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Development of Student Worksheet with Multiple Representation-Based Conceptual Change Learning Model to Reduce Students' Misconceptions on Reaction Rate Material: Aspects of Validity

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Abstract: Development of Student Worksheet with Multiple Representation-Based Conceptual Change Learning Model to Reduce Students' Misconceptions on Reaction Rate Material: Aspects of Validity. The purpose of this study was to determine the validity of the Student Worksheet with a conceptual change learning model based on multiple representations and instrument three tier diagnostic test on the reaction rate material in terms of the presentation aspects of the Student Worksheet, content feasibility, and language aspects. The Student Worksheet is one of the teaching tools that may be utilized to lessen students' misunderstandings by showing the three levels of representation in chemical material. Students can better understand complicated chemistry topics, which can result in misconceptions based on what they already know, by employing a conceptual change learning approach based on numerous representations. The Aiken coefficient (V) validity was employed in content validity analysis, whereas the median data rater was used in construct validity analysis. The results showed that the validation results of the content eligibility criteria using Aiken validity obtained that the percentage of each criterion was determined to be > 0.8 with a high validity predicate, so that Student Worksheet was declared fit for use. While the feasibility of Student Worksheet based on construct feasibility is constructively valid as evidenced by the median value which is in the range of 4 (valid) and 5 (very valid). From this research it is hoped that it can be used as a guide in measuring Student Worksheet and a three tier diagnostic test instrument to reduce misconceptions in students.

Keywords: Validity, Misconceptions, Student Worksheet, Instrument Three Tier Diagnostic Test

Abstrak: Pengembangan LKPD dengan Model Pembelajaran Conceptual Change Berbasis Multiple Representasi untuk Mengurangi Miskonsepsi Peserta Didik pada Materi Laju Reaksi: Aspek Validitas*. Tujuan penelitian ini adalah untuk mengetahui validitas LKPD dengan model pembelajaran conceptual change berbasis multiple representasi dan instrumen three tier diagnostic test pada materi laju reaksi ditinjau dari aspek penyajian, kelayakan isi, dan aspek bahasa. LKPD merupakan salah satu alat ajar yang dapat digunakan untuk mengurangi miskonsepsi peserta didik dengan menunjukkan tiga tingkat representasi dalam materi kimia. Peserta didik dapat lebih memahami topik kimia yang rumit, yang dapat mengakibatkan miskonsepsi berdasarkan apa yang telah mereka ketahui, dengan menggunakan model pembelajaran conceptual change*

berdasarkan multiple representasi. Validitas koefisien Aiken (V) digunakan dalam analisis validitas isi, sedangkan data rater median digunakan dalam analisis validitas konstruk. Hasil penelitian menunjukkan bahwa hasil validasi kriteria kelayakan isi menggunakan validitas Aiken diperoleh persentase masing-masing kriteria ditetapkan > 0,8 dengan predikat validitas tinggi, sehingga LKPD dinyatakan layak digunakan. Sedangkan kelayakan LKPD berdasarkan kelayakan konstruk adalah valid secara konstruktif yang dibuktikan dengan nilai median yang berada pada rentang 4 (valid) dan 5 (sangat valid). Dari penelitian ini diharapkan dapat digunakan sebagai pedoman dalam mengukur LKPD dan instrumen three tier diagnostic test untuk mengurangi miskonsepsi pada peserta didik.

Kata Kunci: *Validitas, Miskonsepsi, Lembar Kerja Peserta Didik, Instrumen Three Tier Diagnostic Test*

