The Feasibility of Integrated Assessment Instrument for Analyzing the Thinking Ability and Chemical Processing Skills

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Abstract

The purpose of this study is to develop and determine the feasibility of the integrated assessment instrument. This research uses 4-D development model, which includes define, design, develop, and disseminate phase. This research product is reviewed by peer reviewers and validated by expert judgment. This product is tested to 284 senior high school students in Gunungkidul. The results of the research were developed in the form of an integrated assessment instrument to analyze the thinking ability and chemical process skills of SMA/MA class XI students in even semester on the subject matter of buffer solution. The Aiken index for this instrument is 0.87, which means that the instrument is valid and feasible to use.

Keywords: integrated assessment instruments, analytical thinking skills, scientific process skills, buffer solutions

Introduction

The aim of education in Indonesia is to prepare qualified Human Resources (HR) to face the XXI century. The one of way to improve the quality of human resources is to improve the quality of education. Improving quality of education is expected to prepare the graduate students to be able to compete in the global world. Educational institutions or schools should improve their graduates' competencies as the best as they can to address these global challenges.

Balistreri, Giacomo, Noisette, & Ptak. (2012) suggests that there are 3 (three) aspects of the global competencies that must be possessed by learners: empirical based skills and knowledge, high cognitive and metacognitive skills as well as behavior, perspective, and global attitudes. Empirical based skills and knowledge are psychomotor aspects, including basic competencies and numeracy, science and technological skills. In this case, which is included in the ability and knowledge based empirically one of them is the science process skills. The next aspect is high-level metacognitive and cognitive abilities that are cognitive aspects, these aspects include critical thinking skills, creative thinking skills, and problem

solving. Analytical thinking is included in the cognitive aspect. Then the next is the behavior, perspective, and global attitude is an affective aspect or attitude. Such cognitive, psychomotor, and attitudinal aspects must be shared by learners thoroughly.

The learning process that starts from the learning planning, the implementation of the learning process, the assessment of the learning outcomes and the follow up of the assessment result must also cover all three aspects. The skill competencies that can be gained in the chemistry learning is the science process skill. The science process skill is an important skill to be trained to the learner and then performed for the assessment.

Learning science involves learning chemistry as a practical subject providing students with the experience to interact with science process skills that can be used to solve problems in everyday life and contribute to national development (Abungu, Okere & Wachanga, 2014). In the chemistry learning, all the material through the lab will facilitate the students' learning process skills. This science process skill is a psychomotor aspect in chemistry learning.

Temiz, Taşar & Tan (2006) assert that the skills of the science process is an integral part as well as having a central role in developing the conceptual understanding of learners in the learning activities. The assessment process for measuring the skills of this science process can be measured using a written test (Subali, 2011). Scientific skills assessment tools are one of the learning outcomes that provide information about the learner's abilities (Bauer, 2000). Implementation of the assessment to measure the skills of the science process of learners less developed by the teacher. During this time, the assessment at the time of practicum is only seen on the results of practical reports and observations. When in fact the skills of the students' learning process can be measured using the appropriate written test instrument.

One of the cognitive aspects mentioned by Balistreri et al. (2012, p.5) is the analytical thinking ability. The ability of analytical thinking is the ability of learners to be able to think analytically in solving problems it faces. Chemical learning as a complex science that can train learners to improve cognitive aspects

especially analytical thinking ability. Analytical thinking is a high-level cognitive level that learners can gain after mastering low-level cognitive levels such as knowing, understanding, and applying.

Implementation of the assessment performed to measure cognitive competence is currently still at a low level of cognitive level, thus less training students to think high-level and analytical thinking. Gardner (Murtono & Miskiyah, 2014) suggests that the assessment of short-answer tests at low-level cognitive levels only captures a small percentage of the skills and intelligence of learners. Therefore, if the teacher still uses the assessment model with a short answer test then the purpose of the assessment to measure the ability of students optimally has not been met. There needs to be an alternative assessment that can be used to measure the intelligence and skills of learners optimally.

Mardapi, Kumaidi & Kartowagiran (2011) stated that to date there are still many learning outcomes, whether used by teachers for daily tests or those used by schools for general repetition have not fulfilled the requirements as good tests, namely nirbias criteria and standard scales. Assessment instruments devoted to measuring science process skills and analytical thinking skills have not been widely developed by teachers.

Based on the results of oral interviews conducted on chemistry teachers in some senior high schools/MA in Gunungkidul, that practicum activity is only done on every sub material that can be done practicum, then the result of the practicum assessment is done based on the report of the practicum received. Assessment of the results of the practicum is done separately with the assessment of cognitive aspects that are usually done at the time of daily test. Thus there is no integrated assessment between the cognitive and psychomotor aspects of the teacher.

