VALIDITY OF ASSESSMENT SHEETS FOR IDENTIFYING CONCEPTIONS AND ARGUMENTATION SKILLS IN CHEMICAL EQUILIBRIUM MATERIALS

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Abstract. *This research aims to determine the validity of the conceptual identification assessment sheet and argumentation skills on chemical equilibrium material. This research uses the Research and Development type of research. The development model uses the ADDIE model by applying the Analyze, Design and Develop stages. The research subject is SMAN 16 Surabaya. Later, this research will use qualitative and quantitative data analysis. The validation results of the product validity assessment show that the data on the material aspect is in the very good category which is get mode score 4, the construct aspect is in the good category which is get mode score 3, and the language aspect is in the good category which is get mode score 4. The results of the teacher's response to the assessment instruments developed are good and can be used.*

Keywords: *Concept identification, argumentation skills, chemical equilibrium, R&D, ADDIE*

INTRODUCTION

Along with the times, the learning factor is very important to demand every individual to prepare reliable resources. In the class's learning, the students must be actively both orally and in writing. It's not impossible if the growing of our technology requires us to be active in responding to global information flows as an asset in meeting the needs if learning in the class. One of the sciences related to conceptual knowledge is chemistry. Chemistry is a learning about science in natural way that specifically studies the structure, properties, the composition, and the changes in matter both chemically and physically along with the energy that accompanies these changes. The field studied in chemistry is much broader, not just numbers but also required to understand the concept of cognitive knowledge.

The important foundation of the scientific approach in learning is that students are required to think critically and act like scientists [1]. In this century, the education system requires the students to have the ability to think in the way of collaborate, critically, and grow their communicate. Communication skills are skills needed by students to convey their arguments on the results of research observations that have been analyzed both verbally and nonverbally [2].

Misconception can be interpreted as an error in understanding the concept. [3] explained that misconception is an understanding that isn't in accordance with the understanding accepted by scientific experts. Learners experience misconceptions when they have a consistent wrong understanding. Problems regarding misconceptions are problems that often occur during the learning process, where these misconceptions can occur due to various factors. Misconception in chemistry is a fatal thing because chemical materials are interrelated [4]. If students experience misconceptions in a material, it can provide the potential to experience greater misconceptions in the next material that is still related.

To identify misconceptions, a proper instrument is needed to help teachers know whether students have misconceptions or not. For identifying student's misconception in learning, in agreement with Treagust who revealed in a right instrument that is using diagnostic test [5].

Four Tier Multiple Choice (4TMC) is a multiple choice test that can be used to diagnose

misconceptions in using 4T. In this multiple choice, the first tier contains questions that have various answer options, the second tier contains the level of the student's answer question confidently in the first tier, the third tier contains the choices of the student's reason in answering the first tier, and the four or last tier is the level of the student's confidence in giving their reasons in the third tier [6].

Argumentation means a central activity in classroom investigations and is important to address when learners use evidence and reasoning to support their claims or to convince others of their claims. Learners need a deep understanding of concepts and the nature of argumentation in order to make quality arguments. Therefore, learners do not focus on the proposed argument but must also be able to know related to their concept knowledge and why they believe what they know [7].

Argumentation ability is the basis of critical thinking skills. Students' concept understanding can be seen from how students build and convey their arguments.

Chemical Equilibrium is one of the material that given to the students in the chemistry, this material explains about the situation where the reaction rate between reactants equilibrates with products over time which is influenced by several factors including the changes in concentration, pressure and volume, and the changes in temperature. This material is very suitable to learned as an effort to improve student's argumentations. Chemical equilibrium is a chemical material that can be obtained conceptually through experimental results. Therefore, students are free to explore themselves to conduct experiments and convey concepts that have been understood during the experiment as a result of observations that have been made.

Through this activity, the argumentation skills of students can be seen and the teacher can find out the extent of understanding of the concepts possessed by each student so that the teacher adjust the teaching process according in the understanding level of the students. Through this learning activity, it is able to create a proactive learning atmosphere, namely the teacher as a facilitator and students are ready play an active role in the learning process, besides that students are free to explore knowledge through phenomena that occur in the surrounding environment or nature, which is the target of the current independent campus curriculum.

Based on the description above, namely the importance of argumentation skills which can be the foundation in knowing the depth of understanding of concepts by students, and also as an effort to improve student's argumentation skiils which are feasible based on validity, practicality, and also effectiveness, finally this study consider takes the title "Development of Assessment Sheets for Identifying Conceptions and Argumentation Skills on Chemical Equilibrium Material".

