The Effects of Geometrical Illustration on Basic Concept Understanding in Real Variable Analysis II

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Abstract: This research examines the effects of geometrical illustration on Basic Concept Understanding (BCU) of students in Real Variable Analysis (RVA) II. This is a quasi-experiment research consists of two classes. They are experiment class and control class. Experiment class is class with geometrical illustration as a supplement material in instructional process, while control class is class without geometrical illustration. Subject researcher was 69 students in Mathematics Study Program Nusa Cendana University joining RVA II class in odd semester 2014/2015. Depend on the result of prior knowledge test, they were grouped by matching in to two classes. There were two subjective types of tests given in this research. They were prior knowledge test and BCU test. Data were analyzed by ANOVA. The result showed that F-value = 45.091 with the probability significance value is 0.00<0.05. It means that there is a significantly different Basic Concept Understanding of RVA between students in geometrical illustration class and students in class without geometrical illustration. Mean value of BCU in geometrical illustration class is 75.88, and that of class without geometrical illustration are 64.73. This result indicated that basic concept understanding of students in geometrical illustration class is better than that of students in class without geometrical illustration. In other word, geometrical illustration gives positive effects on basic concept understanding of students in Real Variable Analysis.

Keywords: geometrical illustration, basic concept understanding, real variable analysis

Real Variable Analysis (RVA) is an abstract mathematics subject learned in Mathematics Education Department. It caused many understanding problems of students year by year. Many students in Mathematics Study Program Nusa Cendana University completed their Undergraduate study for more than 12 semesters because they didn’t pass in RVA. Garak (2008) reported that students achievement in RVA II in that department were very low. Students can solve technique mathematics operations but they had difficulties to understand the definitions and theorems in some books or literatures because they are very abstract.

Depend on the curriculum in Mathematics Education Department, the main topics discussed in RVA II are Sequences and Limits. These topics had been discussed in other mathematics subjects such as Calculus, Differential Equation, and Number Theory (Purcell), (Ayres). In Calculus and Differential Equation, the topics focused on technical mathematics approach but in RVA it focused on abstract analysis. Bartle (2010), Purcell (2009), Ziemer (2010), Thomas (2008), generally write a very abstract approach of RVA concept. For example: $X_n$ converges to x means that for epsilon positive there exists a natural number K such that for $n\geq K$ then $|X_n-x|<\text{epsilon}$.

Definition above doesn’t start by a concrete explanation. It directly performs a very abstract style without a graph or geometrical illustration from the beginning. Because of this, students had difficulties to understand the concept of a RVA. So it needs a graph or geometrical illustration explains the definition and finally can improve the basic concept understanding of students in RVA, need a concrete approach such as graph and geometrical illustration (Garak,
Furtermore Hudoyo (1999), Norainy (2013), Wu Chao, (2006) generally reported that many of mathematics subject can be constructed by real situation such as picture and graph geometrically. By this approach students can understand the concept and apply it to solve the problems.

Graph or geometrical illustration is very similar with basic concept of RVA such as sequences and limit. Thomson (2008), Chukwuyenum (2013), Dorit (2014) generally reported that level of geometry thinking determine level of thinking in other mathematics subjects such as algebra, limits, and trigonometry. Thus, a good understanding of students in geometry is guaranteeing a good understanding of other mathematics subject relationship.

The objective of this research is to examine the effects of geometrical illustration on Basic Concept Understanding (BCU) of students in RVA II. As specially, the research examines the differences of BCU between students in geometrical illustration class and students in class without geometrical illustration. Basic concept understanding is the understanding of students in RVA II depends on Bloom Criteria from C1 to C3.

METHOD

This is a quasi-experiment research consists of two classes. They are experiment class and control class (Ott, 2008). Experiment class is class with geometrical illustration as a supplement material in instructional process, while control class is class without geometrical illustration supplement in instructional process. Subject researcher was 69 students in Mathematics Study Program Nusa Cendana University joining RVA II class in odd semester 2014/2015. Depend on the result of prior knowledge test; they were grouped in to two classes where 35 students were in experiment class and 34 students in control class. The procedure of groping the subjects in to two classes was done by matching (Ott, 2018), Pasaribu, 2008).

There were two types of subjective test given in this research. They were Prior Knowledge test and Basic Concept Understanding test. There were 5 numbers of prior knowledge test hold the validity and reliability criteria. This 5 number were selected from 7 numbers prepared. Other analysis relation to the result of prior knowledge test is normality distribution data and homogeneity variance data from two classes. Test of normality was done by Kolmogorov Smirnov, and homogeneity variances test was done by Levene Statistics. The last two type of analysis are pre-requrement to analyze mean difference of two classes. Mean differences of prior knowledge test from two classes were analyzed by t-test using SPSS-22 (Santoso, 2001).

