FEASIBILITY OF STUDENTS WORKSHEETS USING CONCEPTUAL CHANGE TO REMEDY MISCONCEPTIONS ON CHEMICAL BONDING MATERIAL

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Abstract. *This research aims to determine the feasibility of student worksheets to remediate misconceptions on chemical bonding material, sub-material ionic bonding and covalent bonding with the development of conceptual change models on student worksheets. The research method used is research and development (R&D). Three tier diagnostic tests are used to determine misconceptions experienced by students. Quantitative data analysis is used to determine the classification of student's conceptions and also the remidiation level of misconceptions. The results of this study obtained the feasibility of a student worksheets which was assessed from validity, practicality, and effectiveness. Validity gets a percentage of 83.01% with a very valid category. Practicality gets a percentage of 93.54% with a very practical category. Effectiveness in terms of the N-Gain score in the high and medium level category. This shows that the student worksheets which developed can classified as feasible, so it can be used to remediate students misconceptions on chemical bonding material*

Keywords: *Feasibilty, Student Worksheets, Conceptual Change, Misconception*

INTRODUCTION

Chemistry learning has undergone rapid changes from students as passive recipients of knowledge to students as forming networks of knowledge in the mind. This is in accordance with the philosophical foundation of the 2013 curriculum which education is aimed at developing intellectual intelligence and academic excellence through disciplinary education. One of the disciplinary education in Indonesia is chemistry, which is a part of natural science that contains a set of concepts, principles, laws, and theories [1].

Chemistry consist from simple concepts to more complex concepts. These concepts are interrelated each other. Basic chemical concepts will construct more complex concepts [2]. So in learning it needs continuity and hierarchical knowledge between each concepts. One of the scope chemical material in the standard curriculum of primary and secondary education is chemical bonds. Chemical bonding is a topic that far from the daily experience of students, in addition students cannot see the atom, structure, and how an atom interacts with other atom, so its potential for presenting misconceptions [3]. In ionic bonding concepts there is a misconception of 58% of the ion formation process and the process of ionic bonding, where students define both processes by electron transfer [4].

Misconception is a conception of someone who is not in accordance with scientific conceptions that are recognized by experts [5]. Misconceptions can occur to anyone regardless of age, ability, gender, education level and socio-cultural environment. No matter how talented the group of students is, each group will have students who experience misconceptions regardless of background. So a very large percentage of students will experience misconceptions [4]. If student's misconceptions about a concept develop further, students will feel difficulties in learning

chemical concepts when in high level, so it is important to make efforts to remedy these misconceptions through learning aimed at improving the concept. Especially concepts in chemistry subjects, chemical bonding material.

The effort to avoid misconceptions is designed learning process with conceptual change model [6] The conditions of conceptual change can be fulfilled through cognitive accommodation that starts from the student's initial knowledge. To create the cognitive accommodation process, Novick proposes three phases of learning (1) Exposing alternative frameworks, (2) Creating conceptual conflicts, (3) Encouraging cognitive accommodation [7]. The learning phases proposed by Novick are known as the Novick learning model. In conceptual change learning model students must be dissatisfied with existing conceptions and discover new concepts that can be understood, make sense, and give benefits before conceptual restructuring will occur [8]. Conceptual change as a learning process that can changes an initial conception, then declared that learning process not only collecting fact but also changes the initial concept if this concept contain of wrong concept [9].

Student Worksheets used as teaching material in the form of sheets paper containing material, summaries, and instructions for the implementation of learning tasks to be done by students, both theoretical and practical in nature that refer to core competencies and competencies the basis that must be achieved by students, and its use depends on other teaching materials [10]. In the learning process, it is really needed student worksheets that supports the achievement of learning objectives. This student worksheets must be arranged by the teacher according to the needs of students [11].

METHOD

This type of research is a developmental study of student worksheets to remedy misconceptions on chemical bonding materials. The respondents of this study are 30 students from X MIA-1 class, Gedangan Public High School, Sidoarjo.

The research method used is research and development (R&D). Research to be carried out is limited until product trials because this research aims to test the feasibility of the product. The product development process includes potential and problems, information gathering, product design, product design validation, product design revisions, product trials, and product revisions [12].

