Effectiveness of student worksheets based guided inquiry on acid base material to improve students higher order thinking skill (HOTS)

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Abstract. One of efforts to improve quality of human resources in 21st century is improve the level of education quality by promoting a new curriculum that is 2013 curriculum. 2013 curriculum adheres to the basic view that learning is not merely a transfer of knowledge and ability, but also to build HOTS of learners. The study aims to find out effectiveness of students worksheets based guided inquiry on acid base material to improve students HOTS. Type of research is quasi experiments with design non-equivalent control class. sampling techniques using cluster purposive sampling. The sample was 127 students consisting of two schools are SMAN 4 Padang and SMAN 8 Padang. Experimental class 1 (n=32 students) and control class 1 (n=32 students) came from SMAN 4 Padang. Experimental Class 2 (n=33 students) and control 2 (n=30 students) came from SMAN 8 Padang. The experimental class used a student worksheets based guided inquiry, while control class used textbooks available at school. Result of this research shows experimental class 1 and control class 1 got N-gain score are 0.64 and 0.58, while experiment class 2 and control class 2 got N-gain score are 0.60 and 0.56 both groups proved to have statistically significant different improvement. It means student worksheets based guided inquiry are increase HOTS students.

1. Introduction
The 21st century is a century based on advancement of science and technology, thus demanding an increase quality of human resources to master various skills needed to face global challenges in 21st century. Skills needed in facing global challenges in 21st century are Higher Order Thinking Skills (HOTS). HOTS is 21st century learning trends, which include creative thinking, critical thinking and problem solving [1]. If synergized with Bloom’s taxonomy, indicators HOTS consist of analyzing, evaluating, and creating [2-3].

One strategy for designing learning to train HOTS is guided inquiry [4]. Inquiry learning emphasizes process of thinking systematically, critically and logically to search and investigate answers to a questioned problem [5]. Learning through discovery or experience is important for growing HOTS in students [6]. According to Buck et al [7] most effective inquiry learning is guided inquiry. So it can be concluded with inquiry learning model can be applied in learning process in high school is guided inquiry [8-10]. Guided inquiry stimulates, teaches and invites students to think higher in order to find concepts independently of various problems expressed.

Steps in guided inquiry learning include orientation, exploration, concept formation, application and closing [11]. In supporting guided inquiry teaching material is needed to encourage active students...
in learning process [12]. Teaching materials used in implementing guided inquiry learning in this study are student worksheets. This is based on results of Bilgin and Myers's research in Zammiluni [13] which states that students who learn to use student worksheets based guided inquiry will be easier to understand concepts and can improve interaction effectiveness, team building, learning, and interest through group work which is highly structured. As a supporter of guided inquiry learning model, multiple representations are used, which consist of three levels that have interconnections which are macroscopic level, submicroscopic level, and symbolic level [14].

Some research results are related, such as Aini (2017) who developed student worksheets based guided inquiry on chemical equilibrium material [15]. Jefta (2013) which shows that inquiry learning models influence HOTS of students, this is evidenced by an increase in average value of posttest to pretest [16]. In another study Dian [17] said learning using student worksheets based guided inquiry can increase HOTS students.

2. Experimental Method
The effectiveness test was carried out in two schools, they are SMAN 4 Padang and SMAN 8 Padang. Where in each school sample 2 classes were taken, namely one experimental class and one control class. Furthermore, experimental class and control class from SMAN 4 Padang were called experimental class 1 and control class 1, while experimental class and control class from SMAN 8 Padang were called experimental class 2 and control class 2. Experimental class used a student worksheets based guided inquiry on acid base material that has been developed by Widya Astuti (2017) and has been declared valid and practical [18] but its effectiveness has not been tested on HOTS students. While control class used textbooks available at school.

Type of research used is quasi-experimental research with design non-equivalent control group design. Sampling in this study used techniques cluster purposive sampling.

| Class       | Pretest | Treatment | Posttest |
|-------------|---------|-----------|----------|
| Experiment (E) | O₁      | X        | O₂       |
| Control (C) | O₃      | -        | O₄       |

Description:
O₁ = Value pretest of experimental class
O₂ = Value posttest of experimental class
X = Learning using student worksheets based guided inquiry
O₃ = Value pretest of control class
- = Learning using textbooks available at schools
O₄ = Value posttest of control class

Analysis data used in this study using independent sample t-test and N-Gain to find how much increases HOTS students. In other hands, clarifying of students' skills, that is ability to analyze (C4), evaluate (C5) and create (C6).