▪ INTRODUCTION

The concept of chemical matter is a collection of knowledge pertaining to objects in the form of verifiable symptoms/phenomena. In chemical learning, phenomena can be represented at three levels: macroscopic, symbolic, and submicroscopic (Suyatman & Taher, 2020). According to (Adadan, 2013) states that studying chemistry will be easy to understand if it is able to represent these three levels of representation. To overcome difficulties in learning chemistry, it is necessary to study chemical phenomena which are represented at three levels, namely the macroscopic, sub-microscopic, and symbolic levels. Chemistry learning is usually limited to two levels of representation, namely macroscopic and symbolic. Students often only memorise submicroscopic and symbolic representations that are abstract in nature (in the form of descriptions of words) because the microscopic level is studied independently from the other two levels of thinking. As a result, students are unable to understand the process and structure of a substance that is undergoing a reaction (Herawati, 2013). This causes students to find it difficult to understand chemical concepts that are at the molecular or microscopic level. According to the findings of the pre-research interviews, students frequently get material with explanations on the whiteboard and present films on YouTube that show more macroscopic and symbolic levels, raising concerns about the possibility of misunderstandings on their part. Gabel (1993) states that chemistry learning only emphasizes the symbolic level and problem solving so that it will be difficult for students to develop conceptual understanding in chemistry learning. The inability of students to make correct correlations between the multiple representations and learning chemistry which only focuses on macroscopic and symbolic representations can cause misconceptions (Stojanovska et al., 2012; Ünal et al., 2010).

Chemistry lessons offer information regarding reaction rates. Misconceptions will arise as a result of the existence of the difficult-to-understand concept of reaction rate (Nurpratami et al., 2015). Misconception is one understanding of the concept that is not in accordance the expert (Berg in Fantiani et al., 2023). According to Siswaningsih et al (2014) research on misconceptions in several high schools in West Java, there are as many as 35 misconceptions about the reaction rate concept, which includes collision theory and factors that affect reaction rates (concentration, temperature, surface area, and catalyst). Students were found to be confused with the concepts of a concentration factor of 14%, a temperature factor of 39%, a surface area factor of 40%, and a catalyst factor of 26% based on study by Harahap (2020) done at a public high school in Gresik

Regency. According to research done in May 2023 at SMAN 1 Cerme in class XI MIPA 1, it was discovered that 55.88% of students had misconceptions and 20.58% did not understand the concept of collision theory, 81.36% had misconceptions and 16.66% did not understand the concept of concentration factor, 50.83% had a misconception and 16.38% did not know the concept of surface area factor, and 58.82% had a misconception and 23.52% did not know the concept of the temperature factor concept, 57.64% experienced misconceptions and 38.23% did not know the concept of the catalyst factor concept. The data was acquired from test results obtained using a three-tier diagnostic test instrument in the form of a question sheet including questions and reasons to choose from, as well as the level of trust in the reaction rate material. The findings revealed that students continued to have misconceptions about the reaction rate content.

Problems regarding student misconceptions must be remediated or repaired related to the material, but what needs to be done first is to diagnose misconceptions, because misconceptions can cause students difficulties in learning related material concepts (Mubarak, 2016). Misconceptions will significantly impede students' ability to acquire and assimilate new knowledge, limiting their performance in subsequent learning processes (Klammer, 1998). Using a diagnostic test is one technique to identify pupils' misunderstandings. A diagnostic test is a type of assessment that may be used to determine a student's areas of academic strength and weakness. This method can be used to diagnose students' misconceptions (Depdiknas, 2007). Misconceptions in students can be analyzed through the use of a three-tier diagnostic test instrument. The advantages of the three-tier diagnostic test compared to the two-tier diagnostic test are that it can detect misconceptions experienced by students more thoroughly, distinguish between understanding concepts, not understanding concepts and misconceptions as well as determining material topics that require greater emphasis during the learning process, besides that a three-tier diagnostic test can help organize better learning so that it can reduce students' misconceptions (Mubarak, 2016).

Based on research by Chittleborough (2014) states that the cause of the development of misconceptions comes from understanding the relationship between the three levels of chemical concept representation which is not always adequate. As a result, Chittleborough created a representation model in the shape of a triangle 'iceberg model,' which acts as an analogy for pupils who go to a greater level of comprehension because there are more symbolic and sub-microscopic levels. According to the findings of Davetak's (2018) research, students have developed misconceptions about all chemical principles learned at the sub-microscopic level. Students use the representational approach to solve chemistry issues when they can correlate the three levels of chemical concepts concurrently and accurately (Taber, 2013). Such representations, also known as sub-microrepresentations (SMRs), are comparable models of elements or compounds used as 2D or 3D static or dynamic assistance (Harrison & Treagust, 1998). As a result, the utilization of the three levels of representation (particularly dynamic SMRs) is critical, as is the accurate description of the fundamental elements of chemical representations in the form of explanations connected to macroscopic, submicroscopic, and symbolic levels in order to reduce student misconceptions.