METHODS

The research uses in this study is research and development (R&D) which is a research methode to produce a product, and test the effectiveness of the product [8]. In this study, an assessment sheet will be developed to identify conceptions and argumentation skills on chemical equilibrium material. In this study using development model "ADDIE" consist of 5 stages, which is Analysis, Design, Development, Implementation, and Evaluation Stage. This study will be limited to the Development stage.

1) **Analysis Stage**

The analysis stage is the stage where all information related to the product to be developed is collected based on field studies and literature studies. Enhancing argumentation skills alone is insufficient to foster students' understanding of concepts [9]. Arguing is not merely about presenting existing information but also about problem-solving and drawing conclusions based on students' own information and reasons. Therefore, teachers must facilitate learning by connecting facts to the subject matter in order to promote concept understanding. Concept understanding is a complex phenomenon that involves factual, conditional, and procedural knowledge. Several experts define argumentation skills as important for supporting concept understanding because both of them are related, where students are required to build scientific arguments to address initial problems and draw on their prior knowledge. Toulmin's Argumentation

Pattern is commonly used to evaluate learners' arguments. However, research by Viyanti reveals that students tend to focus on bolstering claims without considering other aspects of argumentation skills, leading to a weak understanding of the subject matter [9].

a) Performance Analysis

Performance analysis is related to the curriculum used for current learning, namely the Merdeka Curriculum. Based on one of the objectives of the independent curriculum, namely increasing the quality of superior and competitive human resources, it can be realized through students who have noble character, and have a high level of reasoning in understanding concepts. Understanding concepts in learning is very important to emphasize so that students do not experience misconceptions. In addition, the independent curriculum emphasizes the development of soft skills, one of which is critical thinking skills. In the independent curriculum, there are learning outcomes and also a flow of learning objectives which must be achieved by students.

Chemical equilibrium is one of the material that we can find for class XI SMA/MA in phase F with the following learning outcomes, At the end of phase F, students are able to learn about the nature, interaction and structure of particles in forming various compounds, and also using their mathematical skill operation in chemical calculations; students also can explain and understand the aspects of rate equilibrium, energy, and equilibrium of chemical reactions; Learners are able to explain the application of various chemical concepts in daily life and show that the development of chemistry produces various innovations. Learners have a deeper knowledge of chemistry so as to foster interest as well as help learners to be able to continue to the next level of education in order to achieve a good future. Learners are expected to increasingly have a critical mind and open mind through scientific work and at the same time strengthen the profile of Pancasila students, especially honest, objective, critical reasoning, creative, independent, innovative, mutual cooperation, and global diversity.

b) Requirement Analysis

Based on the previous research that has been conducted, it's necessary to improve and optimize the test with an assessment sheet instrument that will be given to students at SMAN 16 Surabaya by taking a sample of 15 participants. In addition, students have argumentation skills that are classified as low. Therefore, an assessment sheet is needed for the identification of conceptions and argumentation skills on chemical equilibrium material.

2) Design Stage

The developed assessment sheet is described through the following stages:

a) The researcher determines what material is included in the assessment sheet. In this study, the material used in the assessment sheet instrument was chemical equilibrium, especially the factors that affect equilibrium shifts (concentration, pressure, volume, and temperature).
b) Researchers determine the concept map of the material factors that affect the shift of equilibrium.
c) Researchers determine the order of concepts in the material factors that affect the shift of equilibrium.
d) Researchers determine the learning outcomes of the material tested in the assessment sheet.
e) Researchers designed studying objectives that must be mastered by the students on the material tested in the assessment sheet.
f) Researchers designed question items based on learning objectives on the material of factors that affect the shift of equilibrium.

g) Researchers designed a lattice of assessment sheet instruments in which there was a question answer key. The design is carried out by outlining the contents of the assessment sheet, it is aims to ensure that the assessment sheet doesn't get out of the scope of the material that has been determined and no important part of the material. In addition, the content of the test will also not deviate from the appropriate learning outcomes in the Merdeka Curriculum.

3) Development Stage

The development of test instruments is carried out in accordance with the design stage. After the questions have been made, then a validity test is carried out to find out whether the assessment sheet for the identification of conceptions and argumentation skills developed is suitable for use. After analyzing the validation results and the assessment sheet is declared suitable for use, it is tested on students. At this stage the questions that have been made will be given to students to get answers from them. From these answers, students' understanding will be identified based on these answers. The developed assessment sheet was tested on students of class XI SMAN 16 Surabaya. The assessment sheet for identification of conceptions and argumentation skills was distributed to 15 students in the form of *gform*. After the limited trial, students were given a response questionnaire to determine the practicality of the assessment sheet. At the final stage of development, an evaluation was carried out to analyze the developed assessment sheet for deficiencies or weaknesses. If there are no improvements, then the assessment sheet is suitable for use. If there are still shortcomings or weaknesses, it is necessary to make improvements and refinements.

