The effect of using mathematics learning assessment books on higher order thinking skills based towards the ability of assessment instruments arrangement at elementary school teachers

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Abstract. The purpose of this study is to examine the effectiveness of using mathematics learning assessment books based on higher order thinking skills (HOTS) towards the ability of assessment instruments arrangement at elementary school teachers. It is a quasi-experimental research with nonequivalent comparison-group design. The population in this study were 225 elementary school teachers from Ngawi regency, Sukoharjo regency and Surakarta City. By using a random sampling technique, the sample in this study was 125 elementary school teachers in Ngawi Regency. The technique of collecting the data was obtained through test. In analyzing the data, it applied T test technique with a significance level of 0.05. The results of this study indicate that there were differences in the ability of assessment instruments arrangement between teachers who use HOTS-based mathematics learning assessment books and manual one by tcounts < ttable (-18 < 1.657). Therefore, the book can be used as a reference in preparing HOTS-based mathematics learning assessment instruments.

Keywords: Higher order thinking skills, mathematics learning, elementary school

1. Introduction
The 2013 curriculum was implemented as a completion of the previous curriculum. Fanani [1] contained a statement from the Ministry of Education and Culture (2013) that the low achievement of Indonesian students was due to the large number of TIMSS test materials not included into the Indonesian curriculum. The 2013 curriculum which is characterized by critical thinking and analysis still needs change over time. Changing the 2013 Curriculum to the 2013 Revised Edition Curriculum in 2017 provides a nurturing positive effect in the form of character education towards Higher Order Thinking Skills (HOTS). It is defined as the ability of students to manipulate ideas in certain ways that can give them new understanding and implications [2]. Brokhart (2010) [3] divides the definition of HOTS into 3 parts namely as knowledge transfer, critical thinking and creative thinking. As a transfer of knowledge, it includes the ability at the level of analysis (C4), evaluation (C5) and creation (C6) in accordance with Bloom's taxonomy which was revised by Anderson & Krathwohl [4].

It encourages students to solve problems encountered in everyday life. Therefore, the development of HOTS needs to be trained since elementary school age [5]. Students’ HOTS development needs to be achieved in the whole school subjects. Mathematics is one of the priorities to be developed in HOTS perspective. It is in line with Ministerial Regulation No. 22 of 2006, states that mathematics needs to be given to all students starting from elementary school to equip the ability to think logically, analytically, systematically, critically, and creatively, as well as the ability to cooperate [6]. The
implementation of HOTS in mathematics learning in elementary school is along with its stated learning objectives [7], covering: 1) understanding mathematical concepts, explaining the relationship and applying the concepts / algorithms appropriately in problem solving; 2) using reasoning on patterns, traits, carrying out mathematical manipulations in generalizations, and compiling evidence; 3) problems solving; 4) communicating ideas with symbols, tables, diagrams or other media; 5) appreciating attitude on the use of mathematics.

The assessment in measuring HOTS is oriented to the level of analysis, evaluation and creation. Measurements used to measure HOTS is called as the ability to think not only to remember (recall), restate, or refer without processing (reading) [8]. The teachers’ to set mathematical assessments is still in the realm of implementation (C3). In addition, it is found that the teacher is still doing an assessment based on assumptions and estimation [9] Mulyana (2012). The need for books as a guide to HOTS-oriented elementary school mathematics learning assessment is an urgent need and must be addressed immediately. This comes along with Nasution [10] that the usage of books is to provide knowledge and assist in implementing the curriculum with the Laws of Teachers and Lecturers No. 14 of 2015 concerning Teachers and Lecturers.

Empirical evidence based on the pretest obtained the facts about teachers’ initial ability regarding HOTS. It was conducted in 81 elementary school teachers from Ngawi, Sukoharjo and Surakarta districts. Preliminary test results indicate an average of 55.40% of teachers (minimum grade of 70) have very limited understanding on HOTS. Based on the documentation results, it was found that the teacher has not arranged the questions on test referring to the HOTS level. Therefore, it was concluded that based on the exploration study stage, the procurement of HOTS Oriented Mathematics Elementary School Learning Assessment Books was effectively used as a teacher's guide in understanding HOTS-based assessment instruments.

2. Method
The method used in this research is a nonequivalent control group design which is similar to the pretest-posttest control group design [12] by modification as shown in Figure 1 below:

| Eksperimental Group (KE) | pretest measure | treatment | posttest measure |
|--------------------------|-----------------|-----------|-----------------|
|                         | O₁               | X₁        | O₂              |

| Kontrol Group (KK) | pretest measure | treatment | posttest measure |
|-------------------|-----------------|-----------|-----------------|
|                   | O₃               | X₂        | O₄              |

**Gambar 6. nonequivalent control group design**

Note:
O₁ = pre ability test of experimental class
O₂ = post ability test of experimental class
X₁ = developed book testing
X₂ = existing book testing
O₃ = pre ability test of control class
O₄ = post ability test of control class

The independent sample t-test with a significance level of 0.05 is used to analyze the data of pretest and post-test. The analysis prerequisite test is carried out before t test which consists of:

2.1. Normality test

Normality test is used to test the distribution of data normally or not. It used the Kolmogrov-Smirrov formula in this study, namely:

