



FEASIBILITY TEST OF CRITICAL THINKING SKILLS ON HIGH SCHOOL STUDENTS IN STATIC FLUID MATERIAL

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ABSTRACT

This study aims to develop critical thinking instruments in high school students with static fluid material. The development model used in this study is the Analysis-Design-Develop-Implement-Evaluate (ADDIE) learning design model. The subjects of this study were 90 students of XI MIA class in MAN 1 of Medan. The research methods used were interviews, tests, questionnaires, and documentation. The developed test instrument consisted of a grid of test questions, questions, answer sheets, answer keys and scoring guidelines, and guidelines for interpretation of results. Validity test used is content validity test. The results of the validity test by three expert validators showed that the critical thinking test instrument developed was valid. The reliability of the questions developed was 0.82, which means a reliable test item. There are 15 questions, and 12 questions are used for limited scale tests, 10 questions are used for broad scale tests.

Keywords: *critical thinking skill, multiple choice, static fluid.*

INTRODUCTION

According to the National Education System Law No. 20 of 2003, education is a conscious and planned effort to create an atmosphere of learning and learning process so that students actively develop their potential to have spiritual strength, self-control, personality, intelligence, noble character, and the skills needed by himself, society, nation and state (Hadijah, A 2016). Referring to Government Regulation Number 19 of 2005 concerning National Education Standards, the learning process in the education unit is held interactively, inspiratively, fun and challenging, motivating students to participate actively. The Education Unit Level Curriculum (KTSP) also requires students to have certain competencies

in all subjects after the learning process. Competence is the ability to think, act and behave consistently as an embodiment of knowledge, skills and values Education is important in shaping the next generation of qualified nation in the present and in the future. The development of science and the development of learning outcomes instruments are very influential and important in the world of education.

Educational assessment according to Permendiknas Number 20 Year 2007 about educational assessment standards is the process of gathering and processing information to determine the achievement of student learning outcomes. Van De Walle in Agus and Jailani (2014) states that the principles and standards of assessment emphasize two main ideas namely

assessment must improve student learning and assessment is a valuable tool for making teaching decisions. Assessment of learning outcomes by educators is carried out on an ongoing basis aimed at monitoring the process and progress of student learning and to improve the effectiveness of learning activities. Assessment of learning outcomes by education units is carried out to assess student achievement in all subjects. Assessment of learning outcomes by the government is carried out in the form of national examinations. Aims to assess the achievement of graduate competencies nationally. In certain subjects in groups of science and technology subjects.

Critical thinking can be interpreted as the processes and abilities used to understand concepts, apply, synthesize and evaluate information obtained or information produced. According to Facione (2010) the core of critical thinking skills includes interpretation, analysis, inference, evaluation, explanation and self-regulation. Assessment is not just about data collection of students but also its processing to obtain an overview of the process and learning outcomes of students. Assessment does not just give students a question then finish, but the teacher must follow up for the sake of learning.

To carry out the assessment, the teacher needs an assessment instrument in the form of questions both to test cognitive abilities, affective and psychomotor. Assessment is a very important activity in learning physics. Assessment can provide constructive feedback for both teachers and students. The results of the assessment can also provide motivation for students to perform. Even assessment can influence learning behavior because students tend to direct their learning activities towards the estuary of assessment conducted by the teacher. The quality of learning achievement assessment instruments directly influences the accuracy of the achievement status of students' learning outcomes. Therefore the position of the instrument for evaluating learning outcomes is very strategic in the decision making of teachers and schools related to achievement, learning outcomes of students including high-level thinking skills.

Physics according to Permendiknas No. 22 of 2006 attachment 3, is one of the branches of science that underlies the development of advanced technology and the concept of living in harmony with nature. The rapid development in the field of information and communication technology today is triggered by findings in the field of material physics through the discovery of microelectronic devices that are able to load a lot of information with very small sizes. Physics is important to be taught as a subject at the high school/ Madrasa Aliyah level because Physics as a vehicle to foster the ability to think that is useful for solving problems in daily life and equip students the knowledge, understanding and a number of abilities required to enter the level of education that higher and develop science and technology. According to Chodijah et al., (2012) the purpose of learning physics is that students can understand, develop observations and carry out experiments related to natural phenomena involving substances (matter) and energy, so as to foster awareness and understanding of the greatness of Allah SWT the lord of the universe. While according to (Yulianti & Dwijananti, 2015) learning physics is an active process, so students must be given the opportunity to explore understanding, develop thinking skills and science process skills including scientific inquiry.