Appropriate learning medium is required to eliminate students' misconceptions. The Student Worksheet is one of the learning media that may be used to eliminate students' misconceptions by exhibiting the three levels of representation in chemical

content. LKPD is a type of media that is based on tasks that must be done and serves as a tool to transfer knowledge and skills in order to increase students' interest in engaging in the learning process (Sriyono, 1992). Student worksheet can help students understand complicated chemistry ideas that can lead to misconceptions based on what students know by employing a conceptual change learning approach based on numerous representations. Thus, the goals of learning chemistry can be met appropriately, and the pattern of shifting misconceptions can be changed in a favorable manner (Sari, 2015). In order to establish an active learning environment for students, the use of learning tools should be supported by Student worksheet.

Based on pre-research data collected in February 2023 at SMAN 1 Cerme class XI IPA 1, information was obtained from students that textbooks are the most frequently used learning resources in chemistry lessons, particularly on reaction rate material, and that blackboards are the most frequently used teaching media. Additionally, lecturing, which only conveys theory about a material without presenting images, is the most frequently used teaching method by teachers. Based on the results of an interview with one of the chemistry teachers at SMAN 1 Cerme, information was obtained that the learning outcomes of students in the reaction rate material were 50% of the students did not meet the specified KKM. Teachers frequently use YouTube videos from the site as learning resources during class, therefore one of the challenges they frequently have is that their pupils don't comprehend the questions they are being asked. In addition, learning resources in the form of Student worksheet are only given as a guide in doing practicums that do not include chemical representations (macroscopic, submicroscopic, and symbolic). To overcome misconceptions to students, the teacher only provides material from a video and provides an explanation from the video so that there are still many student misunderstandings regarding the material of reaction rates.

Student Worksheets can increase a positive attitude towards learning so that it can reduce students' misconceptions about the Reaction Rate material. Student Worksheets provide opportunities for students to understand a material independently so that students are able to achieve the expected learning indicators (Andrianie, 2018). This is corroborated by earlier study from Nurpratami (2015) on reaction rate material based on multiple representations, which has valid qualities with an interpretation of a feasibility value of 90.3% and 80% of students' replies to the subject matter. This study shows that the learning model has the ability to reduce student misconceptions. This compiled Student worksheet will later be adapted to the conditions of students when studying reaction rate material with a conceptual change model based on multiple representations, so that it can facilitate all student activities that occur in the ongoing learning process which is expected to be trained together with students' mastery of concepts so as to reduce misconceptions about the rate of reaction and change the pattern of shifting misconceptions in a positive direction.

Based on the description above, the researcher aims to determine the validity of LKPD with a conceptual change learning model based on multiple representations on the reaction rate material in terms of the aspects of Student worksheet presentation, content feasibility, and language aspects.

▪ RESEARCH METHOD

Types of Research

The research method used in this study is the R&D (research and development) method using the 4D model developed by Thiagarajan. According to Thiagarajan (1974)

states that there are 4 stages of research and development using the 4D model, namely the define stage, the design stage, the develop stage, and the disseminate stage.

Research Objectives

The target of the research was student worksheets with a conceptual change model based on multiple representations which would be tested for feasibility by experts and also by the validator team of Chemistry Education lecturers at Surabaya State University which would be tested on students who had misconceptions about reaction rates. In order to examine the degree of feasibility of student worksheets media with a conceptual change model in the reaction rate factor material, the creation of student worksheets media was then evaluated by three experts material experts, language experts, and graphics experts.

Time and Place of Research

This research was conducted at State University of Surabaya and SMAN 1 Cerme, located at Jalan Pasar Cerme Lor No. 176 Ngabetan, Ngabetan, Cerme Lor, Cerme District, Gresik Regency.

