The Effect of Gender on Higher Order Thinking Skills Students in Subject of Work and Energy

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Abstract. The purpose of the research is intended to determine the effect of gender on higher order thinking skills students in subject of work and energy. The population in this research is students in MAN 1 Malang. The sample of 60 students who have taken randomly selected in subject of work and energy. Instrument of measurement of higher order thinking skills in the form of 10 essay test questions (cronbach alpha 0.817) and data were analyzed using Independent Sample T Test. The results of the analysis show that there is no effect of gender on higher order thinking skills students.

INTRODUCTION

The skill empowerment is very important for students in the face of the 21st century. The skills that must be possessed in the 21st century are the adaptability, social/communication skills, problem solving skills, self development and self management, and thinking skills ([1], [2], [3]). Thinking skill is an ability in using mind to find meaning and comprehension on something, exploration of ideas, making decision, problem solving with best consideration and revision on the previous thinking process [4]. The ability to think is divided into two parts, namely Low Order Thinking Skills (LOTS) and Higher Order Thinking Skills (HOTS).

Bloom's taxonomy is considered the basis for higher order thinking. Regarding Bloom taxonomy, thinking processes that remarked as higher order thinking skills are analyzing, evaluating, and creating. Based on this theory, many researchers defined higher order thinking skills in a wide variety of definitions. Higher order thinking skills are critical, logical, reflective, metacognitive and creative thinking [5]. Anderson and Krathwohl [6] proposed the same definition as in bloom’s Taxonomy which are a process that involve analyzing, evaluating, and creating.

The question of physics that exist in school learning tend to focus on the level of remembering, understanding, and applying and rarely using higher levels such as analyzing, evaluating, and creating. In fact of higher order thinking can help students prepare for the real world because it is more complex than learning about facts and concepts [7]. Tests that lead to higher order thinking skills can be provided to encourage students to have these skills. In addition, assessment of higher order thinking skills must be an integral part of the learning and teaching process [8].

One of the topics of physics that is the focus of research is work and energy. The answer to work-energy theorems becomes difficult for students. The work in daily life and work in science that has a different meaning. In addition, energy is one of the physics topics whose scope is very broad and widely used in everyday life [9]. This causes students who have not fully understood this material.

Learning is physics often associated with gender. The some studies that have been conducted on gender related higher order thinking showed no difference between male and female in that regard. The both of male and female have
the same ability at higher order thinking at senior high school [10], [11]). Others claim that female are better than male [12].

Based on the results of interviews with physics teacher MAN 1 Malang, obtained information that on learning physics at the school female students are superior compared with male students. Then after the observation of the data report card, obtained data that the average value of male students is superior that is 86.50 compared with the average value of women is 82.30. Therefore, this study was conducted with the purpose of the research is intended to determine the effect of gender on higher order thinking skills students in subject of work and energy.

**METHODS**

This study was Research and Development (R&D) in nature. It used ADDIE model. As far as ADDIE model was concerned, there were five stages undertaken: analysis, design, development, implementation, and evaluation. The product trial was conducted at SMAN 1 Angkinang located on Angkinang St. Hulu Sungai Selatan, South Kalimantan. The subjects for the trial were the students of class XI IPA 2 at SMAN 1 Angkinang registered in the academic year 2016/2017. The instruments of this study were validation sheets of module, response questionnaire and achievement test; response questionnaire; achievement test and peer assessment. The module validation sheet includes content and display validation, as well as achievement test validation sheets including construct validation and content validation. The validation sheet is rated by 3 validators consisting of academic validators and practitioners.

**Technique of Data Analysis**

This research is quantitative descriptive. The research design used was quasi experiment with posttest only control group design. The dependent variable in this research is higher order thinking skills while the independent variables is gender (male and female students). The population in this research is students in MAN 1 Malang. The sample was randomly selected by 60 students who had taken the subject of work and energy.

Instrument of measurement of higher order thinking skills in the form of 10 essay test questions. The test instrument was first tested for validity and reliability (cronbach alpha 0.817). After that, the prerequisite test is done by data normality with Kormogolov-Smirnov test and homogeneity test with Levene test. Hypothesis test using independent sample T test with significance level 0.05 ($\alpha < 0.05$) [13]. Data were analyzed with the help of SPSS version 20 for windows.

