previously that is equal to 88, 94, so it can be concluded that students can easily read and comprehend language instructional books.

Physich Textbook is very suitable as teaching material in the process of learning physics because in harmony with what is disclosed Angela, Marvin, and Darvina (2013), that the textbook is very beneficial use in learning, which can be speed up discussion of the study materials, students can learn material the study will be taught early, the theories conveyed by the teacher that can not be understood in the class, the students can learn back from the textbook, and with the textbook, if there is a task to be done at home students already have one reference for do it . The advantages of using textbooks are also in accordance with the subjects of physics, which is a subject that trains the learners to be able to dominate the knowledge, concepts and principles of physics, have scientific skills and have skills in building their own knowledge. Development of the book as a teaching material also

participate in supporting the development of the current learning process, where a teacher acts as a facilitator so as to facilitate the needs of the students as much as possible.

The material in physics lessons is never separated from verbal, mathematical, and images. Even often also equipped with graphics. That is, multirepresentation approach is absolutely necessary in understanding the concepts of physics. The IVM representation approach is part of a multirepresentation approach. The IVM representation approach can also be said to be one of the variations of multirepresentation approach. The advantage of this IVM representation is to put the image representation almost at the beginning of the material explanation, followed by the verbal and mathematical representation. Image representation at the beginning of the material discussion will attract and arouse students' curiosity to know the content of the material presented. A great curiosity will lead the students to read the verbal and mathematical representations presented after the image representation. Hanna et al (2016) mentions that the images media used in the learning process other than aim to attract attention and encourage students also serve to facilitate communication that is difficult to imagine by students to a concept or material, so that the learning process is effective. Therefore, be elected format IVM representation in developing textbook of physics for vocational student.

Critical thinking skills are also selected as variables in the development physics textbooks based on IVM representation. Critical thinking skills are chosen because they are one of the eight competencies that must be possessed by 21st century human resources that is critical thinking and problem-solving. These competencies include the ability to think critically, laterally, and systemically, especially in the context of problem solving. Therefore, critical thinking skills become very important trained for students so as to compete with human resources around the world. After the development test, improving students' critical thinking skills using physics textbooks based on IVM representation has high categories for all four indicators, including analytical thinking, inference, interpretation, and evaluation thinking skills. The results are in line with the results of research by Widianingtiyas (2015) found that research using multi-representation approach in physics learning can improve students cognitive ability. The ability to think critically is one part of students' cognitive abilities. Lestari's research (2015) also shows that the implementation of multirepresentation-based learning can improve students' conceptual understanding and critical thinking skills. Therefore, the IVM representation approach seems appropriate for use in physics learning to train students' critical thinking skills.

Learning using physics teaching materials in the form of textbooks based on IVM representation can make it easier for students to understand the concept of physics. A textbook will be meaningful if students can easily use it. However, the success of learning using physics textbook based on IVM representation can not be separated from the constraints faced. One of the obstacles faced is the physics teaching book is a printed material that will be easily lost or damaged if students do not use and store it.

Conclusion:-

Based on the data obtained on the results and discussion of the development of physics textbooks based on IVM representation which has been described in the previous chapter, it can be concluded as follows. (1) content feasibility covering alignment with Core Competence and Based Competency of subject, alignment with child development and community needs, scientific substance and life skills, insight to progress and develop, and diversity of social values, seen from logic validation has category quite valid. When viewed from the empirical validation through test improvement development of students' critical thinking skills, included in the high category. (2) The language feasibility which includes readability, conformity with good and correct Indonesian language rules, and logic of language, seen from logic validation has valid category. When viewed from the empirical validation through the test of readability test has a high category.

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