Team-Pair-Solo: An Experimental Approach in Teaching Random Variables and Discrete Probability Distributions

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Abstract — The general objective of this study was to enhance the mathematical performance of the grade 11 senior high respondents who were presently taking their Statistics and Probability subject for Academic Year 2018-2019 at Telesforo and Natividad Alfonso High School. The main lessons in this study were the random variables and discrete probability distribution that was taught using the Team-Pair-Solo Approach or also known as the Theory of Gradual Released of Responsibility. It came from a theory of gradual released of responsibility where student will experience first the collaboration of work with their team down from a partner brainstorming and lastly, individualistic approach.

The pre-test post-test control group true-experimental research design was used in this study to determine the effectiveness of the given technique and to attain its objectives. The respondents and instruments were also discussed in the methodology of this research.

The following conclusions were drawn from the findings: Both groups had a little idea in terms of random variables and discrete random probability distribution. At the same time, it shows clearly that control group had greater idea in the said topics with a least significant difference of 1.733. There is no significant difference between the pre-test result of both control and experimental groups in random variables and discrete random probability distribution. Both groups had learned random variables and discrete random probability distribution from the two given strategies (team-pair-solo approach and conventional teaching). At the same time, it shows clearly that experimental group had greater mean in the said topics with a least significant difference of 7.333. The result obtained for the pre-test and post-test difference of the experimental group was -8.036 with a p-value of 0.000, which was interpreted as significant. There was a significant difference between the post-test results of the control group and the experimental group. From the result of the mean score for the experimental group during the pre-test which was 12.667 and interpreted as fair (F) it was turned into 35.200 mean score and interpreted as satisfactory (S) with the increase on the level of assessment which is equal to 45.066% significantly showing that the team-pair-solo approach in teaching random variables and discrete probability distribution was also effective. The F-value was 2.583 and T-value was -1.607 with a p-value of 0.132 shows significant results.

Keywords — Teaching Random Variables, Discrete Probability Distributions, mathematics.

I. CONTEXT AND RATIONALE

Today, mathematics considered being very important tool around the world. It is important for the learners in the sense that it will help them to learn knowledge based from their experiences, understanding things around them, apply their knowledge through actualization and develop their logical, critical, and analytical thinking to be ready on their future career (Franke & Kazemi, 2001; Arslan, 2012).

Metacognition awareness in mathematical thinking and problem solving skills is still an issue in the learning problems of the students in mathematics hence, many educators still striving to find ways in order to improve learners’ mathematical performance and achievement (Tamizi, 2010; Ali, 2010).

In the mid-1980s, there was a reform movement in mathematics education as a reaction to dissatisfaction with conventional teaching approaches (Education Alliance, 2006). Specific reports recommending the restructuring of
mathematical delivery (NCTM, 2011) marked the need for modifications in teaching methodology.

On the other hand, Probability is now part of the Enhanced Basic Education Curriculum, hence learners should engage themselves in learning probability in school. However, the problems associated with the teaching and learning of probability are well-documented (Batanero and Diaz, 2011).

In the Philippines, teachers find difficulties in teaching probability and students find it hard to understand the concepts about this subject especially in the problem solving (Batanero and Diaz, 2011).

In connection, grade eleven found difficulties in understanding their lessons on their mathematics core subjects particularly in general mathematics. For the school year 2018-2019 first semester, students found hardship in mathematics wherein most of them got grades from 75-79 which is truly alarming on the part of the teacher. Another, through root-cause-analysis and observation, the researcher found that the students have poor study habit, low self-esteem, negative feelings in math, lack of interest due to the subject boredom, fear to fail, lack of exposure and self-confidence, and incompetence.

Also, in the study of Reyes (2018) entitled students learning styles towards understanding mathematics achievement goals has found that most of the students he handled are divergent learners which means according to Kolb (2005), divergers learn by reflecting on concrete experiences to create a learning style that can view concrete situations from different outlooks. Individual are interested in people, tend to imaginative and emotional, specialize in arts, and prefer working with groups.

Relating to that problem, teacher must know the suitable strategy for students to make the students more comfortable in the class especially in enhancing mathematical skill. Students’ mathematical skill actually can be improved by using Team-Pair-Solo, which is closely related to divergent learning style. Many methods can be used in order to help improving the students’ performance in mathematics but this research is focused on the method of Team-Pair-Solo. It is one of the cooperative learning methods which can be applied in teaching numerical to make students interact actively in the classroom activity, especially in mathematics lesson because it can stimulate students to think and change their thinking.