Research Desaign

The research design used was a Pre-Experimental Research Design using a One group Pretest-Posttest Research Design where the group designs were selected in the same group with the pretest and posttest applied. In this study, the pretest was carried out before being given treatment which was used as an instrument to identify misconceptions in students. The research design is described as follows.

O_1	X	O_2

O1 = Pretest Value (before treatment)
X = Treatment
O2 = Posttest value (after treatment)

(Sugiyono, 2016)

Research Instruments

In this study used a validation sheet in the form of Student worksheet and a three tier diagnostic test instrument.

Data Analysis Technique

The feasibility of Student worksheet is reviewed from the score of the feasibility assessment of expert validation and practitioner validation. The eligibility of Student worksheet is based on the score of the expert validator and practitioner validator. Content validity analysis used the Aiken coefficient (V) validity as shown below, while construct validity analysis used the median data rater.

Aiken validity coefficient = V = $\frac{\Sigma S}{[n(c-1)]}$

s : r – lo
r : total rating score
lo : lowest rating for validity
n : number of raters
c : the quantity of rating categories

(Aiken, 1985)

The analytical data is utilized as a guideline for interpreting Student worksheet evaluation scores. The table of interpretation criteria for Aiken's validity coefficient is contained in Table 3.1 as follows.

Table 1 Interpretation of the Aiken Validity Coefficient

Interval V	Catogorie
V > 0,8	High Validity
0,4 < V ≤ 0,8	Moderate Validity
V ≤ 0,4	Low Validity

(Retnawati, 2016)

If the Aiken V validity coefficient is greater than 0.8 with a high validity predicate, the generated Student worksheet is considered to meet the criteria, and the Student worksheet is pronounced fit for usage.

Data on construct validity were gathered via expert evaluations of assessors and statistically analysed using median statistics in accordance with Haladyna's (2013) recommendations. According to Haladyna (2013), there will be a propensity to average the results when the evaluation is completed by two or more assessors and the final score is calculated by summing the ratings. The mean is the calculation for central tendency if the distribution is normal or platykurtic. However, if the mean is skewed because each rater's ratings are too wide, then the median is the appropriate computational statistic. The validator will assess and score each question by giving a scale of 1 (not valid) to 5 (very valid). Then the results will be interpreted into the criteria contained in Table 2 below:

Table 2 Median Results Interpretation Categorie

Score Range	Catogorie
1 - 1,9	Completely invalid
2,0 – 2,9	Invalid
3,0 – 3,9	Quite valid
4,0 – 4,9	Valid
5	Completely valid

(Adaptation of Riduwan,2015)

▪ RESULT AND DISCUSSION

The Student worksheet validation process is separated into two stages: design validation and material validation. Student worksheet was validated with three-tier diagnostic test instruments, student response questionnaires, and observation sheets. Two chemistry lecturers (experts) and three chemistry teachers validated the learning materials.

It is required to prepare the equipment that will be used to validate the Student worksheet prior to conducting the validation. The validator is asked to evaluate the instruments created in this activity. The expert validator and practitioner validator scores are used to determine Student worksheet eligibility. The Aiken coefficient validity (V) was employed in content validity analysis, whereas the median data rater was used in construct validity analysis. The proportion for each criterion is greater than 0.8 with a high validity predicate, indicating that the Student worksheet is fit for usage (Retnawati, 2016).

Following are the details of the Student worksheet validation results using the Aiken validity, which can be seen in Table 3 below.

Table 3 Data Validation Result of Student worksheet Contents Using Aiken Validity

Rated aspect	LKPD 1 (Collision Theory)	LKPD 2 (F. Concentration)	LKPD 3 (F. Surface Area)	LKPD 4 (F. Suhu)	LKPD 5 (F. Catalyst)	Qualifications
LKPD suitability with the Conceptual Change model	0,8 – 0,9	0,85 – 0,9	0,85 – 0,9	0,9 – 0,95	0,9 – 0,95	High Validity
LKPD suitability with the material	0,85 - 1	0,9 - 1	0,9 – 0,95	0,9 – 0,95	0,9 - 1	High Validity
LKPD Compliance with Multiple Representations	0,9 – 0,95	0,9 – 0,95	0,9	0,9 – 0,95	0,9 – 0,95	High Validity

Based on Table 3, the validation results of the content eligibility criteria obtained LKPD that are content valid. The following is Table 4 regarding the results of construct validation using the median data rater.

