Examining the Effects of the Explicit Instruction on the Learners’ Performance towards Mathematics

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Abstract: This quasi-experimental study was conducted to examine the efficacy of the Explicit Instruction against the conventional instruction in enhancing the performance of Grade 8 learners towards Mathematics.

Two intact groups of Grade 8 learners at Wawangpulo National High School were used in the study during the Third Quarter of SY 2015-2016. The experimental group was exposed to Explicit Instruction whereas the control group was immersed in the conventional instruction.

Validated pretest-post test and ATMI were used as instruments in the study. The scores obtained in the assessments before and after the conduct of the experiment were tabulated, analyzed and interpreted using SPSS. The mean scores and variances of the pretest and post test of the two groups of learners were statistically tested using the Welch t-test and the Analysis of Covariance (ANCOVA). On the other hand, the composite attitude scores of the two groups of learners were treated using the Wilcoxon Test.

Results revealed that the learners who were exposed to Explicit Instruction have better post test mean scores than those who were immersed in the conventional instruction.

Keywords: Explicit Instruction, active learning, performance in mathematics, quality mathematics education.

1. Introduction

The importance of mathematics in almost all aspects of human civilization is undeniable. From the past up to the contemporary times, its contributions are highly given appreciation and credit. It is believed that it can contribute to the solutions of world’s major problems in terms of scientific, economic, social development, citizenship, and personal fulfillment (UNESCO, 2012). Thus, it is deemed necessary that mathematics must be given emphasis not only in the industry but most importantly in the academic institutions.

The global trend in mathematics is mainly focused on how to achieve “quality mathematics education.” The term itself is defined as the formation of affirmative image of mathematics among the learners (UNESCO, 2012). Accordingly, innovation and continuous learning is one of the keys in order to promote the “quality mathematics education.” Professional organizations, educational researchers, mathematicians, academicians, and policy makers worldwide continuously search for ways and means on how to uplift and enhance their mathematics classrooms.

Despite of the trainings and acquisition of new knowledge and techniques in enhancing the mathematics education, it is still interrogative and challenge for every mathematics educator on how to address the deteriorating performance of the learners in mathematics (Imam, 2013). Another issue in the mathematics education in the Philippines is the severe gaps of the high school learners in mathematical concepts and skills (Rubin, et al, 2014). These scenarios were eventually observed by the researcher among his learners in the school level. This study aimed to find out if the explicit instruction will help to increase the performance of the learners in Mathematics 8. This instruction is proven to be effective in teaching language, mathematics, and individuals with learning disabilities as revealed in the plethora of related studies and researches.

2. Explicit Instruction

Explicit instruction is an active teaching approach wherein the facilitator of learning clearly and unambiguously outlines the learning objectives and learning competencies that are expected among the learners. Explicit instruction promotes active learning and gives emphasis on how to develop the learner’s skills than transmitting information and requires the learners to develop their higher-order thinking or deep learning (Brane, 2016). It connects the activities with students’ learning and utilizes backward design approach.

Explicit instruction can be divided into three sequential steps: modeling practice, guided or directed practice, and independent practice (Gauthier, et.al, 2013). Modeling is done by presenting the learning objectives and the learning competencies that are expected among the learners. Guided practice allows the learners to do some drills
and to consolidate their understanding through cooperative learning activities. The independent practice allows the learners to acquire or master the target skills and competencies and it serves as a learning opportunity to work on their own. Archer and Hughes (2011) outlined the elements of explicit instruction as follows:

1. Focus instruction on critical content by using a clear and concise vocabulary, concepts, rules, and skills.
2. Sequence skills logically (teaching the required skills based on the level of complexity).
3. Break down complex skills and strategies into smaller instructional bits/units. (Once mastery is attained, units must be synthesized).
4. Begin the lesson with a clear statement of lesson objectives and expected outcomes.
5. Facilitate a short recall of prior information to verify the readiness of the learners in the new lesson.
6. Use a step-by-step demonstration (guided and supported practice).
7. Provide adequate routine and non-routine problems.
8. Monitor the performance of the learners by providing immediate positive and corrective feedback.
9. Help the learners organize the concepts.
10. Provide distributed and cumulative drills. Distributed drill refers to multitude opportunities to practice the skill/s over time. Cumulative drill is an opportunity to link the previously and newly acquired skills.