Static fluid is one of the subjects in physics that is very related to daily life and is very factual which is certainly very interesting to learn and apply in everyday life. In general it is hoped that physics will no longer be feared by most students, but rather becomes a subject that is sought, liked, and mastered as one of the bases of support in the advancement of technology in the future. The assessment instrument is part of the assessment process in doctor and heller learning in Amalia & Endang, stating that assessment acts as a process assessment program, learning progress and student learning outcomes. Assessment instruments include tests and assessment systems. The assessment instrument is designed to determine the level of understanding of students after learning a competency (Prasasti et al., 2012).

The results of interviews with physics teachers at MAN 1 Medan proved that the Low other thinking (LOT) assessment instrument used still measured aspects of memorization and understanding. Because according to Anderson and Krathwohl there are 2 categories, namely the ability to think at a LOT. The ability that includes LOT is the ability to remember, understand, and apply. A set of High other thinking (HOT) includes the ability to analyze, evaluate, and create. Based on this explanation, this research will focus more on the stages of analyzing, evaluating, and creating. Furthermore, the researchers also conducted interviews or questions and answers with several students, they said that they lacked interest in learning physics because the teacher rarely used the media, the teacher only monotonously explained the material, took notes on the writing board and worked on the questions, and they had never fully practiced in the laboratory. It also has an impact on student learning outcomes such as the results of daily tests of students who, on average, have not been able to reach the Minimum Completeness Criteria (KKM) applied at school that is equal to 70. The results of interviews with physics teachers at a MAN 1 Medan prove that the assessment instruments it is used to measure memorization and understanding aspects only. The assessment instruments should include assessments that train students' critical thinking skills. Based on this, a research was developed to develop students' critical thinking skills assessment instruments on Static Fluid materials. In addition, this subject matter was selected based on the detailed indicators contained in the 2013 curriculum curriculum physics syllabus, namely Static Fluid material.

Basen on the background of the problem that has been described, the following problem 1) development of instruments used in learning is still limited, and 2) student critical thinking skill are still relatively low.

The results of this assessment are used to improve students' thinking skills. Students' thinking skills can be seen from the level of assessment instruments tested and the proportion of completeness. In addition, the critical thinking skills assessment instrument for

static fluid material presented raised phenomena that occur in everyday life. Based on the problem above, the writer needs to conduct research on "The Development of instruments assessment critical thinking skills of high school students on the subject Static Fluid".

RESEARCH METHODS

Research activities need a place of research that will serve as a background for obtaining the data needed, in order to support the achievement of research objectives. This research took place at MAN 1 MEDAN Jl. Williemi Iskandar No.9b, Bantan Tim., Kec. Medan Tembung, Kota Medan, North Sumatra 20222 due to various considerations including:

- a. There is no previous research about the research that will be conducted now, namely the Development of Instrument for Assessment of Critical Thinking Skills of High School Students on Static Fluid Material.
- b. Appropriate and in accordance with the conditions needed in this study (relevant).
- c. MAN 1 Medan there are some subjects that still use simple instrument assessment.
- d. MAN 1 Medan gave permission to researchers to conduct research.

The school principal is a leader who gives permission to researchers to conduct research on the development of instruments at the MAN 1 Medan and teachers who are given additional duties to lead a school that is held in a teaching and learning process or where interactions occur between the teacher giving the lesson and the student receiving the lesson. Maisaroh as the school principal at MAN 1 Medan .

In this study helps the process of research conducted. In consideration the principal can provide information about the school profile, academic students, curriculum, facilities, and extracurricular student activities (extracurricular).

The Development Model used in this study is the ADDIE Learning Model which is combined according to the development research steps recommended by Borg and Gall on the basis that the model is suitable for developing instructional model products / learning is on target, effective and dynamic and

is very helpful in developing learning for teachers.

The ADDIE instructional design model developed by according in Reiser and Mollenda (1990) is a generic learning / training design model that guides the building of effective, dynamic and supportive training program tools and infrastructure training performance itself. Thus helping training instructors in managing training and learning (Pargito, 2010: 46).

The purpose of this study, namely to obtain appropriate data, we need a data collection tool called a research instrument. Research instruments are tools that are selected and used by researchers in data collection so that these activities become systematic and simplified.

Data collection techniques in a study are very necessary because the data taken by researchers is not only focused on one source as a reference, but consists of several sources.

The research data collected is then processed in-depth study by looking at the type of research data. The data analysis techniques used in this study were qualitative and quantitative, namely (a) qualitative analysis was carried out descriptively according to the results of the questionnaire, documentation, and observation. In limited trials and extensive trials of data analysis conducted with a qualitative approach in order to evaluate the material design to assess weaknesses and shortcomings as a form of revision to improve material design and assess the achievement of the design of critical thinking skills assessment design. (b) quantitative analysis is used to determine the effect of the application of assessment instruments to learning outcomes and positive responses from students and teachers to the assessment instruments for critical thinking skills. The quality test of the instrument was carried out on the observation sheet questionnaire, the student's thinking activity test, the Multiple Choice Test, the test was in the form of validity and reliability. The following describes the testing of the instrument quality and analysis of the research data conducted.