Table 4 Data from the Results of LKPD Construct Validation Using the Median

Rated aspect	Median					Qualifications
	LKPD 1 (Collision Theory)	LKPD 2 (F. Concentration)	LKPD 3 (F. Surface Area)	LKPD 4 (F. Suhu)	LKPD 5 (F. Catalyst)	
Language Criteria	5	4 – 5	4 – 5	4 – 5	5	Valid
Serving Criteria	5	5	5	5	5	Very Valid
Graphical Criteria	5	4 – 5	4 – 5	4 – 5	5	Valid

All components of build feasibility have been validated in a positive way, according to the data in Table 4, it can be shown. The median value, which falls between 4 and 5 (valid and highly valid), serves as proof of this.

The three tier diagnostic test instrument was verified in addition to the Student worksheet so that findings between the tests used to identify students' misunderstandings and the Student worksheet created could be compared. Two chemistry lecturers (experts) and three chemistry instructors validated the three-tier diagnostic test instrument.

The instruments that will be utilised to validate the three tier diagnostic test instrument must be ready prior to the validation. The validator is requested to evaluate the created instruments in this activity. The assessment score of the expert validator and practitioner validator is used to determine if the three tier diagnostic test instrument is feasible. Aiken coefficient validity (V) was employed for content validity analysis while the median data rater was used for construct validity analysis.

Following are the details of the validation results of the three tier diagnostic test instrument using the Aiken validity, which can be seen in **Table 5** below.

Table 5. Content validity using the Aiken validity coefficient (V) in the Three Tier Diagnostic Test Instrument

Rated Aspek		Question Number																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A.1	s	19	19	19	19	18	19	19	18	19	18	19	19	19	19	18	18	18	18	18	18
	V	0,95	0,95	0,95	0,95	0,9	0,95	0,95	0,9	0,95	0,9	0,95	0,95	0,95	0,95	0,9	0,9	0,9	0,9	0,9	0,9
A.2	s	16	17	17	16	17	16	17	17	17	17	17	17	17	16	17	17	17	17	17	17
	V	0,8	0,85	0,85	0,8	0,85	0,8	0,85	0,85	0,85	0,85	0,85	0,85	0,85	0,8	0,85	0,85	0,85	0,85	0,85	0,85
A.3	s	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
	V	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9
A.6	s	18	18	18	17	17	18	18	18	17	17	18	18	18	18	18	17	18	18	18	18
	V	0,9	0,9	0,9	0,85	0,85	0,9	0,9	0,9	0,85	0,85	0,9	0,9	0,9	0,9	0,9	0,85	0,9	0,9	0,9	0,9
A.7	s	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
	V	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8
A.8	s	18	18	18	17	18	18	18	17	17	17	18	17	17	17	18	18	18	18	17	17
	V	0,9	0,9	0,9	0,85	0,9	0,9	0,9	0,85	0,85	0,85	0,9	0,85	0,85	0,85	0,9	0,9	0,9	0,9	0,85	0,85
A.9	s	16	16	16	17	17	17	17	17	17	17	17	16	15	17	16	16	17	17	17	16
	V	0,8	0,8	0,8	0,85	0,85	0,85	0,85	0,85	0,85	0,85	0,85	0,8	0,75	0,85	0,8	0,8	0,85	0,85	0,85	0,8

A three-tier diagnostic test instrument that is content valid was created using Table 5 as the basis for validating the content eligibility requirements.

The findings of construct validation using the median data rater are shown in Table 6 below.