3. Active Learning

Active learning is essential and more effective as compared to passive learning. The study about active learning techniques is believed to exist for more than three decades now. In the meta-analysis conducted by Freeman in 2014, for instance, it was established that the STEM learners who were exposed to passive learning through traditional lecture were 1.5 more likely to fail in courses than those who were exposed to active learning.

The field of neuroscience has more scientific explanation why educators must subscribe to active learning approaches, such as explicit instruction. Accordingly, explicit (declarative) instruction affects the conscious memory of the brain which can be divided into two: the semantic memory (facts) and the episodic memory (events). These are essentially long term memories and are fundamentally associative. It is easier to remember new information if it is linked with previously acquired knowledge that is already stored in the memory. The more significant the connections of the information, the more effectively it will help remember. In the study of Bruneau, it was found out through functional MRI that when the brain is active, arterial oxygenated blood will redistribute and increase to the concerned area of the brain. The explicit instruction affects the medial temporal lobe and the diencephalon of the human brain. The medial temporal lobe composed of structures that are essential for declarative or long term memory. The diencephalon, on the other hand, relays the sensory information between brain regions and controls various autonomic functions of the peripheral nervous system (Bailey, 2017). Thus, a teacher must utilize an active teaching strategy/approach in order to address the learning styles, individual differences and learning needs of the students.

4. Method

4.1. Research Design

Quasi-experimental research was utilized in the study. This was specifically done using the pretest-post test control group design. The groups who were chosen as learners-respondents in the study were two heterogeneous sections in Grade 8. The research design was illustrated in the table below.

| R   | O₁O₂ → X → O₃    |
| R   | O₁O₂ → C → O₃    |

Figure 1. Experimental Design of the Study

Where:
- R = random assignment
- O = observed measures
- X = experimental group
- C = control group
- O₁O₂ = pretest and attitude test of the control and the experimental group.
- O₃ = posttest of the control and the experimental group.

4.2. Respondents

The total number of learner-participants in this research was seventy eight. This number represented forty three percent (43%) of the total number of Grade 8 learners at Wawangpulo National High School. The two heterogeneous sections consisted of equal number of learners. The experimental group was exposed to the Explicit Instruction whereas the control group was immersed in the conventional instruction.
4.3. Instrument

This study used various instruments to obtain the necessary data. It includes the Attitude towards Mathematics Inventory by Martha Tapia, a prepared Table of Specification (covered all the topics in the Third Quarter, SY 2015-2016) and the validated pretest-post test.

In the previous research of Salao (2016), the attitudes of the learners were measured using the Attitude towards Mathematics Inventory (ATMI). This test was developed by Martha Tapia and was found to be applicable in many countries worldwide. This instrument was done before the conduct of the study. Unlike the previous work of the researcher, similar attitudinal test was not given to the same groups after the conduct of the study due to the fact that attitude is a complex aspect that is influenced by both internal and external factors. Fifty (50) hour exposure to a particular teaching instruction would make an almost negligible influence to the attitudes of the learners. The ATMI measures four dimensions of the attitudes towards mathematics such as enjoyment, motivation, self-confidence, and value. Similarly, it utilizes five response codes ranging from 1-5. The response codes are interpreted in the table below.

<table>
<thead>
<tr>
<th>Numerical Value</th>
<th>Verbal Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Strongly Disagree (SD)</td>
</tr>
<tr>
<td>2</td>
<td>Disagree (D)</td>
</tr>
<tr>
<td>3</td>
<td>Neutral (N)</td>
</tr>
<tr>
<td>4</td>
<td>Agree (A)</td>
</tr>
<tr>
<td>5</td>
<td>Strongly Agree (SA)</td>
</tr>
</tbody>
</table>

A table of specification was constructed to find the congruence of the topics allotted for the Third Quarter of Grade 8 Mathematics, based on the Curriculum Guide set by the department of Education (DepEd). A 50-item multiple choice pretest-post test was prepared, reviewed, and evaluated by the academic experts to ensure that fairness and no bias existed.