The initial stage after determining the material is the preparation of the assessment sheet in Google Form. In the first section there are instructions for working on tier questions. After that, the next column there's a concentration factor in chemical equilibrium material's problem as shown before contains question based on the image that has been given. Tier 2 contains the level of students confidence in the answers they have given. For the next tier, tier 3 contains the right reasons for the answers chosen by students. The last is tier 4 contains the level of confidence in the answers to the reasons given by students.

For pressure and volume factors in the assessment, as shown below and also the first tier contains the questions based on the images have given. The nest is tier 2 which contains of the confidence of students level in the answers they have given. The next is tier 3 which also contains the right reasons for the answers chosen by students. For the next tier is tier 4 contains the level of confidence in the answers to the reasons given by students.

Furthermore, for temperature aspect also contains of the same tier. For tier 1 contains the question based on the phenomena given. Tier 2 contains the confidence of students level in the answers that they have given. Tier 3, contains the right reasons which can support the answers. And the last tier is tier 4 the confidence students level in the answers to the reasons given by students. Furthermore, the second part contains argumentation questions where the first column contains instructions for working on phenomenon questions. The next column is a phenomenon question that given about the chemical equilibrium factors of concentration, pressure, and volume, as well as temperature presented with pictures, facts, and also claims that must be chosen by students. Then the next column is given 6 argumentation columns consisting of aspects of claim, data,

warrant, backing, qualifier, and rebuttal.

RESULTS AND DISCUSSION

In this study, the product designed is an assessment sheet for the identification of conceptions and argumentation skills on chemical equilibrium material in class XI SMA. In this instrument, to identify conceptions that occur using four tier multiple choice (4TMC). In the 4TMC question there are 4 tiers, where the first tier contains answers to questions given related to existing phenomena. The second tier contains the level of confidence in answering the first tier, where the level of confidence is a graded scale with the following information:

Table 1. Confidence Rating (CR)

Confidence Rating	Description
1	Just Guessing
2	Very Unsure
3	Not Sure
4	Sure
5	Very Sure
6	Extremely Sure

[10]

The third tier contains the reasons for choosing the answer in the first tier. The fourth tier contains the level of confidence in choosing the reasons in the third tier, for the level of confidence in this tier is also a multilevel scale with the same information as Table 1. Meanwhile, to identify argumentation skills using the Toulmin's Argument Pattern (TAP) model which is a model for testing the quality of arguments through the basic properties for each argumentation component. In the TAP model there are 6 components consisting of 1) Claim (proposition, or statement), 2) Evidence (evidence that supports the claim), 3) Warrant (explanation of the link between claims and data), 4) Backing (basic assumptions that support evidence), 5) Modal Qualifier (condition that the claim is true) and, 6) Rebuttal (condition that invalidates the claim) [11].

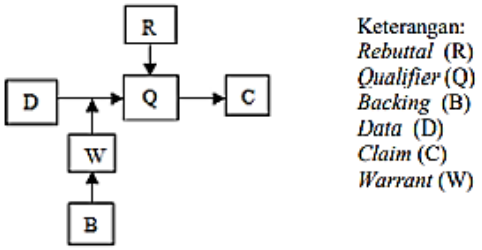

Figure 1. Toulmin's Argumentation Pattern

The assessment sheet validity is to identify the argumentation skills and the conceptions on chemical equilibrium material was obtained from a validation sheet that had been filled in by 3 validators. The validation sheet in this study includes material, construct, and language validation. The results of the validity of the assessment sheet for the identification of conceptions and argumentation skills on chemical equilibrium material were declared valid based on the assessment of the experts where the results of expert validation on the material aspect obtained mode 4 with a very good category, the construct aspect got mode 3 with a good category, and the language aspect got mode 4 with a very good category. Based on the following data table from the validator, the test results on material aspects, construct aspects, and also language aspects that have been checked by 3 validators where 1 validator is from a chemistry students and 2 of them are lecturers form the Chemistry Education study program.

