DEPLOYMENT OF INTERACTIVE STUDENT WORKSHEET OF CHEMISTRY LEARNING IN SENIOR HIGH SCHOOL (SMA)

Muharram¹, Adnan², Muhammad Anwar³

¹ Department of Chemistry, State University Of Makassar
² Department of Biology, State University Of Makassar
³ Department of Chemistry, State University Of Makassar

muharram_pasma@yahoo.com

Abstract— This research is a development research that aims to produce a valid, practical, and effective Interactive Student Worksheet of chemistry learning in senior high school. Interactive worksheets were developed include: true-false, multiple choice, multiple choice with more than one correct answer, match, sort, maps, and crossword puzzles. The development model used on is ADDIE development model with five stages: analysis, design, development, implementation and evaluation. The validity based on assessments of two validators and two chemistry teachers. Test the practicality of the device is done by giving a questionnaire on student. The effectiveness is based on N-gain critical thinking skills of students. The trial stiffened in class XI MIA student of SMAN 11 Makassar in the second semester of the academic year 2014-2015. Interactive worksheets were developed have valid, practical and effective criteria. The average results of the validation performed by experts for true-false, multiple choices, multiple choices with more than one correct answer, matching, sequencing, mapping, and crossword puzzles of interactive worksheets are: 4.08; 4.02; 4.27; 4.11; 4.10; 4.38; and 4.25 respectively. Results of the validation by chemistry teacher shows the average value for true-false, multiple choices, multiple choices with more than one correct answer, matching, sequencing, mapping, and crossword puzzles of interactive worksheets are: 4.15; 4.13; 4.05; 4.16; 4.16; 4.36; and 4.25 respectively. The percentage of positive responses of students to true-false, multiple choices, multiple choices with more than one correct answer, matching, sequencing, mapping, and crossword puzzles interactive worksheets are: 74.8; 72.2; 71.3; 71.1; 72.5; 75.8; and 75.8 respectively. The average N-gain critical thinking skills of students was 0.45 or medium category.

Keywords: interactive worksheet, ADDIE development model

I. INTRODUCTION

Nowadays, Science and Technology develop progressively of which students are able to learn anywhere and anytime based on their learning interest and learning style. In this case, teachers do not only play role as learning source, but also they can design a learning taking the advantage of media and learning sources to create effective and efficient learning (Sanjaya, 2012).

The progression of technology induces humans to interact each other both consciously and unconsciously. Electronical media as the result of technology development clearly attract students’ interest and have important role to the development of education. The advantage of learning activity caused by the improvement of science and technology is that students are able to seek for information and learn it by themselves. This learning means an activity conducted realistically and concretely which can enhance understanding and critical thinking. In addition, it frequently avoids verbalism.

Technology advancement can be used as learning sources meaning information provided and stored in the form of media which may help students to learn as the manifestation of curriculum (Prastowo, 2011). They can be the form of object, data, facts, ideas, or humans which can elicit learning process. This usage may help students increase their understanding and skills of a lesson. However, most teachers teach using direct learning model with preaching method without sufficient learning source facilities. Consequently it causes boredom, misperception, and unattractive learning which result in unsatisfying learning outcomes.
One of the examples of learning source is Student Worksheet. SW is a learning alternative appropriate for students since it helps them collect information related to concept through systematic learning. In learning process, SWs has been used by teachers and students (Indrianto, 1998). Based on the observation conducted in SMA Negeri 11 Makassar, the SWs used by the teachers are are quite conventional i.e. SW distributed by a publisher to teachers without the contribution from teachers such as the plan, the preparation, and the arrangement. Then, it causes the SWs unattractive and monotonous. Besides that, they don’t notice the need of students.

Furthermore, the SWs may not help students in comprehending concept since they are in the form of exercises only. Based on an interview with a chemistry teacher in SMA Negeri 11 Makassar, she feels difficulty in making students comprehend the subject caused by the abundance of materials and the limited time of teaching. It then forces her to use SW as learning source in students’ house to fulfill the material giving implementation.