**RESULTS AND DISCUSSION**

The instrument tested first before being tested in sample class. Instruments tested on 60 students. The validity test of the higher order thinking skills test using correlation product moment. Validity test results of the higher order thinking skills test shows there are 10 questions have $r_{xy}$ more than $r_{table} = 0.2542 (r_{xy} \geq r_{table})$. It means that 10 questions are valid. The reliability test of the higher order thinking skills test using the equation Cronbach’s alpha. Reliability test results on 10 questions indicated that the value $r_{count} = 0.817$ which means that 10 questions including in the high category [14]. Items that have a valid and reliable can be used to collect research data.

The requirements analysis tested first before conducting independent sample T test analysis. Normality test by using methods Liliefors. Based on computation obtained for gender female have Sig$_{count}(0.200) > 0.05$ and for gender male have Sig$_{count} (0.139) > 0.05$ it’s means that samples derived from normal distributed population. The summary of the normality test results are in the following table.

<table>
<thead>
<tr>
<th>GENDER</th>
<th>Kolmogorov-Smirnova</th>
<th>Shapiro-Wilk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Statistic</td>
<td>Df</td>
</tr>
<tr>
<td>Value</td>
<td>Female</td>
<td>.118</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>.140</td>
</tr>
</tbody>
</table>

* This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Homogeneity test by using Levene statistic. Based on computation have $\text{Sig}_{\text{count}} (0.146) > 0.05$ means that samples derived from homogenous distributed population. The summary of the homogeneity test results are in the following table.

<table>
<thead>
<tr>
<th>Levene Statistic</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.172</td>
<td>1</td>
<td>58</td>
<td>.146</td>
</tr>
</tbody>
</table>

Based on computation have the average value of female students are 24.700 and the average value of male students are 31.133. It’s mean the average value that the male students are higher than female students. If seen from the standard deviation to see the effectiveness of student learning in the classroom. Male students with standard deviation of 7.6822 and female students 5.3925. The summary of the average value results are in the following table.

<table>
<thead>
<tr>
<th>GENDER</th>
<th>Value</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>30</td>
<td>24.700</td>
<td>5.3925</td>
<td>.9845</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>30</td>
<td>31.133</td>
<td>7.6822</td>
<td>1.4026</td>
<td></td>
</tr>
</tbody>
</table>

Data were analysed using independent sample T test with significance level of 5 %. The results of processing shows that the number of significance for gender differences is $\text{Sig}_{\text{count}} (0.000) < 0.05$. If $\text{Sig.} < 0.05$ then there is a significant difference between the groups. The summary of the independent sample T test results are in the following table.

<table>
<thead>
<tr>
<th>Levene's Test for Equality of Varniances</th>
<th>t-test for Equality of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Sig.</td>
</tr>
<tr>
<td>---</td>
<td>------</td>
</tr>
<tr>
<td>Value</td>
<td>Equal variances assumed</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>-3.754</td>
</tr>
</tbody>
</table>

The result of data analysis shows that there was a significant difference in score between the two groups of students, $t(58) = -3.754, \alpha < 0.05$, two tailed with male students ($M = 31.133, SD = 7.6822$) scoring higher than female students ($M = 24.700, SD = 5.3925$). The magnitude of the differences in the means (mean difference = -6.4333, 95% CI = -9.8635 to -3.0031) was small (eta squared = 0.05). This is in line with research conducted by previous studies. Previous research has shown that the score of male are better than female at higher order thinking skill ([15], [16], [17]).

The some research related to thinking skills shows that there was no gender effect on metacognitive skills [18]. The results revealed by Anandaraj and Ramesh [19] reveal that there was a gender difference to the metacognitive learners. Female learners are better in terms of metacognitive than male learners. Dilla, etc [20] revealed that there was a positive relationship between gender factor and student resilience to the achievement of creative thinking skills of high school students.
Arifin [21] explains that male and female students with high initial knowledge are able to perform the five creative thinking processes, but have little difference in the process of understanding and evaluation process. Theodosiou, etc [22] reveals that women are superior to men in terms of problem solving but men are superior in terms of planning, evaluation, task orientation, and self-orientation. Thus it can be seen that in fact female and male learners have their own advantages in relation to high-level thinking skills, including: problem solving, critical thinking, reflective, metacognitive and creative thinking.

**CONCLUSION**

Based on the results of research and discussion, the number of significance for gender differences is $\text{Sig}_{\text{count}} (0.000) < 0.05$. It’s mean there was a significant difference in score between the two groups of students, and male students scoring higher than female students.

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**REFERENCES**