In this question instrument, validity is determined based on content, construct, and language criteria. Later the E-LKPD will be declared valid if it gets a total mode score> 3 from declared valid if it gets a total mode score ≥ 3 from the three validators. The use of mode is based on the validity result data obtained is ordinal data that cannot be mathematized so that the analysis of funds used is by mode [12]. Validity data are analyze by mode if the aspects or indicators assessed by the validator obtain a mode at <3 score and it state less valid so must be made the revisions and reassesments 'til they reach the predeterminded criteria, namely each aspect obtaining an assement, while if the aspects or indicators assessed by validator obtain a mode at >3 score it state valid. The following will describe the feasibility of validity aspects based on the content and construct of the developed e-LKPD.

Table 2. Data from Aspect Validator Test Results Material

Aspect	Indicator	Mode	Category
Material	Suitability of question items with indicator' s question	4	Very good
	Sustabiliy of each question with answers and reasons	4	Very good
	Product suitability with the claim aspects of argument ation	4	Very good
	Product suitability with data aspect argument ation	4	Very good
	Product suitability with the warrant aspect of argument ation	4	Very good
	Product suitability with the backing aspect of argument ation	3	Good
	Product suitability with the qualifier aspect of argument ation	4	Very good
	Product suitability with the rebuttal aspect of argument ation	4	Very good
	Mode	4	Very good

The data from the validator test results on the material aspect uses the mode / number that appears most often. Based on *Table 2*, it can be conclude that the mode is 4 with criteria being very good.

Based on the table above, content validity indicates that the instrument is prepared in accordance with the material, curriculum, and also the expected learning objectives [13]. Ifada states that indicators of content validity in question instruments can be said to be valid if there are indicators, namely: 1) the suitability of the indicator with the item, 2) the item indicator with the aspect under study, 3) the clarity of language or images in the question, 4) the feasibility of the item for the sample, and 5) the suitability of the material or concept being tested. Some of the above indicators can be found in the validation aspects presented in the table above. The first indicator, namely the suitability of indicators with question items, is found in table 2 of the first statement which gets mode 4 with a very good category. The second indicator, namely the suitability of the item indicators with the aspects studied, is found in table 2 of the third statement which gets mode 4 with a very good category [14].

Table 3. Data from Aspect Validator Test Results Construct

Aspect	Indicator	Mode	Category
Construct	Suitability of first tier questions with answer choices	4	Very Good
	Checkers on answer choices are rational and	3	Good

Aspect	Indicator	Mode	Category
	homogeneous in the first tier		
	Suitability of third tier questions with reasoning options	3	Good
	The reasoning options are rational and homogeneous in the third tier.	3	Good
	Facts and figures on the assessment sheet are clearly visible	4	Very Good
	Mode	3	Good

The data from the validator test results on the construct aspect uses the mode/number that appears most often. Based on *Table 3,* it can conclude that the mode is 3 with the value criteria being good.

The fourth indicator based on Ifada, namely about the feasibility of question items for the sample, can be found in the table above, namely in the first indicator which gets mode 4 with very good category, the second indicator which gets mode 3 with a good category, the third indicator which gets mode 3 with a good category, and the fourth indicator which gets mode 3 with a good category. Meanwhile, the fifth indicator related to the suitability of the material or concepts tested can also be found in the table above in the fifth indicator which gets mode 4 with a very good category [14].

Table 4. Data from the Aspect Validator Test Results Language

Aspect	Indicator	Mode	Category
Language	Suitability of first tier questions with answer choices	4	Very Good
	Mode	4	Very Good

The data from the validator test results on the language aspect uses the datum/mode that appears most often. Based on *Table 4*, it can be conclude that the mode is 4 with the value criteria being very good.

The third indicator based on Ifada, which is related to the clarity of language or images in the questions, can be found in the language validation aspects presented in the table above, namely the first indicator which gets mode 4 with a very good category [14].

CONCLUSIONS

Based on the research that has been conducted and the data obtained, the researcher can conclude that the validity of the assessment sheet for the identification of the conceptions and argumentation skills on chemical equilibrium material that has been developed is valid and there's no revisions. This can be seen from the results of the validation of the product validity assessment obtained data on the material aspect getting mode 4 and is included in very good category, the construct aspect getting mode 3 which is included the good category, and for the aspect of the language getting mode 4 which is very good category.

Based on the data above, it can also be concluded that the assessment sheet for identifying conceptions and argumentation skills is very good or valid for use by teachers and tested on students.

SUGGESTIONS

In order for the scorecard instrument for identification and argumentation skills developed to be even better, the author realizes the need for further research with a broader discussion, and also research can be developed again by testing the effectiveness and practicality of the scorecard instrument for identification of conception and argumentation skills. The author is also willing to accept criticism and suggestions from any party that

could make the developed product even more perfect.

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