EFFECTS OF PRACTICAL WORK APPROACH ON THE PERFORMANCE OF COLLEGE STUDENTS IN GRAPH THEORY

RAQUEL D. QUIAMBAO

College of Arts and Sciences, Don Mariano Marcos Memorial State University-SLUC, Philippines
E-mail: rquiambao2015@gmail.com

Abstract- The role of mathematics in man’s life is an established fact. However, the marked difficulty experienced by students in learning mathematics as noted by the researcher calls for the need of alternative approaches to enhance performance. This paper dealt with the effects of practical work approach on the performance of college students in Graph Theory, specifically on the interaction effects of teaching approach with mathematical ability and manipulative skills. The post test-only control group true experimental design was used. Findings showed that below-average and above-average mathematical ability students taught by practical work approach performed better than their counterparts in the conventional approach. Moreover, the students with high and low manipulative skills taught by the practical work approach performed better than those students with high and low manipulative skills taught by the conventional approach. Furthermore, results of the ANCOVA revealed a significant interaction between teaching approach and mathematical ability. Overall, the practical work approach as a teaching strategy was shown to be significantly effective in improving performance of the students in Graph Theory. Practical work approach should be adopted by teachers to enhance performance of students in said course.

Keywords- Analysis Of Covariance, Effects, Graph Theory, Interaction, Manipulative Skills, Mathematical Ability, Performance, Practical Work Approach.

I. INTRODUCTION

The vital role of Mathematics to almost all aspects of man’s life is an established fact. However, the sad reality remains, that most students perform low in mathematics. A recent study revealed the number of Filipino students who lag behind their foreign counterparts in terms of their achievement levels in science and mathematics. Results of the Third International Mathematics and Science Study 2011 conducted by the International Association for the Evaluation of Educational Achievement show that Filipino students scored below average against the international aver-age standard (TIMMS, 2011). Having taught the course Graph Theory to BS Mathematics students for so many years, the researcher observed the marked difficulty experienced by students in learning the course. This difficulty was evidenced by poor examination results and inability of students to correctly interpret answers to solutions. The same observations have been expressed by other instructors in Mathematics on several occasions, namely, departmental meetings and deliberations of final grades. The above-mentioned findings and observations call for remedial measure in order to raise the level of science and mathematics achievement to one that is at par with developed countries.

The training of mathematics teachers has been identified as among the specific steps to improve instruction. The conduct of implementation programs and the implementation of innovative teaching strategies can also be used to uplift the quality of mathematics instruction. No single technique or approach has been proven to maximize student performance. Hence, it is an added responsibility of a teacher to select, organize and present the lessons in a develop-mental manner tailored to the objectives of the course and the needs of the students. Cognizant of the need for alternative teaching approaches, this study investigated the effects of one of the new trends in mathematics instruction. This is called the practical work approach.

The practical work approach highlights the dynamic nature of teaching and learning mathematics. This dynamism advocates the teachers as facilitators of learners’ active construction. The students’ ideas are elicited and discussed. They must be able to think for themselves, to reason and explain, to discover connections and consolidate their learning. In the end, they develop confidence in their ability to do and create mathematics, recognize and apply mathematics in their everyday activities and appreciate the importance of mathematics.

Realizing the potential usefulness of practical work approach in instruction, this research was focused on the effects of this approach on students’ performance in Graph Theory. Viewed in this context, the effectiveness of practical work approach was tested in teaching Graph Theory to determine whether it can help lessen the students’ difficulties in learning concepts and processes which could lead to enhanced mathematics performance. Hence, the researcher aimed to provide useful data through the results of this experimental study that could help teachers to be more effective in mathematics teaching. Specifically, the study determined the following: the profile of the students taught by the practical work approach and those taught by conventional approach.
Effects of Practical Work Approach on the Performance of College Students in Graph Theory

in terms of School ability (IQ), Mathematical Ability, Manipulative Skill; the performance of the students in Graph Theory taught by the practical work approach and those taught by the conventional approach when grouped according to mathematical ability and manipulative skill; a significant difference in the performance in Graph Theory of the students taught by the practical work approach and those taught by the conventional approach in terms of mathematical ability and manipulative skill; and a significant interaction effect of teaching approach and mathematical ability and teaching approach and manipulative skill on performance in Graph Theory.

II. MATERIALS AND PROCEDURES

A post test-only control group true experimental design was employed in this study. Two intact classes of BS Mathematics sophomores of Don Mariano Marcos Memorial State University-South La Union Campus were taken as subjects of the study and that they are not equivalent at the start of the experimental period. The experimental group with 29 students was taught by the practical work approach and the control group with 31 students was taught by the conventional approach.

Aside from the teaching approach, mathematical ability and manipulative skill were considered in analyzing the posttest scores of the students. Above-average and below-average mathematical ability and high and low manipulative skill students were separated. Thus, students with above-average mathematical ability and below-average mathematical ability were taught the practical work and conventional approaches as well as those with high manipulative and low manipulative.