The research instruments used were validation sheets, student activity sheets, student questionnaire responses, and three-tier diagnostic tests for the pretest and posttest.

The feasibility of worksheet are obtained from the analysis of validity, practicality, and effectiveness data

a. Validity

The percentage of validation data obtained by the Likert Scale as in table 1.

Table 1. Likert Scale for Validity

Criteria	Score
Very good	4
Good	3
Good enough	2
Bad	1
Not present	0

[3]

The score interpretation table shows the percentage of validation assessment worksheets by the validator. The interpretation of the percentage results score is presented in table 2

Table 2. Interpretation of Score

Score	Criteria
0 % - 20 %	Very bad
21 % - 40 %	Bad
41 % - 60 %	Good enough
61 % - 80 %	Good
81 % - 100 %	Very good

[3]

Based on the scale criteria above, student worksheets can said valid when the percentage obtained from the results of validation on the content validity and construct validity is ≥ 61%, so the student worksheets can be used as teaching material during the teaching and learning process.

b. Practicality

Practicality asses from two instruments.

They are students responses and students activity. The percentage of data obtained based on the Guttman Scale as in table 3.

Table 3.Guttman Scale

Answer	Score
Yes	1
No	0

[3]

The score interpretation table shows the practicality of students worksheets. The interpretation of the percentage results score is presented in table 4

Table 4. Interpretation of Score

Score	Criteria
0 % - 20 %	Very bad
21 % - 40 %	Bad
41 % - 60 %	Good enough
61 % - 80 %	Good
81 % - 100 %	Very good

[3]

Based on the score interpretation table, student worksheets can declared to fulfill practical criteria if the response of students who answered "Yes" has a percentage of ≥61% and the student's activity outcome of ≥61%, so the student worksheets classified as practical.

c. Effectiveness

The effectiveness of students worksheets can be seen through the learning outcomes of students at the pretest and posttest of chemical bonding material, in sub material ionic bonding and covalent bonding using a three-tier diagnostic test. The results of the pretest and posttest were analyzed according to the classification criteria know the concept. If students are declared knowing concept then the answer is considered correct. If students are declared misconceptions and don't know the concept, then the answer is considered wrong. Then the data is processed using the formula N-gain (normalized gain) with the formula

$$N - gain = \frac{posttest\ score - pretest\ score}{maximal\ score - pretest\ score}$$

The calculation results are interpreted using the N-gain score (g) criteria shown in table 5.

Table 5. Interpretation Score of N-Gain

No	Score <g>	Criteria
1.	g > 0,7	High
2.	0,7 < g < 0,3	Medium
3.	g < 0,3	Low

Learning outcomes are declared successful in remediating student's misconceptions if the n-gain score in the medium and high category.

RESULT AND DISCUSSIONS

The development of student worksheets with the conceptual change model to remedy student's misconceptions on chemical bonds material was tested on 30 students at X MIA-1 Class in Gedangan public high school on 5-6 February 2020. This trial was conducted to find out the feasibility of students worksheets developed in terms of three aspects, these are validity, practicality, and effectiveness.

Validity

Validity was assessed using a validity sheet instrument conducted by 3 validators, consisting of two chemistry study program lecturers and one high school chemistry teacher. The validation results are the data of the validity of the students worksheets that was developed in terms of content and construct [13].

Validity of Content

Content validity includes (1) suitability of material with basic competences, (2) suitability of students worksheets with child development, (3) conformity with student worksheets to remediate misconceptions, (4) suitability of learning material substance, (5) suitability of three-tier test diagnostic with concepts [14]. Table 6 below is the result of student worksheets with the conceptual change model to remediating misconceptions evaluating about the content validity.

Table 6. Result of Content Validity

No	Validation aspect	% validity
1.	Suitability of the material with basic competencies	87,45
2.	Suitability of student worksheets with the child development	79,40
3.	Suitability of student worksheets to remedy misconceptions	83,3
4.	Suitability of learning material substance	91,65
5.	Suitability of three-tier test diagnostic with the concept	83,3
Average		85,02% Very good

The results of the content validity assessment from table 6 having a percentage of 85.02% and it interpreted in table 2 produce very good criteria, so its mean that the students worksheet very valid to used.

