Effect of Using Guided Inquiry-Based Chemical Bonding Modules on Student Learning Outcomes

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Abstract. This Study is a continuation of Study on the development of guided inquiry-based chemical bond modules that have been tested for validity and practicality, but have not yet been tested for its effects. This study purposed to reveal the influence of using guided inquiry-based chemical bonding modules on the learning outcomes of class X students of SMAN 4 Padang and SMAN 9 Padang. The data of the two schools of them are normally distributed and homogeneous. T-test results at the significant level of 0.05, namely t-count (1.79) > t-table (1.67) on SMAN 4 Padang and (2.93) > t-table (1.66) on SMAN 9 Padang. Based on the analysis it appears that student learning outcomes using the guided inquiry-based chemical bond module is increase significantly.

1. Introduction
Chemistry is one of the subjects studied in high school (SMA). One of the materials in chemistry is chemical bonding which is studied in class X MIPA. This material includes dimensions of factual, conceptual and procedural knowledge where this chemical bonding material contains abstract concepts[1]. Based on the results of observations and questions and answers with chemistry teachers and students from two schools in Padang city (SMAN 4 Padang, SMAN 9 Padang), it was found that students still have difficulty distinguishing between ionic bonds and covalent bonds. Students have to do a lot of practice questions. Therefore, this material must be really understood by students by reading and doing a lot of exercises.

One way that be able is done to improve students’ understanding of that material is by selecting a learning model. Learning model that apply a scientific approach in accordance with the demands of the 2013 curriculum, the inquiry learning mode is one of which. the learning activity that emphasizes critical and analytical thinking processes to seek and find answers to a question in question is Inquiry learning question in question[2]. guided inquiry is One of the effective inquiry learning models used.
The opportunities for students to learn to actively develop the ability to think systematically, logically and critically. So, students are able to find concepts independently through the questions asked is provided by Guided inquiry. In guided inquiry is the teacher acts as a facilitator and motivator, not only as a learning resource [3].

On the learning process students are required to be active, so to make its happen, it is necessary to use teaching materials that to be able support students' learning process. Module is One of the teaching materials that support learning process in guided inquiry. Modules are print-based learning media that teachers use to increase the effectiveness and efficiency of student learning. The module used is which developed based on the guided inquiry learning model. This module is in accordance with the demands of learning in the 2018 revised 2013 Curriculum which requires teaching materials that are able to involve active students [4].

Research on the development of Guided Inquiry-Based Module on Chemical Bonding has been carried out by Suci Ulan Sari [5]. Based on the stages in the guided inquiry learning model, it consists of 5 stages, namely: orientation, exploration, collecting data, application and closing[6]. The Plomp Model is used to module development. Consists of three stages of development is on his model, namely: 1) preliminary research (initial investigation stage), 2) prototyping stage (prototype formation stage), and 3) assessment phase (assessment stage) [7]. The Chemical Bonding Module has been developed up to the assessment phase, where validity and practicality tests have been carried out, but the effectiveness test has not been carried out. The module effectiveness test has not been carried out on student learning outcomes, high-order thinking skills.

2. Materials and Methods
Quasi-experimental research Is this type of study. Two sample classes use this study, namely the control class and the trial class. The study design used is the Non-equivalent Control Group Design. This design is determined by specific subjects for two class, namely the trial class and the control class, where students are given a pretest, given treatment, and given a posttest[8]. The instrument is used in this study was the results of the learning test. This instrument has been an analysis. The test results were analyzed by means of the normality gain. The N-gain test Looks the effectiveness of the module. The students scores of The posttest and pretest were analyzed before and after the learning process. its data is be able to be analyzed using the following formula[9].

\[
N - \text{Gain} = \frac{S_{\text{post}} - S_{\text{pre}}}{S_{\text{max}} - S_{\text{pre}}} 
\]

(1)

average of \( N - \text{Gain} = \frac{\sum n - \text{Gain of student}}{\text{the total number of students}} \)

(2)

Note: \( S_{\text{pre}} = \) Score of initial test 
\( S_{\text{post}} = \) Score of final test 
\( S_{\text{max}} = \) maximal score (100)

| Score | Category |
|-------|----------|
| \( g \geq 0.70 \) | High |
| \( 0.30 \leq g \geq 0.70 \) | Medium |
| \( g < 0.30 \) | Low |

Table 1. Classification of N-gain
Hypothesis testing can be done using the two-mean difference test or t test. Hypothesis testing aims to determine whether the research hypothesis can be accepted or rejected [10]. The hypothesis is written in the form of a statistical hypothesis, namely:

H₀: Student learning outcomes in a class that uses a guided inquiry module (experiment) are the same as a class that does not use a guided inquiry module (control)

H₁: Students’ learning outcomes in a class that uses a guided inquiry module (experiment) are higher than in a class that does not use a guided inquiry module (control)

\[ t_{\text{count}} = \frac{\bar{x}_1 - \bar{x}_2}{s_{\text{combined}} \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \] (3)

where:

\[ s_{\text{combined}}^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2} \] (4)