On the basis of education research, sw simplifies students to comprehend learning material since the material is summarized and it contains exercises which helps students to understand the point of learning, simplifies the work of teachers, and stimulate students to learn. Moreover, it helps lazy students who free unwilling to read long description of material

Advantages of LKS will not be perceived by students when worksheets that have been used by students in learning is still not practical and effective. Students’ worksheet can be developed that can be tailored to students’ needs and technological developments. One way to do that is to develop worksheets by using certain software, so students’ worksheet more practical and effective for use in learning, both used at school and home use. A software which can be used is a quiz creator that can be used to create interactive worksheets.

Students’ worksheet is packaged using software quiz creator can be used by students as a source of learning to create learning process a fun, interesting, interactive, and effective, and is expected to motivate students to learn independently, creatively, and can reduce the saturation of the students in the learning process in the classroom. Based on the above description, the necessary research to develop interactive chemistry students’ worksheet using quiz creator program as an innovation in the world of education that utilizes the development of science and technology, especially in high school chemistry material. The research question posed in this study is that “is the developed students’ worksheet valid, practice, and effective?”.

II. RESEARCH METHOD

The kind of this research was (Research and Development) aimed at creating teaching material in the form of interactive students’ worksheet in the subject of chemistry which satisfying valid, effective, and practice criteria. The result of the developed teaching material was tested with restriction (small scale) in SMA Negeri 11 Makassar. The subject for product validation was the expert of media and chemistry material including two chemistry teachers. The subject of the test was students in grade XI MIA consisting of 20 students of which there are 8 boys and 12 girls.

The development of the interactive students’ worksheet applied research and development, which refers to the ADDIE development model. ADDIE Model consists of five stages, namely analyzing, designing, developing, the implementing, and evaluating. Model development ADDIE was chased based on its advantages i.e.: 1) it can be used as a basis for developing instructional media because of a general nature, 2) the description of the model in a more complete and systematic, making it easier for researchers to control its execution, 3) it can save time and costs, 4) in its development involves the assessment of experts, so prior the test, there are advices from the experts

The validity test of the students’ worksheet was obtained from the review of two experts, meanwhile the practical test was obtained from the responses of students and teachers. During the use of the package, effectiveness test was obtained using the instrument of critical thinking of students.

III. FINDINGS AND DISCUSSION

A. Analysis Stage

Currently students generally already have a personal computer or laptop and a smartphone, even in some schools, they require that each student should bring laptop to school. The circumstances in which students prefer to operate a computer should be utilized by teachers to obtain learning aims and also can reduce the misuse of technology by students
The number of effective weeks which is not balanced to the number of material which should be taught makes teachers overwhelmed. Besides that, students feel difficulty to comprehend the material caused by some of the materials which are taught rapidly to fulfil the target of competency achievement and education agenda. Most of the time, students are just asked to take exercise in a worksheet which make them bored except one or two of them who pay attention to finish their exercises.

Based on the observation conducted in SMA Negeri 11 Makassar, the Students’ Worksheet used by the teachers are are quite conventional i.e. SW distributed by a publisher to teachers without the contribution from teachers such as the plan, the preparation, and the arrangement. Then, it causes the SWs unattractive and monotonous. Besides that, they don’t notice the need of students.

Consequently, interactive students’ worksheet should be developed. The interactive students’ worksheet made in the form of software quiz creator as learning source which can motivate students is expected to solve all the problems. Besides that it can be used as reflection for their comprehending. The interactive can also solve the problem of the effective time since students can study in their houses using this students’ worksheet

**B. Design Stage**

In this stage, the students’ worksheet had been designed to cover: true false question, multiple choice with more than one correct answers, matching, ordering, mapping, and puzzles. The students’ worksheet used software quiz creator.
C. Development Stage (Students’ Worksheet Validation by Expert Validator and Chemistry Teacher)

Based on the results of the validation of the experts and chemistry teacher toward true-false students’ worksheet, the instruction should be revised, the sentence patterns should be altered, and the information related to the use of worksheets should be provided. The changes are shown in Figure 2.