Below is example of student worksheets content that has been validtated as content validity

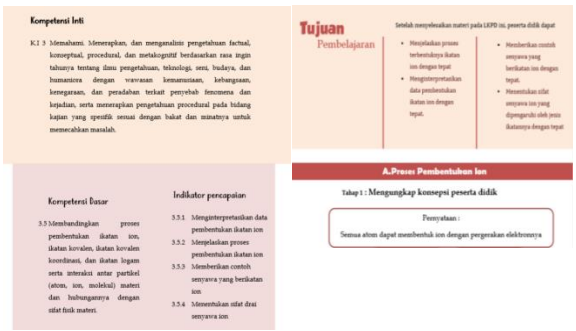

Figure 1. Validity Content of Student Worksheets

Based on this picture, can be informed that student worksheet developed with core competence 3 and basic competence 3.5 for chemistry senior high school at ten grade. So, to make the goals indicator dan learning goals its accordance with core competence and basic competence. Based on validity score it can conclude that learning goals dan indicator goals it represent core competence and basic competence well, so the validity score for content get high percentage.

Validity of Construct

Construct validity includes: (1) display, (2) presentation, (3) language. Table 7 below is the result of evaluating the construct validity of the student worksheets using the conceptual change model to eliminate misconceptions.

Table 7. Result of Construct Validity

No	Validation aspect	% validitity
1.	Display	75
2.	Presentation	85
3.	Language	83
Average		81% Very good

The results of construct validity assessment from table 7 that have a percentage of 81% are interpreted in table 2 produce very good criteria, so its mean that the students worksheet very valid to used.

Based on previous research which is relevant, validity of learning media will influences the learning process. The development of anti-miskim software that used to remedy misconceptions in acod base material having content validation 75% and construct validation 78% can be used to remedy misconceptions in high level [15]. So, this proves that SWS which developed can be used to remediate misconceptions because getting higher percentage in validity aspect.

Below is the example of student worksheets content that has been valiated as content validity

Figure 2. Validity Construct of Student Worksheets

This picture shows the cover of student worksheet part 1 and part 2. In part 1 contain of ionic bonding with red theme, and in part 2 contain of covalent bonding with blue theme. The cover using chemical bonding as basic background to represent student worksheets overall. But, both of these two didn't show any correlation in color, its make the percentage of validity construct at display aspect having lowest score than another.

The results of the validation content and construct got an average percentage of 83.01%, so students worksheets with the conceptual change learning model to remediate student's misconceptions on the chemistry class X bond material that was developed classified as valid with a very valid category.

Practicality

The practicality of the developed students worksheets can be obtained from the results of student questionnaire responses that are supported by observing student activity data when the trials take place. Based on previous experiment, its mention that response questionnaire and student activity used to determain the practicality of learning media because from both of the data can be seen how learning media operated by user, how learning media make efficiency in learning process, and how learning media give another experience for user to study so its make user know material easier [16].

Response Questionnaire

The response questionnaire contained questions that represented student's responses to various aspects of student worksheets. There are 10 question which needed to fulfill by user. These question classify as 3 aspect. For the first is interests aspect, these aspect preset in question number 1, 3, and 10. Second aspect is about motivations that represent in question number 4, 8, and 9. The third aspect is about the SWS display that represent in question number 2, 5, 6, and 7. Response questionnaire is used to determine the practicality which is supported by the results of observations of student's activities. At the time of the trial student worksheets, the results obtained by student's responses to student worksheets is 95.34% so it classified as practice with very good criterion which mean that student woeksheets having a good responses from user.

Students Activity

Observations of student's activities were carried out by 3 observers, each observer observed the activities of 10 students. There are 4 types activity in the trials which is accordance with the step of the conceptual change learning model, they are: (1) exposing alternative frameworks, (2) creating conceptual conflicts, (3) encouraging cognitive accomodation [5]. Table 8 below is the result of observing student activities for 2 worksheets limited trial meetings

Table 8. Student Activities Data

No	Metting	% activity
1.	Meeting-1 (SWS 1)	98,17
2.	Meeting-2 (SWS 2)	90
Average		94,01 Very accomplish

Based on table 8, it can be seen that during the trial of student worksheets, the student's activities gained a percentage of 94.01% with a very fulfilling category both at the first and second meetings.