Table 6. Construct Validity using the Median in the Three Tier Diagnostic Test Instrument

Rated aspect	Question Number																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A.4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
A.5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
A.10	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
A.11	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
A.12	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
A.13	4	4	5	5	4	4	5	5	5	4	5	4	5	4	5	5	5	4	4	4

Information :

A1. The elements that influence the response rate are the items' compatibility with the sub-material.

A2. The items' conformity to the question indicators

A3. The items' conformity to the material's sequence

A4. The clarity of the boundary questions, the replies, and the justification of the expectations

A5. Instructions for diagnostic tests are clear.

A6. The degree to which the item items and the question indicators and fundamental abilities are consistent

A7. Each diagnostic test question can lessen pupils' erroneous beliefs.

A8. The selection of the explanations given might highlight the root causes of student misunderstandings.

A9. The distractor on the selection of motives is logical and consistent with the first-level responses.
A10. The relevance of tables, graphs, figures, and similar elements
A11. Comprehensible sentences in Indonesian
A12. Different phrases or inquiries do not elicit different interpretations.
A13. Each exam item's questions are presented in an understandable and informative manner.

Based on the information in Table 6, it is evident that the three tier diagnostic test instrument's build feasibility may be considered to be valid in all respects. The median value, which falls between 4 and 5 (valid and highly valid), serves as proof of this.

According to Table 3, the validation findings of the content eligibility criteria utilizing Aiken validity determined that the proportion of each criterion was > 0.8 with a high validity predicate, hence the Student worksheet was pronounced fit for usage. The feasibility of the produced Student worksheet contents includes the Student worksheet learning activities in line with the conceptual change learning syntax, the Student worksheet appropriateness with the material, and the Student worksheet suitability with numerous representations. The first aspect is the suitability of the Student worksheet with the conceptual change learning syntax to get a validity value of > 0.8, which means getting the appropriate criteria. Student worksheet is in accordance with the syntax of the conceptual change learning model according to Nusabaum & Novick (1982) which consists of 3 phases, namely phase 1 reveals the students' initial conceptions, phase 2 creates cognitive conflict, and phase 3 seeks accommodation. This stage involves doing an analysis through phenomenon observation, practicum activities, and a number of student-driven questions to ensure that the Student worksheet created is consistent with the syntax of the conceptual change learning model. This supports Davis's (2001) assertion that the Conceptual Change model is defined as learning that modifies preexisting conceptions (i.e., beliefs, ideas, or ways of thinking), suggesting that learning entails more than only collecting knowledge or developing new skills. Similarly, Posner et al. (1982) define Conceptual Change as two processes: assimilation and accommodation. Students in the assimilation phase employ old and well-known concepts to deal with new situations, with only minor adjustments. Because their old conceptions are no longer relevant, students must replace or modify them as part of the adaptation process. In the conceptual change learning model, one of the most important syntaxes is to create conceptual conflicts against conceptions, which at this stage are able to overhaul false beliefs based on facts. According to Dahar, in conditions of cognitive conflict students are faced with three choices, namely 1) defending the initial concept, 2) revising some of the initial concepts through the assimilation process, 3) changing the concept and accommodating new knowledge. Conceptual changes occur when students decide on the third choice (Pebrianti, 2013). This is in accordance with phase 3 in Student worksheet, which is seeking accommodation so that it can reduce misconceptions in students.

The second aspect is the suitability of the Student worksheet with the reaction rate material, which based on Table 3 gets a validity value of >0.8 which means it gets the appropriate criteria. To ensure that the Student worksheet created is in compliance with the learning outcomes, learning objectives, and the flow of learning objectives utilised in the Merdeka curriculum, an analysis of the subject matter of the rate of reaction is conducted in this phase.