The purpose of developing the test : Based on the formulation of the problem in research, the objectives to be achieved (1) to obtain the process of developing a critical thinking skills assessment instrument (2) obtaining a new innovative critical thinking skills assessment instrument that can measure students' critical thinking skills.

RESULT AND DISCUSSION

a. Research Results

The development of the critical thinking skills assessment instrument has reasons for development based on preliminary study data both in the field studies and literature studies. The following explanation of the research data is listed in :

Reason for development, Types of assessment instruments in schools : The instrument was in the form of an essay test with a total of 15-40 questions, short multiple choice questions with 3-5 questions. Aspects measured by memorization and understanding of concepts. Reason for development, School facilities and infrastructure : Based on observations MAN 1 Medan has spacious classrooms and has media such as infocus and laboratory. Reason for development, Physics learning process : Based on documentation studies, discussion activities carried out in class are less conducive, the approach used is conceptual.

This study begins with the analysis phase, at this initial stage, the researcher analyzes the physics assessment instruments in MAN 1 Medan and student learning outcomes on Static Fluid material. In addition, assessing school facilities and infrastructure, and physics learning processes. Research can depart from the existence of potential or problems. Potential is everything that when utilized will have added value (Sugiyono, 2010).

In this case, the potential possessed is students who are interested in physics and have an average value of Static Fluid material tests higher than the scores of other physics material. The problem as stated above is the difference between what is expected and what is happening (Ramalis & Rusdiana, 2015). From

the results of the analysis of the physics assessment instruments for Static Fluid material in MAN 1 Medan, we get questions that only measure memorization and understanding of concepts, ranging from the C1-C3 level, from the year the questions are almost the same and there are no significant changes.

Determine the indicators for the Student Critical Thinking Skills Assessment Instrument and the problem solving process in the Static Fluid material. Compiling a grid about developing Critical Thinking Skills for Students on Static Fluid material, questions containing indicators of critical thinking skills and indicators of multiple choice objective curriculum testing so that there are two different grids, in addition, there are questionnaire sheets for students' responses to the development of critical thinking skills 2013. In this case there are two question models namely the test model.

Validation is the process of validating the research instruments to be used. The validation process carried out is content validation to experts. The expert or expert who validates the instrument is a validation physicist namely Mr. Rappel Situmorang, M.Sc and expert in critical thinking skills in physics material, Mr. Ridwan Abdullah Sani, and Mrs. Dewi Aisanti MAN 1 Medan teacher. According to table 1 about validation of multiple choice.

Validation of multiple choice items is done by expert validation

Table 1. Validator score

Validator	Total Criteria score	Total Criteria score
Validator 1	15	very valid
Validator 2	18	very valid
Validator 3	16	very valid

According table 2 about result instrument criteria:

Table 2. Instrument criteria

Range	Valid criteria
$15 \leq J \leq 20$	very valid
$10 \leq J \leq 15$	valid
$5 \leq J \leq 10$	valid enough
$0 \leq J \leq 5$	invalid

The results of the validation of the multiple choice instrument Static Fluid material are declared to be very valid for all item items by all experts who have validated the multiple choice analysis test instrument to be used for research.

b. Final Product Discussion

The process of making an instrument of critical thinking skills goes through several stages of research and development. The stages used refer. The first stage is analytical research, obtained data in the form, types of instruments used by physics teachers in schools, facilities and infrastructure, and the learning process. Based on these data, there is potential for innovative instruments to be developed. The initial condition of particular concern is the type of physics instruments that are present in schools. The instrument only measures the aspects of memorization and understanding. This does not benefit students to practice critical thinking skills.

The analysis phase obtained data about the types of physical assessment instruments specifically the Static Fluid material at school, measuring memorization aspects and understanding concepts. Lissa (2012) suggested that based on the taxonomy of Bloom C1 (memorization) and C2 & C3 (understanding). Such conditions are certainly not better for training students' higher-order thinking skills. Learning instruments oriented to thinking skills are important to be developed because of advances in science and technology, this is in line with the opinion of (Mapeala & Siew, 2015) in his research that states good thinking skills can be a strong asset for students in Asia to be able to face complex problems that exist in the development of the modern era. The demands of this era certainly cannot easily be dealt with without going through a training process, this is in accordance with the opinion of (Yildirim & Ozkahraman, 2011) which emphasizes thinking skills can be developed through a conditioning for thinking.

The type of validation that is measured is the content validation of critical thinking skills instruments should have good content validity before being used to measure (Ennis, 1985; Docktor & Heller, 2009). Therefore, this stage is

important because before the instrument is tested, it must be declared valid beforehand by the expert so that the data obtained can be accounted for. At this development stage is the pre-trial stage, to measure the validity and reliability of the questions. A valid result is obtained with the validity coefficient category ranging between sufficient and good. Reliability about thinking, tested and declared reliable before use, this is in line with what was said (Pradana, 2017).