Below is the example of student's answer at worksheet part 1 at Exposing Alternative Farmework steps

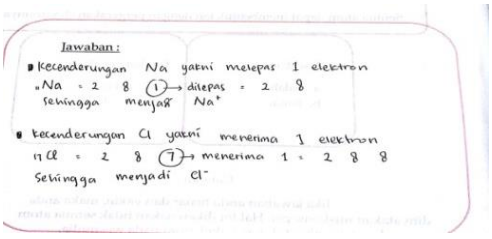

Figure 3. Exposing Alternative Farmework Activity during Trial

In this picture shows that student already answer the question in worksheet. Its mean that student doing the students activities in a good way. In this picture can informed that student in concept 1, ionic forming at step exposing alternative framework can analyzed the phenomenon that has been given well about how to stabilized atom Na and Cl. So, student can make the electron configuration to stabilized these two atoms.

Based on student responses questionnaire that having 95.34% in percentage and student activity data having 94.01% in percentage, its

shown that the student worksheets can classified as practice with very practice category.

Effectiveness

Student learning outcomes are used to determine the effectiveness of student worksheets with the conceptual change model to remediates misconceptions in chemical bonding. To find out the effectiveness of student worksheets can be obtained from Three Tier diagnostic test data given to students at the beginning and at the end of the trial. Three Tier diagnostic tests are used to detect student's understanding of concepts before and after using student worksheets.

The data is processed using the N-gain (normalized gain) formula. N-gain shows the results of student achievement at the time of the test and compared with the maximum score used. In the previous experiment that already done its mention that conceptual change learning model can increasing the N-gain score of student learning result with 62% in percentage, which is categorized as medium level [17]. So, its proof that conceptual change can increasing the student's understanding material and its can help to remediates misconception well. Figure 4 present the N-gain result of student outcomes

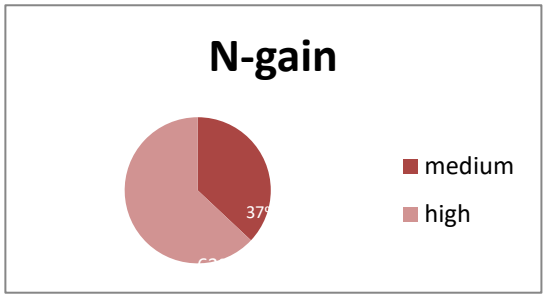

Figure 4. N-Gain Score

It can be seen that the percentage of N-gain score in the high category reaches 63% or 19 students, this shows that there are a difference in understanding student's concepts to know the concept on a large scale. Meanwhile, for the percentage of N-gain score of the medium category of 37% or 11 students, this shows that there are differences in understanding student's concepts to know the concept on a medium scale, meaning there are still some misconceptions that have not been emanated completely. For the percentage of N-gain score in the low category of 0%, this shows the achievement of student learning outcomes get good results. With the high percentage of medium and high categories, student worksheets with the conceptual change learning model to remediate student's misconceptions in class X SMA on chemical bonding material is said to be effective or successful because it is able to remediate student's misconceptions with a high scale.

CONCLUSION AND RECOMENDATION

Conclusions

Student worksheets with Conceptual Change Learning Model to remedy misconceptions on the chemical bond material that has been developed can be declared feasible in the details below:

1. The validity of the contents and constructs obtained respectively are 85.02% and 81% which are classified as very valid
2. Questionnaire responses and activities of students get a percentage of 95.34% and 94.01% respectively so that it declared very practical
3. Student learning outcomes get 37% in the medium category and 63% in the high category, so the student worksheets is declared effective.

Recomendation

1. Student worksheets content in the form of practice questions need to be improved and adjusted to the emotional development of students, so they can support intellectual and emotional development at the same time.

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