Besides that, there were some mistakes in the writing of chemistry formula. Then the refinement is shown in the figure 3.

Before validation

5. Perubahan CH₃CH₂CHO CH₃CH₂CH₂OH dapat dilakukan dengan reaksi adisi
   - Incorrect
   - Correct

After validation

5. Perubahan senyawa kimia seperti ditunjukkan pada gambar di samping dapat dilakukan dengan reaksi adisi
   - Correct
   - Incorrect
Figure 3. Change of Interactive Students’ Worksheet content in the section of True-False Question

According to the suggestion from the validation result, some refinements were done shown in figure 4.

Figure 4 Change of Interactive Students’ Worksheet Instruction in the section of Multiple Choices

In addition, there were some mistakes found in the form of molecule formula writing and the use of Bahasa Indonesia aspect. The refinement is shown in the figure 5.

Figure 5. Change of Content in the interactive Students’ Worksheet in the section of multiple choice

Based on the result of validation result, the refinement conducted to the interactive students’ worksheet in the section of multiple choices with more than one answers includes the instruction in the interactive students’ worksheet (Figure 6).
Gambar 6. The change of the instruction in the section of multiple choices with more than one answers

In the content of students’ worksheet, it was found some shortages which should be refined. The result of the refinement is shown in the figure 7.

Figure 7. Change of the interactive students’ worksheet content in the section of multiple choices with more than one answers

The change administered to the section of matching is related to the instruction as well as shown in the figure 8.
Before validation

after validation

Figure 8 The change of Interactive students’ worksheet in the section of matching

For the other sections e.g. crossword puzzle, the validators didn’t give any suggestion for the refinement. In total, the results of the validation is shown in the table 1. In the table, the interactive students’ worksheet has valid category.

Table 1 The Value Average of Validation Result of Interactive Students’ Worksheet in the Subject of High School Chemistry by Expert

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Form of STUDENTS’ WORKSHEET</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Instruction Aspect</td>
<td></td>
</tr>
<tr>
<td>1 The instruction is clearly stated</td>
<td>4</td>
</tr>
<tr>
<td>2 The instruction is understandable</td>
<td>4</td>
</tr>
<tr>
<td>Aspect of Interactive students’ worksheet</td>
<td></td>
</tr>
<tr>
<td>1 Activating students</td>
<td>4</td>
</tr>
<tr>
<td>2 Simplifying students to understand</td>
<td>4</td>
</tr>
<tr>
<td>3 Simplifying teachers to give exercise to students</td>
<td>4</td>
</tr>
<tr>
<td>4 Being used students to independently learn</td>
<td>4,5</td>
</tr>
<tr>
<td>5 Interesting layout</td>
<td>4</td>
</tr>
<tr>
<td>6 There is a feedback</td>
<td>4</td>
</tr>
<tr>
<td>Language Aspect</td>
<td></td>
</tr>
<tr>
<td>1 In accordance to Bahasa Indonesia’s rule</td>
<td>4</td>
</tr>
<tr>
<td>2 Communicative Statements</td>
<td>4,5</td>
</tr>
<tr>
<td>3 Using simple language, understandable, not ambiguous</td>
<td>4</td>
</tr>
<tr>
<td>Average</td>
<td>4,08</td>
</tr>
<tr>
<td>Criteria</td>
<td>V</td>
</tr>
</tbody>
</table>

Description:

V : Valid
A: True-False
B: Multiple Choices
C: Multiple choices with more than one answers
D : Matching
E : Ordering
F : Mapping
G: Crossword puzzles

The results of the validation by the chemistry teacher is shown in the table 2. In the table, the interactive students’ worksheet has valid category.
Tabel 2 The Value Average of Validation Result of Interactive Students’ Worksheet in the Subject of High School Chemistry by Chemistry Teacher