The validated pretest and post test were administered to the learners in Grade 9 of Wawangpulo National High School to find its reliability. Using the Split-Half Reliability Procedure, the pretest garnered a Spearman-Brown Coefficient of 0.83 whereas the post test showed a Spearman-Brown Coefficient of 0.79. These values were higher than the reliability coefficient set by the Blooming Evaluation Services and Testing (Salao, 2016).

4.4. Data Collection

Before the Third Quarter in SY 2015-2016 started, the researcher administered ATMI to two heterogeneous sections in Grade 8. The learners were given sufficient time to answer the 40-item Attitude towards Mathematics Inventory (ATMI). The following day, during their Mathematics classes, the two sections which were selected as participants of the study, were given the pretest to find their prior knowledge on the topics that will be discussed for the Third Quarter Mathematics 8.

The researcher handled the experimental group to introduce the Explicit Instruction among the learners in Grade 8. On the other hand, another teacher handled the control group using the Conventional instruction. Mathematics classes in these two heterogeneous sections were conducted simultaneously. This was done to eliminate possible biases in the conduct of the study.

After the allotted 50-hour immersion in all topics intended for the Third Quarter, the two groups of learners were given post test to assess the amount of knowledge they gained for the Third Quarter.

4.5. Ethical Consideration

The proponent of the study sought the consent to proper authorities, particularly the principal of Wawangpulo National High School and the Schools Division Superintendent of the Division of City Schools- Valenzuela City.
4.6. Statistical Treatment

All quantitative data were tabulated, computed, analyzed and interpreted using the Statistical Package for Social Sciences (SPSS Version 22). Mean percentage scores, weighted mean, standard deviations, Analysis of Covariance, Welch t-test, and Wilcoxon test were used in the study.

Statistical literature suggests that all quantitative data must be tested using the normality tests to ascertain that the appropriate statistical tests will be applied accordingly. Shapiro-Wilk test of normality showed that the pretest-post test scores of the two groups are normally distributed. Thus, parametric tests such as Welch t-test and ANCOVA were applied. However, the composite attitude scores of the two groups of learners registered values which did not conform to the required standards in conducting parametric tests. Thus, Wilcoxon test was applied to compare the composite attitude scores of the two groups of learners. All assertions of hypotheses utilized a significance level (α) 5%.

5. Result and Discussion

All data gathered were presented and interpreted based on the chronological order of the statement of the problem.

5.1. Scores of the Experimental Group and the Control Group in the Pretest-Post test

Table 1. Descriptive Statistics on the Pretest-Post test Scores of the Experimental and the Control Groups

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pretest</td>
<td>Post test</td>
</tr>
<tr>
<td>No. of Learners</td>
<td>39</td>
<td>39</td>
</tr>
<tr>
<td>Mean Scores</td>
<td>14.256</td>
<td>31.872</td>
</tr>
<tr>
<td>S.D.</td>
<td>4.558</td>
<td>2.577</td>
</tr>
<tr>
<td>MPS</td>
<td>35.64%</td>
<td>79.68%</td>
</tr>
<tr>
<td>Verbal Equiv.</td>
<td>Lower Average</td>
<td>Superior</td>
</tr>
</tbody>
</table>

The table revealed that when the pretest was administered, the experimental group got a mean score of 14.256 and standard deviation of 4.558 whereas the control group got a mean score of 14.051 and a standard deviation of 4.673. Likewise, both groups got an MPS of 35.64% and 35.13%, respectively, which are interpreted as “lower average”.

On the other hand, when the posttest was given after 50 hour immersion on the topics discussed for the Third quarter, the experimental group obtained a mean score of 31.872 and a standard deviation of 2.577. The control group of learners garnered a mean score of 26.79 and a standard deviation of 4.53. Apparently, these results showed that the experimental group obtained higher mean scores and MPS than the control group of learners.