A performance test in Graph Theory consisting of 50-item multiple choice test with four options was developed and validated. The reliability coefficient of the performance test was 0.804, high reliability using Kuder-Richardson Formula 20. The test covered the topics in the study, namely, trees, paths and distance in graphs, Eulerian graphs, Hamiltonian graphs, planarity and coloring graphs (Chartrand& Santos, 1993).

The school ability (IQ) was indicated by the score of each student in the Otis-Lennon School Ability Test (OLSAT) Advance prepared by Arthur S. Otis and Roger T. Lennon. Reliability coefficient for the OLSAT was 0.93.

The mathematical ability was indicated by the score of each student in the numerical ability portion of the College Admission Test which consisted of 50-items with four options.

The manipulative skill is indicated by the score of each student in the space relation and mechanical reasoning portions of the Differential Aptitude Tests (DAT). All DAT tests are essentially power tests and the reliability coefficients are high. The test which consisted of 60 items with four options was administered to the students by the guidance counselor of the College of Sciences before the experimental period.

Both the experimental and control classes took up the same topics. They were given the same set of exercises, assignments and parallel quizzes. The teaching strategy, however, differed for the two groups. The practical work approach used in the experimental class involved hands-on and minds-on activities to develop concepts, investigate relationships among these concepts, solve problems and engage the teacher and the learner in mathematical thinking. On the other hand, the combination of lecture-discussion and the discovery methods which involved confirmation and practice was used in the control class.

The main data gathering instrument which was the posttest in Graph Theory and instructional materials which included worksheets were prepared by the researcher. The posttest was validated and the reliability of the test was 0.83, highly reliable. The experiment lasted for 6 weeks. The performance test was administered to the experimental and control groups which was used to compare their performance after the experimental period.

The necessary data for the school ability and mathematical ability were taken from the Guidance Office.

Validation of the performance test was done by pilot-testing to 40 randomly selected students who have finished Graph Theory. Results were subjected to item analysis which included computing the indices of the item’s level of difficulty (P) and discrimination (R). Items with discrimination values lower than 0.20 do not yield much information about differences among the abilities of the students and should be improved or discarded (Clark, et al.,1999). Items with discrimination values 0.30 and above were retained. Items whose difficulty levels approximate the optimal difficulty value of a 4-alternative multiple-choice item which is 0.62 were retained. This range was from about 0.50 to 0.90. Items with difficulty close to 1 or below 0.25, the guessing level of the items were rewritten.

Scores obtained by the students in the 50-item posttest were given the following descriptive rating: 45-50, excellent; 36-44, above average; 27-35, average; 18-26, below average; 9-17 fair; and 0-8, poor.

The mathematical ability and manipulative skill scores of the students were given the following descriptive rating:
Effects of Practical Work Approach on the Performance of College Students in Graph Theory

<table>
<thead>
<tr>
<th>Range</th>
<th>Math Ability</th>
<th>Manipulative Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>42-50</td>
<td>51-60</td>
<td>Excellent</td>
</tr>
<tr>
<td>34-41</td>
<td>41-50</td>
<td>Very Satisfactory</td>
</tr>
<tr>
<td>26-33</td>
<td>31-40</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>17-25</td>
<td>21-30</td>
<td>Good</td>
</tr>
<tr>
<td>9-16</td>
<td>11-20</td>
<td>Fair</td>
</tr>
<tr>
<td>0-8</td>
<td>0-10</td>
<td>Poor</td>
</tr>
</tbody>
</table>

Mean, standard deviation, skewness, and kurtosis were used to describe the respondents in terms of the following: school ability, numerical ability score in the College Admission Test (CAT), manipulative skill, scores of the students in the posttest according to mathematical ability groups, manipulative skill groups and teaching approach.

Two-way Analysis of Covariance (ANCOVA) was used to determine the significant differences in the performance in Graph Theory between the above-average and below-average mathematical ability groups, between the high and low manipulative skill groups, between the experimental and control groups, the significant interaction effects of teaching approach and mathematical ability and teaching approach and manipulative skills on the performance of the students using school ability (IQ) as covariate.

CONCLUSIONS

The BS Mathematics students enrolled in Graph theory possess the necessary school ability, mathematical ability, and manipulative skills. The BS Mathematics students who possess the skills of mathematical reasoning and critical thinking have better performance in Graph Theory.

Furthermore, the BS Mathematics students with high manipulative skills have better performance in Graph Theory than those with low manipulative skills.

The practical work approach is significantly more effective than the conventional approach in teaching Graph theory.

The performance of the BS Mathematics students in Graph Theory whether they are exposed to practical work approach or conventional approach varies with the level of mathematical ability. The practical work approach is more effective to the below-average mathematical ability students than to the above-average mathematical ability students.

The performance of the BS Mathematics students in Graph Theory whether they are exposed to practical work approach or conventional approach does not vary with the level of manipulative skills. The high and low manipulative students exposed to the practical work approach performed equally well.

REFERENCES