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Form of STUDENTS’ WORKSHEET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruction Aspect</td>
<td>A  B  C  D  E  F  G</td>
</tr>
<tr>
<td>1 The instruction is clearly stated</td>
<td>4   4   4   4   4   4   4</td>
</tr>
<tr>
<td>2 The instruction is understandable</td>
<td>4   4   4   4   4   4   4</td>
</tr>
<tr>
<td>Aspect of Interactive Students’ Worksheet</td>
<td></td>
</tr>
<tr>
<td>1 Activating students</td>
<td>4.5 4 4 4.5 4 4 4 4 4</td>
</tr>
<tr>
<td>2 Simplifying students to understand</td>
<td>4   4   4   4   4   5</td>
</tr>
<tr>
<td>3 Simplifying teachers to give exercise to students</td>
<td>4.5 4.5 4.5 5 4 4 4 4 4 4 4 4 4</td>
</tr>
<tr>
<td>4 Being used students to independently learn</td>
<td>4   4   4.5 4.5 4.5 4.5 4 4 4 4</td>
</tr>
<tr>
<td>5 Interesting layout</td>
<td>4   4   4   4.5 4.5 4.5 4.5 4 4</td>
</tr>
<tr>
<td>6 There is a feedback</td>
<td>4   4   4   4   4   4.5 4 4 5 5</td>
</tr>
<tr>
<td>Language Aspect</td>
<td></td>
</tr>
<tr>
<td>1 In accordance to Bahasa Indonesia’s rule</td>
<td>4.5 4 4 4 4 4 4 4 4 4 4</td>
</tr>
<tr>
<td>2 Communicative Statements</td>
<td>4   4.5 4 4 4 4 4 4 4 4 4 4</td>
</tr>
<tr>
<td>3 Using simple language, understandable, not ambiguous</td>
<td>4.5 4.5 4 4.5 4.5 4.5 4 4 4 4 4</td>
</tr>
<tr>
<td>Average</td>
<td>4.15 4.13 4.05 4.16 4.16 4.36</td>
</tr>
<tr>
<td>Criteria</td>
<td>V   V   V   V   V   V   V</td>
</tr>
</tbody>
</table>

Description:
V : Valid
A: True-False
B: Multiple Choices
C: Multiple choices with more than one answers
D : Matching
E : Ordering
F : Mapping
G: Crossword puzzles

D. Implementation and Evaluation

- Response of Students towards the Interactive Students’ Worksheet

  The results of students’ response to the interactive Students’ Worksheet to true-false problems in chemistry teaching in high school shows that aspects of the instructions obtained an average value of 3.68, interactive worksheets aspect with an average value of 3.83 and aspects of language with value average 3.58. The average value of the validation for true-false question in the whole aspects is 73.8 with positive category. After being validated the items in the first validation, there is one point on aspects of language which was firstly in a less positive category be positive that the response of students in making the formulation more communicative with an average value of 3.9. So that the average value of the the validation result to the interactive questions in the form true-false questions for the entire aspects is 74.8 with positive category.