3. Result and Discussion
3.1. Result
3.1.1. Learning Outcomes
The score of N-gain is obtained through a difference between the pretest and posttest scores. In addition, N-gain result can also see an upgrade in students’ understanding and mastery of the material before and after learning chemical bonding. The result of the data analysis are be able to look in table 2 and table 3.

| Class   | Amount of student | Average of N-Gain | Category |
|---------|-------------------|-------------------|----------|
| Experiment | 33                | 0.55              | Medium   |
| Control   | 33                | 0.47              | Medium   |

| Class   | Amount of student | Average of N-Gain | Category |
|---------|-------------------|-------------------|----------|
| Experiment | 35                | 0.34              | Medium   |
| Control   | 35                | 0.16              | Low      |

Based on the calculation of it, it was found lest the N-gain score of the trial class was significantly higher than the control class. Its score at SMAN 4 Padang for the trial class was 0.55 (medium) and the control class was 0.47 (medium), while for SMAN 9 Padang for the trial class it was 0.34 (medium) and the control class was 0.16 (low). Therefore, the guided inquiry learning-based climax module is effectively used to improve student learning outcomes.

The results of study that have been carried out are the same as previous research, Koksal's findings regarding the guided inquiry model reveal that guided inquiry learning has a significant effect on improving learning outcomes, science process skills and attitudes towards students' science [11]. This is in line with research conducted by Lestari where the learning outcomes of students with guided inquiry learning were higher than classes with traditional learning and learning activities in the experimental class were more effective than learning activities in the control class. The difference in cognitive learning outcomes between the control class and the experimental class is due to the different learning processes. In the experimental class, the learning process uses a guided inquiry learning model, where
the teacher explains the short steps of guided inquiry, and then the students carry out these steps and discuss with each group. Simple questions in everyday life are presented and explored by students themselves so that students can build their own concepts[12]. This is also related to study conducted by Novilia who states that colloid system material on guided inquiry modules are effective in improving student learning outcomes seen from post-test scores (after using colloid modules) which are significantly higher than pre-test scores (before using the colloid module). This is because the guided inquiry module includes abilities and activities related to the environment or daily life, which consists of knowing, understanding, applying, analyzing, evaluating, and creating[13].

3.1.2. Hypothesis Testing
The research hypothesis is proven to be correct, if the experimental class that is taught using modules is significantly higher than the control class. Proof of the hypothesis is done through hypothesis testing (t-test) because the sample is normally distributed and homogeneous, which is obtained after obtaining the N-Gain value. Based on data processing at SMAN 4 Padang, the distribution is normal and homogeneous. The result of t-test at a significant level of 0.05 is t-count (1.79)> t-table (1.66). The second data in SMAN 9 Padang is normally distributed and homogeneous. The result of the t test at a significant level of 0.05 are t-count (2.93)> t table (1.66). Its difference in learning outcomes in this study is due to the effect of the teaching materials used.

3.2. Discussion
The purpose of testing the effectiveness is to determine whether the module is feasible or not, so that the module can be disseminated. Student learning outcomes increase because of the excess modules. This module is based on the guided inquiry stages. First is the orientation, which is the initial for preparing students to learn. Students gain initial knowledge in the form of learning objectives, motivation that can build interest and generate student curiosity, and apperception, namely previous knowledge related to the knowledge to be learned, which is obtained from guided inquiry-based modules[6][14][15][16][11][17]. also explained that students are prepared to learn, students are given an introduction to the material and motivation to build curiosity and make connections about previous knowledge with the knowledge to be learned.

Next stage, namely exploration and concept formation, are two interconnected stages. At the exploration stage, students observe pictures, models or tables. This activity is in accordance with the stages in the scientific approach, namely observing, where students read, listen, listen and see (without or with tools) with the aim of practicing sincerity, thoroughness and seeking information [18]. Concept formation stage, where students form concepts through exploration activities previously carried out. The concept is discovered, introduced and formed through questions that can make students think critically and analytically. Students must be able to think critically and analytically so that learning can take place well. Critical thinking is a skill that students must have[19]. The next is the application, where students are given practice questions so that student understanding is stronger and train students' abilities to solve problems related to previously obtained concepts. When the concept applied in the form of practice questions is successful, students can integrate with other concepts[6][14][15][16][11][17].

The last is the closing, where students present a results of group discussions based on the material they have learned. Students from other groups gave rebuttals, comments and input. The teacher provides input and confirms the results of student discussions. This stage is in accordance with the stage of communicating in the scientific approach, where students convey the results of observations that have been carried out both orally and in writing, making conclusions the results of the analysis, so students have ability to speak properly and correctly [19]. Students who were taught using the Guided Inquiry-Based Chemical Bonding Module had significantly higher learning outcomes. That is, the Guided Inquiry-Based Chemical Bonding Module is given effect in improving student learning outcomes.
4. Conclusion

Based on the analysis, it is able to be seen that learning outcomes of students who use guided inquiry-based chemical bonding modules are significantly higher than students who do not use guided inquiry-based chemical bonding modules.

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