D max = Fα (x) – Fₑ (x)
Note:
D_{\text{max}} = \text{maximum difference value from 2 cumulative frequency distributions}
F_\alpha (x) = \text{cumulative frequency of relations}
F_e (x) = \text{theoretical cumulative frequency}

2.2. Uji Homogeneity test

Homogeneity test is performed to determine whether the data obtained from the two groups having homogeneous variants or not. Analysis of variance can be used if the data variance is homogeneous. Testing homogeneity of variants with the F. test.

\[ F = \frac{\text{variance terbesar}}{\text{variance terkecil}} \]

It uses the formula proposed by Sugiyono [13] called as: The homogeneity test calculation process is used at a significant level of 5% which means that if the F count is smaller than the F table at a significant level of 5% then both groups have homogeneous variant gro

2.3. Hypothesis test

Hypothesis testing on the value of pre-test post-test experimental class and pre-test post-test control class use the independent t test with a significance level of 5%. It is used to determine the difference between the average value before treatment (pre-test) with the average value after treatment (post-test).

The hypothesis used is
Ho: there is no significant difference between the average pre-test scores and the average post-test scores.
H1: there is a significant difference between the average post-test scores and the average post-test scores.

Based on probability: Ho is accepted if significant > 0.05 Ho is rejected if significant <0.05

3. Result and Discussions

3.1 Result

Product testing was conducted to find out the effectiveness of developing the elementary school mathematics learning assessment books based on Higher Order Thinking Skills. It was held in Surakarta City and Ngawi Regency which were divided into 65 experimental groups and 60 control groups. The results of the analysis of the effectiveness test data were carried out with a normality test, a homogeneity test, and a balance test. The results of the analysis of the ability of teachers in compiling elementary school mathematics learning assessments based on Higher Order Thinking Skills in the effectiveness test can be seen in Table 1 below.

| Test       | Type of test     | Sig.          | Decision        | Conclusion |
|------------|------------------|---------------|-----------------|------------|
| Normality  | Kolmogorov       | Pretest       | Eksperimen      | H_0        | Normal     |
|            | Smirnov          |               | = 0,200         | accepted   |            |
|            |                  | Control       | H_0             | accepted   |            |
|            |                  |               | = 0,200         |            |            |
| Normality  | Kolmogorov       | Posttest      | Eksperimen      | H_0        | Normal     |
|            | Smirnov          |               | = 0,200         | accepted   |            |
|            |                  | Control       | H_0             | accepted   |            |
|            |                  |               | = 0,200         |            |            |
| Homogenity | Levene’s test    | Sig.          | 0,831           | H_0 accepted | Homogen    |
Based on the analysis of cognitive abilities data processed using SPSS version 24, it can be seen that the normality of tested data by Kolmogorov-Smirnov at the significance level of pretest results at the obtained value by 0.200 for the experimental class and 0.200 for the control class. It can be concluded that the data were normally distributed. The significance level of the posttest value was 0.200 for the experimental class and 0.200 for the control class which means that the data were normally distributed. The data homogeneity was tested using the Levene's test that resulted in a significance level of 0.831. It can be inferred that the experimental class and control class data coming from homogeneous variance. After conducting the normality test and the homogeneity test, a pretest value balance test was obtained with a significance of 0.849. It can be said that the data coming from two balanced populations.

Table 2. The Analysis Results of teachers’ ability to set elementary school mathematics learning assessments based on Higher Order Thinking Skills on the Difference Test

| Test          | Type of test | Sig.      | Decision   | Conclusion     |
|---------------|--------------|-----------|------------|----------------|
| Test the      | Independent  | $t_{hitung} = -18.149$ | H0 rejected | There is a difference |
| difference    | Sample $T$-Test |           |            |                |

Table 2 explains the results of significance further tests by using Independent Sample $T$-test. The results of the analysis using SPSS show that the value of $t_{table} = 1.657$. It can be concluded that H0 is rejected or there is a difference in the ability of the teacher in setting an elementary school mathematics learning assessment based on Higher Order Thinking Skills between the experimental class and the control class significantly.

3.2 Discussions
Activities carried out in the effectiveness test are conducting prerequisite tests and $t$ tests. For the prerequisite test, the pretest and posttest data meet the normal criteria and homogeneity which is proceeded to the $t$ test. Based on the $t$ test, it can be seen that there are differences between the experimental groups (using HOTS-based mathematics learning assessment books) and controls (using existing manuals). This is in line with the research conducted by Jenny I.S. Poerwanti & Siti Istiyati [14] which shows that the use of teaching materials in the form of assessment textbooks is effectively used in educational evaluation courses.

In addition, it was found that the questions developed by the teacher in the experimental group could encourage students to HOTS. It is a process of thinking involving mental activities to capture all information and concluding in a problem solving process through analyzing, evaluating, and creating [15] [16]. It is a skill needed to face the era of industrial revolution 4.0 and society 4.0.

4. Conclusion
Based on the description above, it can be concluded that there is a significant difference in the results of the effectiveness test at the teacher's ability in arranging elementary school mathematics learning assessment based on Higher Order Thinking Skills between the experimental class and the control class. It can be seen from the results of the $t$ test using the Independent Sample $T$-test with $t_{count} = -18 < t_{table} = 1.657$. Theoretical implications in this study can be used to add insight and reference material for similar research. The practical implication in this study is that teachers can use this assessment book to develop HOTS assessment instruments in mathematics learning in elementary schools.
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