  The results of the students’ response to the Interactive Students’ Worksheet to multiple choice questions in the learning of high school chemistry indicates that aspects of instruction has the average value of 3.53, interactive worksheets aspect has the average value of 3.43 and aspects of language has the average of 3.55. The average value of the validation results of interactive questions in the form of multiple choices for all aspects is 70.00 with positive category (Attachment 16). In the aspect of interactive worksheets, there are two attractive points i.e. interactive multiple choice which can facilitate students to understand the material (3.35), interesting layout (3.30) and students’ worksheet can give direct feedback (3, 05). After being revalidated several items on the first validation which is in quite positive category has become positive i.e. the interactive aspect or aspects of language. In the interactive aspect, there are three points which was in a less positive category that students’ response to worksheets to facilitate the students to understand the material, presenting interesting and students’ worksheet can provide feedback directly with the average value of the three i.e. 3.7 (positive). Furthermore, in the aspect of language, there are two points to be positive that the students’ responses to the formulation of
The results of students' response to the interactive Students' Worksheet to multiple choice questions with more than one correct answer in the learning of high school chemistry indicates that aspects of the instructions obtains the average value of 3,43, interactive worksheets aspect with an average value of 3,29 and the aspect of language with an average value of 3,50. The average value of the validation results to the multiple choice question with one correct answer for all aspects is 68,00 which is in less positive category (Attachment 17). In the aspect of interactive worksheets, there are five attractive points, which is about interactive multiple choice with one correct answer which can activate students (3,30), enabling the students to understand the material (3,00), students can use to learn independently (3,20), presenting interesting students’ worksheet (3,45) and students’ worksheet can give direct feedback (3,30). After being revalidated, several items on the first validation which is in included in less positive category become positive category, the interactive aspect or aspects of language. In the manual aspect, there are two points which was in less positive category be positive that students' response to the instructions students’ worksheet clearly stated and easily understood by the average value of the two is 3,67. In the aspect of interaction there are five points that initially also less positive to positive student response tehadap namely interactive worksheets that can enable students to facilitate the students understand the material, can be used by students to learn independently, interesting layout and can give direct feedback with the average of the five aspects is 3,31. While the aspect of language, there is one point which was also in less positive to positive student response towards the formulation of communicative statement with the average value 3,2.

The results of students' response to the interactive students’ worksheet of matching questions in learning of high school chemistry shows that aspects of the instruction obtains the average value of 3,53, interactive worksheets aspect with an average value of 3,51 and aspects of the language with the average of 3,57. The average value of the results of validation interactive questions in the form of matching for all of the aspects is 70,60 with a positive category (Attachment 18). In the aspect of interactive worksheets, there are three points to concern namely the interactive questions in the form of matching which can facilitate students to understand the material (3,40), allows teachers to give assignments to the students (3,45) and interesting presentation (3,45 ). After being revalidated several items on the first validation which includes less positiv categories become less positive category in the instructions and interactive aspects. In the manual aspect, there is one point which was originally in a less positive category becoming positive i.e. students' response to the instructions worksheets that are easy to understand by the average value of 3,4. While the aspect of interactive worksheets that contained three points which are initially in less positive category becoming positive student responses namely worksheets that facilitate students understand the material, allows teachers to assign work to students and the interesting presentation with the average value of the three i.e. 3,43.

The results of students' response to the interactive Students’ Worksheet in the section of ordering in learning of chemistry in high school shows that aspects of the instruction obtains the average value of 3,48, interactive worksheets aspect with an average value of 3,53 and aspects of the language with the average value of 3,90. The average value of the results of validation in the form of interactive questions in the section of ordering of all of the aspects is 71,40 with positive category (Attachment 19). In the aspect of interactive worksheets, there are three points to concern, namely, the question in the form of ordering, students can use to learn independently (3,45), interesting layout (3,45) and students’ worksheet can give direct feedback (3,53 ). After revalidated, several items on the first validation that is included in less positive become positive, both the student responses on the user aspect, the interactive aspect and the aspect of language. In the aspect of instructions there is one point that was in a less positive category becoming positive i.e. students' response to the instructions worksheets that are easy to understand with the average value is 3,35. In the aspect of interactive worksheets that contained three points which are initially in less category positive to positive student responses namely worksheets that students can use to learn independently, attractive presentation and worksheets can provide direct feedback with the average value of the three i.e. 3,41 . While the aspect of language, there is one point that is initially in a less positive category becoming positive i.e. the students' responses towards formulation of communicative statement with the average value i.e. 3,45.

The results of students' response to the interactive students’ worksheet for mapping question in the learning of high school chemistry indicates that aspects of the instructions obtains the average value of 3,75, interactive worksheets aspect with an average value of 3,77 and aspects of language
with the average value of 3.87. The average value of the results of the validation in the form of sorting questions for all of the aspects is 75.80 with positive category.