Based on the description of the problem, it is necessary to develop a quality integrated assessment instrument to be able to measure the cognitive and psychomotor aspects in an integrated manner. Psychomotor aspects measured in this study is the science process skills and cognitive aspects measured is the ability to think analytically. Integrated assessment instruments are intended to

enable teachers to easily measure analytical and analytical thinking skills in an integrated, effective and efficient way.

The subject chosen in the development of an integrated assessment instrument is the material of the buffer solution. The selection of materials is based on field surveys, practicum materials carried out in schools and based on core competencies and basic competencies in the 2013 curriculum. Therefore, this study aims to develop an integrated assessment instrument to measure analytical thinking skills as well as chemistry process skills in high school chemistry students as well determine the feasibility of the instrument of the integration assessment.

Method

This research uses the research steps of developing the 4-D model (Four-D) developed by Thiagarajan, Semmel & Semmel (1974, p.5). The instrument of data collection in this study was conducted using: (1) the questionnaire prepared in this study is specifically addressed to the reviewer, and the expert judgment to obtain the desired data according to the purpose of developing the instrument. (2) a scoring instrument which is a valid end product so that it can be used to measure the analytical thinking and chemical science process skills of SMA / MA students in buffer solution materials.

Data analysis technique used is qualitative and quantitative data analysis. Qualitative analysis is used to describe the process of product development, while quantitative analysis is used to know the item information in the integrated assessment instrument.

Qualitative Data Analysis

Qualitative data analysis is conducted based on the development stage of integrated assessment instrument. The first stage of the analysis of learners, analysis of the beginning end, the formulation of learning objectives, concept analysis, task analysis. The next step is to design the product, the preparation of the matrix and determine the product assessment stage. The instrument design is then developed to produce an integrated assessment product that will be reviewed by peer reviewers. This initial product will get feedback from peer reviewers, the

results of this peer reviewer review are then analyzed and revised. After the revision, validation of the item by the expert judgment is required to produce a valid integrated assessment instrument. The results of validation by the expert judgment are then analyzed, revised, and reassembled against the integrated assessment instrument.

Quantitative Data Analysis

The result of the validation of the item is analyzed according to the data on the validation sheet of the item that has been obtained from the expert judgment. Data analysis of product validation results is aimed to improve test quality through revision and to know the feasibility of integrated assessment instrument before field trial.

Result and Discussion

Define Results

At the defining stage, collected preliminary data on the importance of developed products. The results of this stage are as follows.

Preliminary Analysis–End

At this stage, an interview was conducted on five SMA/MA teachers in Gunungkidul Regency. The results of interviews to 5 (five) teachers obtained the following conclusions: (1) Assessment of teachers to learners is still a test to measure cognitive abilities in the form of daily or task repetition. (2) Preparation of daily test questions is not intended to measure certain aspects, only the cognitive aspect in general. (3) Assessment on psychomotor aspect especially lab work has not been compiled by teacher, teacher only judging based on observation of practicum implementation and practice report. (4) The teacher has not yet made standard scoring guidelines on the instrument questions that have been made.

Based on the results of the final analysis, further research on the development of integrated assessment instrument to measure the analytical thinking ability and chemistry process skill of high school/MA chemistry students on buffer solution material, to help facilitate teachers in conducting psychomotor and cognitive aspect assessment in an integrated, effective, and efficient. In addition, in order to

assess the ability of analytical thinking and to improve the student's science process skills.

Analysis of Learners

Students in 5 (five) schools observed from SMA Negeri 1 Wonosari, SMA Negeri 2 Wonosari, SMA Negeri 2 Playen, Krangmojo State Senior High School and MA Negeri 1 Wonosari seen that most of the students have not been trained in exploring the ability of analytical thinking and skills the process of science owned. This can be seen from the form of problems created by teachers, still in the realm of C1, C2 and C3, so that the ability of learners is still at low level cognitive level. The test subjects in this study were students, with analytical thinking ability and scientific process skills measured specifically by using the test. Learners who become the subject of research is the students of class XI in the even semester of the school year 2015/2016 amounted to 374 learners. Learners who can be used as test subjects are learners who have obtained material about buffer solution and practicum of buffer solution in their school.

Formulation of Learning Objectives

This stage is an analysis of competency standards and basic competencies to formulate learning objectives. Based on the basic competence, the learning objectives are formulated, that is, the learners are expected to: (1) Design and conduct experiments to analyze buffer and non-buffer solutions, (2) summarize the buffer and non-buffer properties, (3) Calculate the pH or pOH of the buffer solution, (4) Describes the function of buffer solution in the body of living things

Concept Analysis

Conceptual analysis is conducted to identify the subject matter to be elaborated, to arrange it in hierarchical form, and to elucidate it clearly. The buffer solution is a chemical material in the class XI SMA/MA even semester.