Furthermore, as prior knowledge test, there exists 5 numbers of basic concept understanding test hold validity and reliability test. They are also selected from 7 numbers prepared. Test of validity, reliability, normality, and homogeneity variance of BCU data were done by the same procedure. Hypothesis test of BCU data was analyzed by ANOVA using SPSS-22 (Santoso, 2001).

RESULT

Data analysis relation to prior knowledge test holds the normality distribution and homogeneity variance. By Kolmogorov Smirnov test, significant value of geometrical illustration class is 2.00 and another class is 0.179. This two coefficient are greater than 0.05. So data prior knowledge test from the two classes are normally distributed. Furthermore, output data showed that the coefficient of Levene Statistics is 0.083 with probability significance=0.775>0.05. This coefficient indicates that there exists a homogeneity variance population under prior knowledge of the two classes.
From independent sample test table (table-2), t-value is 0.912<0.05. This value indicated that there is no significantly differences prior knowledge between students in geometrical illustration class and students in class without geometrical illustration. This is supported by data analysis from group statistics in table-1 showing that mean score of the two classes are relative the same where mean=70.6571 in geometrical illustration class and mean= 70.8824 in class without geometrical illustration.

Data analysis relation to Basic Concept Understanding test holds the normality distribution and homogeneity variance. Coefficient of Levene Statistics is 0.948 with probability significance=0.334>0.05 indicating that there exist a homogeneity variance population under BCU data between the two classes. Descriptive statistics given in table-3, and Output ANOVA given in table-4:

Table-1: Group Statistics of Prior Knowledge

<table>
<thead>
<tr>
<th>Prior_Knw</th>
<th>CLASS</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>35</td>
<td>70.6571</td>
<td>8.30288</td>
<td>1.40344</td>
<td></td>
</tr>
<tr>
<td>2.00</td>
<td>34</td>
<td>70.8824</td>
<td>8.55557</td>
<td>1.46727</td>
<td></td>
</tr>
</tbody>
</table>

Table-2: Independent Samples Test of Prior Knowledge data

<table>
<thead>
<tr>
<th>Prior_Knw</th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
<td>T</td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>.083</td>
<td>.775</td>
<td>.111</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>.111</td>
<td>-.111</td>
<td>66.76</td>
</tr>
</tbody>
</table>

Table-3: Statistics Descriptives of BCU

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>95% Confidence Interval for Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower Bound</td>
</tr>
<tr>
<td>GEO ILLUSTR</td>
<td>35</td>
<td>75.8857</td>
<td>7.42322</td>
<td>1.25475</td>
<td>73.3357</td>
</tr>
<tr>
<td>WITHOUT GEO ILLUSTR</td>
<td>34</td>
<td>64.7353</td>
<td>6.30684</td>
<td>1.08161</td>
<td>62.5347</td>
</tr>
<tr>
<td>Total</td>
<td>69</td>
<td>70.3913</td>
<td>8.85374</td>
<td>1.06587</td>
<td>68.2644</td>
</tr>
</tbody>
</table>

Tabel-4: ANOVA

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>2144.274</td>
<td>1</td>
<td>2144.274</td>
<td>45.091</td>
<td>.000</td>
</tr>
<tr>
<td>Within Groups</td>
<td>3186.161</td>
<td>67</td>
<td>47.555</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5330.435</td>
<td>68</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
From table-4, F-value = 45.091 with probability significance value is 0.00<0.05. It means that $H_0$ is rejected and conclude that there exist a significantly different Basic Concept Understanding of RVA between students in geometrical illustration class and students in class without geometrical illustration.

From descriptive statistics (table-3), mean value of BCU in geometrical illustration class is 75.8857, and that of class without geometrical illustration is 64.7353. Also the minimum and maximum score of BCU in geometrical illustration class is 64.00 and 91.00 but the minimum and maximum score of BCU in class without geometrical illustration is 55.00 and 79.00. These scores indicated that basic concept understanding of students in geometrical illustration class is better than that of students in class without geometrical illustration. In other word, geometrical illustration gives positive effects on basic concept understanding of students in Real Variable Analysis. It means that the basic concept understanding of students in RVA learned by geometrical illustration is better than that without geometrical illustration. The resulting of this study is consistent with Norainy (2013) and Wu Chao, (2006) which reported that that many part of mathematics can be improved by real situation approach such as picture, and graph geometrically. By this approach students can have ability to understand mathematics concept and apply it to solve the problems.

CONCLUSION

From the result obtained, a number of implications can be forwarded in the interest of applying geometrical illustration as supplement material in Real Variable analysis.

Firstly, The significant differences in Basic Concept Understanding of the geometrical illustration class as compared to the without geometrical illustration class indicated that geometrical illustration give positive effect on Basic Concept Understanding of students. The achievement of students in RVA II learned by geometrical illustration is better than their achievement without geometrical illustration.

REFERENCES