The results of students' response to the interactive students' Worksheet for crossword puzzle item in learning of high school chemistry indicates that aspects of the instructions obtains the average value of 3.75, interactive worksheets aspect with the average value of 3.72 and aspects of language with the average value of 3.77. The average value of the results of validation in the form of sorting questions for all of the aspects is 75.80 with positive category.

- **Data Analysis of the Interactive Worksheet**

  The effectiveness test was conducted to see the increase of critical thinking skill of students N-gain in the chemistry learning using the interactive worksheet. The distribution of the skills can be seen in the table 3.

  **Table 3. The distribution of critical thinking skill of students**

<table>
<thead>
<tr>
<th>Descriptive Statistics</th>
<th>The ability of critical thinking of students in experiment class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pretest</td>
</tr>
<tr>
<td>Number of Sample (N)</td>
<td>20</td>
</tr>
<tr>
<td>Minimum value</td>
<td>21</td>
</tr>
<tr>
<td>Maximum value</td>
<td>59</td>
</tr>
<tr>
<td>Average</td>
<td>31.98</td>
</tr>
<tr>
<td>Interval</td>
<td>38</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>12.25</td>
</tr>
<tr>
<td>N-gain average</td>
<td>0.45 (fair)</td>
</tr>
</tbody>
</table>

**IV. DISCUSSION**

In this study, the instrument used is questionnaire instrument given to the validator expert, the validator practitioners (teachers) and students. The questionnaire consists of seven categories: true-false, multiple choices, multiple choices with more than one correct answer, matching, ordering, mapping and crossword puzzle. Questionnaire was used to measure students' critical thinking skills in the chemistry material. The contents of the instrument are the same for each category. The following is the description of the data analysis for each category.

Based on the data analysis of the interactive worksheets validity, the average value for the category true-false is $\bar{X} = 4.08$, it can be concluded that the average value from the expert validators is included in the category of "valid" ($4 \leq V_a < 5$). Meanwhile, in the multiple choice categories, the value of the average validity from expert validators is $\bar{X} = 4.02$, it can be concluded that the average value of the expert validators is included in the category of "valid" ($4 \leq V_a < 5$). For the category of multiple choice multiple answers, the average value from the expert validators is $\bar{X} = 4.27$, it can be concluded that it is included in the category of "valid" ($4 \leq V_a < 5$). For the category of matching, the average values obtained from the expert validator is $\bar{X} = 4.11$, it can be concluded that it is in the category of "valid" ($3 \leq V_a < 4$). Meanwhile the average of the category of ordering from expert validator is $\bar{X} = 4.27$, it can be concluded that the average value is included in the category of "valid" ($3 \leq V_a < 4$). Moreover, the validity of category of mapping and a crossword puzzle are respectively $\bar{X} = 4.38$ and 4.25, it can be concluded that the average value of the expert validators are included in the category of "valid" ($4 \leq V_a < 5$).

Based on the analysis of data of validity of interactive worksheets by practitioners, the average for the category true-false question from is $\bar{X} = 4.15$, it can be concluded that the average is included in the category of "valid" ($3 \leq V_a < 4$). For the category of multiple-choice with more than one answers and ordering the respective average obtained from the expert validators is $\bar{X} = 4.13$, 4.05 and 4.16, it can be concluded that the average is included in the category of "valid" ($3 \leq V_a < 4$). Meanwhile the category of matching, mapping and crossword puzzle, the respective average values obtained from the expert validators is $\bar{X} = 4.16$, 4.36 and 4.25 it can be concluded that the average values is included in the category of "valid" ($4 \leq V_a < 5$).
Based on the results of data analysis of students' response to interactive worksheets for categories of right and wrong values obtained by an average of 74.8 %, for the category of 72.2 % multiple choice, multiple-choice category, with over one answers by 71.3 %, to match category of 71.1 %, to sort the category to 72.5 %. While the category mapping or map and a crossword puzzle at 75.8 %. Of these six categories, it can be concluded that the average value of students' response toward the interactive worksheets included in the positive category.