5.2. Attitude Scores of the Experimental Group and the Control Group

Table 2. Composite Attitude Scores of the Experimental and the Control Groups

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Score</td>
<td>Description</td>
</tr>
<tr>
<td>Value</td>
<td>30.51</td>
<td>Strongly Positive</td>
</tr>
<tr>
<td>Enjoyment</td>
<td>21.13</td>
<td>Strongly Positive</td>
</tr>
<tr>
<td>Self-confidence</td>
<td>19.08</td>
<td>Negative</td>
</tr>
<tr>
<td>Motivation</td>
<td>21.77</td>
<td>Strongly Positive</td>
</tr>
<tr>
<td>Composite Score</td>
<td>92.49</td>
<td>Negative</td>
</tr>
</tbody>
</table>

The table shown above features the different dimensions of the Attitude towards Mathematics Inventory (ATMI). The experimental group has a value score of 30.51 (strongly positive), an enjoyment score of 21.13 (strongly positive), a self confidence score of 19.08 (negative) and a motivation score of 21.77 (strongly positive). On the other hand, the control group of learners scored 26.0 (strongly positive) in the value domain, 16.59 (positive) in the enjoyment, 13.23 (strongly negative) in the self confidence, and 16.28 (negative) in the motivation. Overall, both groups garnered low composite scores which were interpreted as “negative” in terms of the standards set by Martha Tapia.

5.3. Comparison of the Pretest Scores between the Experimental Group and the Control Group

Table 3. Welch Test for the Comparison of the Pretest Scores between the Experimental Group and the Control Group
Robust Tests of Equality of Means and Homogeneity of Variances

<table>
<thead>
<tr>
<th>Levene Statistic (Sig.)</th>
<th>F value (Welch)</th>
<th>Sig. (p-value)</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.893</td>
<td>0.039</td>
<td>0.845</td>
<td>Accept Ho</td>
</tr>
</tbody>
</table>

Asymptotically F distributed

At 5% level of significance and degree of freedom of 76, the computed F value of 0.039 indicated that the null hypothesis must be accepted. This was further confirmed using the p-value of 0.845.

With these results, it can be gleaned that both groups of learners have similar performance in mathematics before the experiment was conducted. Furthermore, it showed that both groups of learners were homogeneous in terms of cognitive level prior to the conduct of the study.

5.4. Comparison of the Post test Scores between the Experimental Group and the Control Group

Table 4. Welch Test for the Comparison of the Pretest Scores between the Experimental Group and the Control Group

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>Degree of Freedom (α=5%)</th>
<th>Mean Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>502.615</td>
<td>1</td>
<td>502.615</td>
</tr>
<tr>
<td>Within Groups</td>
<td>1030.718</td>
<td>76</td>
<td>13.562</td>
</tr>
<tr>
<td>Total</td>
<td>1533.33</td>
<td>77</td>
<td></td>
</tr>
</tbody>
</table>

Robust Tests of Equality of Means and Homogeneity of Variances

<table>
<thead>
<tr>
<th>Levene Statistic (Sig.)</th>
<th>F value (Welch)</th>
<th>Sig. (p-value)</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.019</td>
<td>37.060</td>
<td>0.000</td>
<td>Reject Ho</td>
</tr>
</tbody>
</table>

Asymptotically F distributed

At 5% level of significance and a degree of freedom of 76, the computed F value of 37.06 and a p-value of 0.000 suggested that the null hypothesis must be rejected.

Based on the data, it can be culled out that the two groups of learners have different mean square scores (variance) in the post test. Moreover, it was revealed that the experimental group of learners has higher mean scores in the post test as compared to the control group of learners.