The third aspect is compatibility with multiple representations. In this aspect, it gets validity > 0.8 which means it gets the appropriate criteria. This stage involves analysing the created Student worksheet by looking at it through the lenses of its symbolic, submicroscopic, and macroscopic representations. The emergence of students' misconceptions shows the inability of students to connect the three levels of representation. According to Ainsworth (in Treagust 2018) describes that the function of the level of representation in learning, namely by completing information and cognitive processes, to limit misconceptions/misinterpretations of phenomena, and to increase understanding and reasoning power which is more about solving problems. The linkage of the three levels of understanding of representation determines success in mastering chemistry as a whole and well, if you are able to connect the three levels of understanding of representation (Farida et al., 2017). Students will face an increasing number of mistakes when three levels of representation are used to explain direct chemical phenomena (Sirhan, 2007). In order to properly explain chemical concepts, one must move from the macroscopic to the submicroscopic to the symbolic levels (Shui-Te et al., 2018). based on this foundational truth Gilbert and Treagust (2009); Head et al. (2017); Milenkovi et al. (2014); and Sunyono et al. (2015) contend that a strategy for developing the notion of chemical material with a comprehensive representation is necessary as an appropriate action in studying chemistry. The Three Tier Diagnostic Test Questions are also in line with Student worksheet. Overall, the generated Student worksheet contents meet the necessary criteria for practicality.

The feasibility of the Student worksheet construct model based on multiple representations of conceptual change which is developed is based on several aspects. The first aspect is language which includes writing Student worksheet using easy-to-understand terms, concise and clear language, compliance with good and correct Indonesian language rules and effective and efficient use of language (Depdiknas, 2008). Factors that cause students' misconceptions include wrong initial concepts, stages of cognitive development that are not in accordance with the concepts being studied, limited and wrong reasoning of students, the ability of students to capture and understand the concepts being studied, the use of wrong language and terms , and students' interest in learning the concepts given and taught (Dwi, Rahayu, & Erman, 2013). So that the language factor is needed in helping students to understand a concept. The information in Table 4.3 demonstrates that the linguistic criteria's components are valid in a constructive way. The median number, which ranges from 4 (valid) to 5 (very valid), serves as proof of this.

The second is the presentation criteria, which includes the presentation of learning outcomes, learning objectives, and the flow of learning objectives. There are activity titles in each phase of the Student worksheet, and the presentation of the Student worksheet includes 3 chemical representations (macroscopic, submicroscopic, and symbolic) that are interesting and increase student curiosity. This fact is supported on the basis that the level of representation is very important for learning chemistry (Guci et al, 2017) because it can determine success in understanding chemistry concepts as a whole (Farida et al, 2017) and is effective in reducing students' misconceptions. Other facts also explain Azhar et al., (2020) that the level of understanding representation can be a place to increase meaningful learning so that it helps students remember the material being taught. The statistics in Table 4 demonstrate that the presentation criterion features are valid in a constructive manner. The median number, which is in the range of 5 (extremely valid), serves as proof of this.

The third element is graphic, which comprises the Student worksheet cover, which summarises the contents, the reader-friendly typefaces and sizes, the harmony of the text and picture layouts, and the use of contrasting and suitable colour schemes. The information in Table 4 indicates that the graphical criterion aspect has been valid in a positive way. The median number, which ranges from 4 (valid) to 5 (very valid), serves as proof of this.

The median rating, which ranges between 4 and 5, indicates that the Student worksheet generated in terms of presentation, language, and graphic criteria is generally constructively valid. This shows that the developed Student worksheet is student-centered where students start from phenomena to carry out scientific investigations. This is in accordance with the implementation of chemistry learning as other learning which emphasizes students as forming knowledge networks or known as student centers (Kemendikbud, 2013).

The developed Student worksheet was declared feasible using the Aiken Validity with results > 0.8, which means getting the eligibility criteria for the content. While the feasibility of Student worksheet based on construct feasibility is constructively valid as evidenced by the median value which is in the range of 4 (valid) and 5 (very valid).

▪ CONCLUSION

The three tier diagnostic test instrument and the Student worksheet were declared feasible using the Aiken validity with results > 0.8, which means meeting the proper criteria for content eligibility, based on the suitability of the research findings with the formulation of the problem. Although the media ratings, which range from 4 (valid) to 5 (very valid), indicate that the Student worksheet and the three tier diagnostic test instruments based on construct feasibility have been valid in a constructive sense.

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