To determine the effectiveness of interactive worksheets on chemistry learning then it is conducted test of critical thinking skills of students before and after learning. From the test results, it is then calculated to determine the N-Gain increase students' critical thinking skills. Critical thinking is one of the skills that are required both in the scope of education and within the scope of the community. Within the scope of education, critical thinking skills can help students to improve understanding of the material being studied so that students do not just memorize the course material and help students to face the demands of a world increasingly challenging (Burden, 1998, Halpern 1999, McTighe and Schollenberger 1991 Toy and Ahmet, 2012). The importance of critical thinking skills is also described by Lim (2011) that critical thinking is a key element to be someone who is fully functional in a complex modern society. This is because people are able to think critically has the skills to understand, analyze and solve everyday problems.

Many experts who have defined the critical thinking among them are Dewey, the father of the tradition of critical thinking modern (1909 in Fisher, 2009), called critical thinking as 'reflective thinking' and define it as a consideration active, persistent (continuous), and carefully about a belief or a form of knowledge that is taken for granted in light of the reasons which support it and the conclusions advanced into trends. Manyer and Goodchild in Fathurrohman (2011) also defined critical thinking stating that critical thinking is a cognitive process that is systematic and active in assessing the arguments, judging a fact, assessing the wealth and the relationship of two or more objects and giving evidence to accept or reject a statement. This is in line with the notion of critical thinking by Norris and Ennis (in Fisher, 2009) that critical thinking is thinking that makes sense and reflective focusing to decide what should be trusted or do. Reflective means considering all alternatives before making a decision actively, diligently and carefully.

Table 3 shows the lowest score on the pretest results in the experiment class is 21 while the lowest score on the posttest results is 36. Furthermore, in the pretest, the highest value is 69 while the value posttest results is 81. The average value of pretest of critical thinking is 31.98 while the value of average in the posttest of critical thinking of students is 62.65. Critical thinking test results obtained by the students can be grouped based on the value of N-gain. The average N-gain of thinking skills of students gain is 0.45 (fair category).

The improvement of critical thinking in more detail can be seen by the analysis of the normalized gain (N-gain). Analysis of N-gain functions to determine the effect of the use of the interactive worksheets to see an increase in students' critical thinking after being given treatment. Based on the table 4.1 it can be seen that the average of value normalized gain in the experimental class is 0.45. This shows an increase in critical thinking skills of students in the experimental class falls into the category of fair. The improvement of critical thinking skills that are measured in the above table is the average accumulated value of the five indicators of critical thinking skills that are measured in this study that includes focusing on the question, analyzing arguments, considering the report observations, concluding, and assessing.

V. CONCLUSION

Based on the research findings, it can be concluded that the interactive worksheet in the chemistry material which is developed to measure the critical thinking of students is valid, practical, and effective. The average of the validation done by the expert for the interactive STUDENTS' WORKSHEET in the section of true-false, multiple choices, multiple choices more than one answer, matching, ordering, mapping, and crossword puzzles are respectively: 4.08; 4.02; 4.27; 4.11; 4.10; 4.38; and 4.25. The average of the validation done by the teacher for the interactive STUDENTS' WORKSHEET in the section of true-false, multiple choices, multiple choices more than one answer, matching, ordering, mapping, and crossword puzzles are respectively: 4.15; 4.13; 4.05; 4.16; 4.16; 4.16; 4.36; and 4.25. The average of the expert validation and teachers is in valid category. For practical aspect, students give positive response for sections true-false, multiple choices, multiple choices more than one answer, matching, ordering, mapping, and crossword puzzles i.e. 74.8; 72.2; 71.3; 71.1; 72.5; 75.8; and 75.8. Moreover, for effectiveness aspect, the value of N-gain is 0.45 which is in fair category.
REFERENCES