5.5. Comparison of the Composite Attitude Scores

Table 5. Hypothesis Test of the Composite Attitude Scores using Mann-Whitney U Test

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Sig</th>
<th>Decision</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>The distribution of the composite attitude scores is the same across categories of groups.</td>
<td>0.685</td>
<td>Accept Ho</td>
<td>Not significant</td>
</tr>
</tbody>
</table>

Independent Samples Mann-Whitney U Test

Mann-Whitney U 720.0 Test Statistic 720.0

Wilcoxon W 1.500.0 Std. Error 99.945

(Asymptotic, 2 sided-test at α = 0.05)

A Mann-Whitney U test revealed that there was no significant difference in the composite attitude scores of the two groups of learners (U = 720.0 and p-value = 0.685).

It can be stated with these limited data that the two groups of learners have similar attitudes towards mathematics before the conduct of the experiment.

5.6. Mean Scores of the Experimental and the Control Groups

Table 6. Analysis of Covariance on the Gain Scores of the Experimental Group and the Control Group

<table>
<thead>
<tr>
<th>Groups</th>
<th>Mean</th>
<th>SD</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>17.62</td>
<td>5.204</td>
<td>39</td>
</tr>
<tr>
<td>Control</td>
<td>12.74</td>
<td>6.881</td>
<td>39</td>
</tr>
<tr>
<td>Total</td>
<td>15.18</td>
<td>6.538</td>
<td>78</td>
</tr>
</tbody>
</table>

Post Hoc Test (Bonferroni, α = 0.05)

<table>
<thead>
<tr>
<th>Degrees of Freedom</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>75</td>
<td>36.894</td>
<td>0.000</td>
<td>0.330</td>
</tr>
</tbody>
</table>

Dependent Variable: Gain Score
R Squared = 0.688 (Adjusted R Squared = 0.680)

Decision: Reject Ho

There was a significant difference in the mean gain scores of the experimental group and control group at a computed F value (1.75) of 36.894 and a p-value of 0.000 (using Bonferroni Test). The result of ANCOVA revealed that the mean gain score of the experimental group was higher than the mean.
gain score of the control group. Furthermore, it was found out that the partial eta squared of 0.330 described that the covariate (pretest) has little to moderate effect on the mean gain scores of the learner, as stipulated in the Cohen’s guidelines.

6. Conclusions and Recommendations

In the light of the aforementioned results, findings and hypotheses presented, the researcher arrived at the following conclusions:

1. The learners have similitude of cognitive levels before the experiment was conducted. After the experiment was conducted, the learners who are exposed to the Explicit Instruction have better post test mean scores than those who are exposed to the conventional instruction.
2. Both groups of learners have negative attitudes towards mathematics.
3. The cognitive level of the experimental group before the conduct of the study is not significantly different from the cognitive level of the control group.
4. There was a significant difference on the post test scores between the experimental group and the control group was observed.
5. The composite attitude scores of the experimental group were significantly similar to the composite attitude scores of the control group.
6. The experimental group garnered a higher mean gain score than the control group.

In view of the findings, conclusions, and scope and delimitations of the study, the following are suggested:

1. Active Teaching Approaches like the Explicit Instruction brings meaningful learning experiences among the learners. Thus, enhances the performance of the learners towards mathematics.
2. Attitude is a broad and complex spectrum that is hard to measure. Thus, a more scientific study that would focus on the attitude towards mathematics and how it affects the performance in mathematics is highly encouraged. It is also encouraged that future researchers should design a localized mathematics inventory that adheres to the contemporary culture, interests, and needs of the Filipino students.
3. A replication of the study using a larger sample size and a broader coverage of Mathematics topics must be done to ascertain the results of this study.
4. Facilitators of mathematics are hereby encouraged to engage all learners in the activities that will address their learning needs.
5. Facilitators are encouraged to subscribe themselves to innovate, and research more to guide the learners attain their full potential.

7. Acknowledgement

The researcher wishes to express his profound gratitude to the entire Wawangpulo National High School, Division of City Schools- Valenzuela for providing unbounded assistance to make this study feasible.

8. References

Bruneaue, E. Cognitive Neuroscience: Implicit vs Explicit Learning Activity.