3. Result and Discussion
Analysis data using independent sample t-test and N-Gain, was carried out after carrying out normality test and homogeneity test on research data derived from value difference posttest-pretest. Test Normality using Kolmogorov-Smirnov. Tests Homogeneity using Levene Statistics.
**Table 2. Normality Test Results**

| Schools     | Class         | α     | Asymp. Sig | Distribution |
|-------------|---------------|-------|------------|--------------|
| SMAN 4 Padang | Experiment 1  | 0.05  | 0.819    | Normal       |
|             | Control 1     |       | 0.570    | Normal       |
| SMAN 8 Padang | Experiment 2  |       | 0.05     | 0.454        | Normal       |
|             | Control 2     |       |          | 0.430        | Normal       |

**Table 3. Homogeneity Test Results**

| Schools     | Class         | α     | Asymp.Sig | Distribution |
|-------------|---------------|-------|-----------|--------------|
| SMAN 4 Padang | Experiment 1  |       | 0.093    | Homogeneous  |
|             | Control 1     |       | 0.05     |              |
| SMAN 8 Padang | Experiment 2  |       | 0.190    | Homogeneous  |
|             | Control 2     |       |          |              |

Based on Tables 2 and 3 above sample data has a significance value > 0.05 at a significant level α=0.05. Thus, value data of HOTS *posttest-pretest* in both samples have normal and homogeneous variances. Therefore, test research hypothesis used *independent sample t-test*. Acceptance criteria if value is *Sig. (2-tailed)* > 0.05 then Ho is accepted and if value is *Sig. (2-tailed)* < 0.05 so Ho is rejected. The results of hypothesis test on HOTS can be seen in Table 4 below:

**Table 4. Test Results of t-Test**

| School     | Class         | α     | Sig. (2-tailed) | Decision |
|------------|---------------|-------|-----------------|----------|
| SMAN 4 Padang | Experiment 1  | 0.05  | 0.039           | Ho rejected |
|             | Control 1     |       |                 | Ho rejected |
| SMAN 8 Padang | Experiment 2  |       | 0.041           | Ho rejected |
|             | Control 2     |       |                 |          |

Based on Table 4 above sample class has a *Sig. (2-tailed)* less than 0.05. Where is *Sig. (2-tailed)* for SMAN 4 Padang which is 0.039 and for SMAN 8 Padang which is 0.041 so it can be concluded that Ho is rejected. Ho rejecting decision means HOTS learners who use student worksheets based guided inquiry and without student worksheets based guided inquiry differ significantly.
Based on Figure 1, it is known experimental class and control class have N-Gain HOTS in moderate category (Hake). However, N-Gain indicator HOTS to analyze (C4), evaluate (C5) and create (C6) in experimental class was higher than control class. Average N-Gain HOTS for SMAN 4 Padang, experimental class 1 was 0.64 and control class 1 was 0.58. While, N-Gain average HOTS for SMAN 8 Padang, experimental class 2 was 0.60 and control class 2 was 0.56. This show enhancement HOTS of experimental class that learning using student worksheets based guided inquiry was higher than HOTS of control class that learning using text books available at school.

Factors increase HOTS students are meaningful learning activities, where students are actively involved in discussion process to build knowledge and utilize relevant resources to explore desired knowledge. This is based on opinion expressed by Bohan & Bohan in Rosaini that learning process that involves active participation of students can solve various problems, presenting meaningful learning activities for students [19]. In addition, students became enthusiastic because they were challenged to answer key questions given. This of course can increase students learning motivation. This is in line with Loewen's opinion which states that problems challenging in learning can increase HOTS students, interests and motivations for learning [20].

4. Conclusion
The result of this research shows significant difference between experimental class and control class. After get a treatment (using student worksheets based guided inquiry) experimental class have increase HOTS, with N-Gain are 0.64 (experiment 1) and 0.60 (experiment 2), while control class got N-Gain are 0.58 (control 1) and 0.56 (control 2), and experimental class have good ability to analyse, evaluate and create in evaluation test. The student worksheets based guided inquiry treatment as that ability improvement is beneficial to students accustoming in HOTS as the 21st century learning outcome.

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