The buffer solution is a solution which can maintain its pH value when added water, slightly acidic or slightly alkaline. The buffer solution is an acid buffer solution and an alkaline buffer solution. The acid buffer solution contains a weak acid and a conjugate base, while the alkaline buffer solution contains a weak base and conjugate acid.

Task Analysis

The stage in this task analysis identifies the chemical science process skill indicators and analytical thinking skills to be achieved. Indicators of science process skills that can be achieved are to predict, plan experiments, apply concepts, communicate, interpret and classify. Indicator of analytical thinking ability to be achieved is to differentiate, connect and organize.

Design results

This stage includes product design, lay out design and product contents. The description of this stage is as follows.

Determination of Test Objectives

This study developed a test instrument to facilitate teachers in measuring the analytical thinking ability and science process skills on buffer solution materials. This test is given to students of XI SMA/MA class in Gunungkidul district who have followed the learning and practicum of buffer material.

Determination of Competence

The material competence of the buffer solution is to understand the properties of the acid-base solution, the method of measurement, and its application. The basic competence taken is to describe the nature of the buffer solution and the role of the buffer solution in the body of living creatures Material Determination Based on the basic competency and basic competency that has been selected, then determine the material that will be developed into items. The buffer material includes an acid buffer solution and an alkaline buffer solution, then the elaboration of buffer component components and buffer solution functions in the body of living things.

Determination of the Test Grid

The test grids are organized on the basis of competency standards derived into basic competencies, then downgraded to learning indicators. After that it is combined with indicators of analytical thinking ability and science process skills. Indicators of analytic thinking indicators include the ability to distinguish, organize and link, while science process skill indicators include experimental

planning skills, prediction, classification, interpretation, measuring, inference, applying concepts, graphing and communicating results.

Development Results

Prior to the testing of the learner with the developed instrument, the item writing stage, the preparation of scoring guidelines, the validation of the test items, the improvement of the items, and the determination of the test subjects.

Writing Items

The design stage has been done preparation of the test grille, then the problem is made based on the grating that has been made, adjusted between the learning indicators, indicators of analytical thinking ability, and indicators of science process skills. The test consists of a set of items of objective description.

Drafting of Scoring Guidelines

Sa'dijah (2009) revealed that the rubric serves as a guide to scoring results and improving teacher objectivity in scoring and helping teachers to assess learners' performance more accurately and objectively. Scoring guidelines (rubrics) for each question are arranged clearly and coherently according to the thinking path of the learner and the level of difficulty in resolving the items. In this study selected Partial Credit Model (PCM) 1 -PL which is based on the ability of the model in analyzing all items that have different weight of each item grains.

Validation of Test Items

The study of the item is done by validating the initial product to the expert judgment. The initial product developed in the form of 12 items of description. The validity of the item is seen from the aspects of substance, construction, language, validity, practice, and suitability of learning indicator, analytical thinking ability and science process skill.

Validation of integrated assessment instruments is performed by 7 (seven) expert judgments. The result of the validation of the test item is stated that the test is valid with revision, so after the improvement on the item, this new instrument can be used for field trials.

Improved Items

After validation of the integrated assessment instrument developed, the results obtained are valid with revisions. Then performed improvements according to the advice obtained from the validator. The results of this item improvement are consulted back to the validator so that it is declared valid and ready to be tested for the learner's pause.

Product Trial Results

Peer Review Test Results

The initial product developed is then assessed by 3 (three) peer reviewers, the result of this peer reviewer's assessment of suggestions used for initial product improvement before being judged to the expert judgment. Products that have been assessed by peer reviewers are then used to improve the product of integrated assessment instruments. Instruments that have been repaired then consulted to the supervisor.

Validity Verification Results

After the peer reviewers were tested then the item was fixed. After repaired it is validated by expert judgment. Aiken (1985) states that for the number of rater 7 and c = 4 then the item is said to be valid if the value is V> 0.76. The results of the validation by the expert judgment were analyzed by Aiken's V and the result was 0.87, which means that the items in the integrated assessment instrument are valid.

The result of validity by the expert judgment is also in the form of the suggestion presented in the item. After getting advice from the expert judgment then made improvements on the number of items that need to be repaired and reassembled. Based on the advice of the expert judgment in Table 15, the numbers of items 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, and 12 need to be corrected, using notations, numbers and compounds. On the number item 11 has been received and does not need to be repaired.

Conclusion

Based on the result of the analysis, it can be concluded that the integrated assessment instrument to analyze the analytical thinking ability and chemistry

process skill of the students of XI SMA/MA class on buffer material based on the validator assessment is feasible to be used with the content validity index of 0.87.

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