The complexity of the questions on the multiple choice test instrument of analysis is indeed a bit unfavorable, it is due to the type of questions which are oriented towards thinking skills. The instrument of thinking skills, not only emphasizes the concept understanding but more on the aspects of synthesis, analysis, and evaluation, so that it has a relatively low prevalence. The trial time of the problem is in poor condition support. These conditions, are students faced with the school final exam so that the work on the matter in a hurry. These results, in accordance with the explanation of (Lissa ,2012), factors that influence the variety of instruments are the students' psychological conditions, conditions that are less pleasant, cheating, questions that are too short, and questions that are too easy or difficult. According to (Magno, 2010) assessment with the type of questions that rely on memorization will have a high degree of reliability or reliability, while thinking questions are smaller.

The instrument is because the matter of thinking relies on individual thinking abilities that are indeed different whereas rote learning has almost the same standard of answers for each individual. The instrument of critical thinking skills was declared valid by the expert, then it was tested on a limited scale trial. In limited scale trials the reliability and response of the students were measured. Thinking skills require learning that activates students. The use of special designs such as conducting investigations, problem solving or asking questions can improve thinking skills when compared to conventional classes. In a limited scale trial, the instrument was declared practical with a percentage of student questionnaires

included in the very high category. Practicality means that the use of instruments is not judged to disrupt learning and does not interfere with the normal learning process, so that the instrument of critical thinking skills can be used.

Beginning test instrument test students are invited to follow things that are contextual and problem-based. Students who are used to being passive from receiving what is said, are slowly invited to contribute actively to learning. The instrument used to assess critical thinking and problem solving skills should be guided by basic knowledge. (Carson,2007) explains, in solving problems the thought process is more important than the knowledge possessed, even so basic knowledge is also a factor that is no less important in solving a problem. Therefore the development of an instrument of critical thinking skills is done without ignoring the concepts.

Critical thinking skills instrument is part of the process of student learning outcomes that are not easy to improve, it is because it is not only critical thinking skills that affect learning outcomes, including family, economic, cultural, multicultural conditions (Lissa, 2012). Thus, to get good learning outcomes it is necessary to strengthen factors other than critical thinking skills. The thinking skills of multiple choice objective test students at the implementation stage did not differ significantly.

Instruments of practical critical thinking skills are used in learning. The preparation of this critical thinking skills assessment instrument product has several limitations including, the type of instrument developed only uses one type of skill namely the multiple choice test. The second limitation is the use of indicators, but only taking indicators that are appropriate to the study, and the type of instrument developed is still in the multiple choice type so that it still impresses the test student like a normal test.

CONCLUSIONS AND SUGGESTIONS

Based on the description, the conclusions that can be drawn are as follows:

The development of critical thinking skills instruments for high school students is carried out through the following steps, starting from the defining stage by conducting a preliminary study covering the analysis stage starting from the field study and preliminary study. The product design phase begins with compiling the problem grid, compiling the questions, compiling the answer key, and design validation. The next stage of development includes pre, small scale trials and large scale trials. The first stage is tested on a small scale, then analyzed and implemented in a large scale test.

1) The form of instruments of critical thinking skills that are relevant for static fluid material are in the form of assessment instruments that can measure critical thinking skills that contain indicators of critical thinking skills, and in the level of bloom taxonomy c4-c6. Assessment instruments can be formed multiple choices and essay tests, in this study multiple choice tests.

2) Characteristics of critical thinking instruments based on empirical data obtain validity values from research instruments in the form of multiple choice tests expressed in either category. Multiple choice test reliability is in the good category. Questionnaire sheets are declared reliable because they have alpha cronbach > 0.70.

Based on the results of research and discussion from another journal it can be concluded that the process of developing a students critical thinking ability assessment instrument is carried out in five stages, namely the initial investigation which includes field studies and literature studies, the design stage of the realization / construction stage . the test stage, evaluation and revision, there are two activities. The main thing at this stage it the validation process and small group trial and the implementation stage and limited trial was carried out.

The preparation of these critical thinking skills assessment instrument products has several limitations including, the types of instruments developed only use multiple choice tests. Limitations on the use of indicators of critical thinking and problem solving, do not

use all indicators, but only take indicators in accordance with research, and the types of instruments developed are still in the multiple choice type so that it still gives an impression on the student test like a normal test. For other researchers, if they are going to conduct research of the same type, it is recommended to improve the limitations of this research, which is to add the type of thinking skills that will be developed in the assessment instruments, make questions more interesting for students and add to the object of the implementation phase test

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