Team-pair-solo approach was originated from the framework of Nancy Frey and Douglas Fisher (2013), which was Gradual Released of Responsibility Instructional Framework. According to Pearson and Gallangher (1983), that gradual released of responsibility suggest a cognitive work shifted slowly through modeling and representation of teachers, by joint collaboration a teacher and a learner, and by individual practice and application of the learners’ understanding. This simply means that all the responsibility in a performing task is assume to be accomplished by the students with responsibility (Duke and Pearson, 2004).

This framework was built through the theories of: Jean Piaget cognitive structure in 1952, Lev Vygotsky Zone of Proximal Development in 1978, Albert Bandura’s framework on attention, retention, reproduction and motivation in 1965, and Jerome Bruner, David Wood, and Gail Ross scaffold instruction in 1976.

According to Fray and Fisher (2008) gradual released of responsibility has four components namely: focus lessons, guided instruction, productive group work, and independent learning.

Focus lessons in the first stage of the framework wherein teachers model the lesson to the students using representation at the same time following the objectives of the lessons. The next stage was the guided instruction wherein the teacher shows some cues to the lessons where in students are group together. In this part, the teachers start releasing the responsibility through scaffolding technique. The third one was the productive group work wherein students are doing collaborative effort to produce something that is related to the topic. This is the part wherein students brainstorm and collect and select ideas from their group mates. And lastly was the independent learning wherein students apply their work individually through new learning situation. In this part, students apply what they learned in class inside and outside the classroom. Usually, this last stage was applied through formative or summative assessment.

In relation to gradual released of responsibility instructional framework, team-pair-solo approach is a method of cooperative learning in which the students do problem first as a team, then with a partner, and finally on their own (Cook, 2007). It is designed to motivate the students to tackle and succeed at problem which initially were beyond their ability. Then, all students take individual quizzes on the material, at that time they must not help each other. It was based on the simple notion of mediated learning.

The process of discussing and sharing knowledge can be held through a cooperative learning strategy that is a technique in which the students are divided into pairs or
groups. The team-pair-solo is one of the cooperative learning strategies, developed by Kagan (2002). In this study this method is believed as a prospective way to achieve mathematical skill development.

Kagan (2002) defined cooperative learning as a technique using small group of people working together with heterogeneous skill to achieve the common goal or purpose of the lesson.

Therefore, from several definitions above, it can be drawn that cooperative learning is a kind of technique done in a teaching and learning process in which the students work in small groups or in pairs in order to improve their understanding of the given material. The process of cooperative learning can encourage the students to optimize and add their knowledge; thus, they are expected to solve the given problem better than when they do it alone.

**Team**

Group work permits students to develop a range of critical thinking, analytical and communication skills; effective team work; appreciation and respect for other views, techniques and problem-solving methods, all of which promote active learning and enhance student learning.

Therefore, a team in this structure involves a small group of people in which they work in groups of four. The consideration of putting four members in a team is that in order to make it easier to divide them in pairs as the next step of team-pair-solo.

Moreover, the advantages of working as a team of four are stated by Lie (2002) such as: (1) Many ideas to share, (2) More tasks that can be done, (3) Easy to divide into pairs, and (4) Easy to monitor.

**Pair**

Pair is the next step in which there are two people working together to discuss the given problem. In team-pair solo, after working as a team, the team is divided into pairs. They progress to the next step that is working in pairs. Lie (2002) also states some advantages of working in pairs. Among of them are: (1) Increasing participation, (2) More chances to give contribution, and (3) Easier interactions.

These advantages show that working in pairs can be considered as the bridge to help people progress from working together with many people to working with less people and finally working as an individual.

**Solo**

After people work as a team, and then, as a pair, they progress to the last step, which is solo, in which one works individually. The basic principle of this last step uses Vygotsky’s theory, which can be inferred that every person’s development includes the development inside the person as an individual. Because when people work on their own, they can use their own knowledge and understanding that they have already got as the result of the earlier discussions as groups of four and pairs.

An inference that can be drawn here is that every step of team-pair-solo has its own advantages. Each of the steps plays important roles to support each step in team-pair-solo with the hope that the goal and purpose of this activity can be accomplished.

Beside the advantages of each step in team-pair-solo, according to Kagan (2002), there are several virtues fostered by implementing team-pair-solo as the whole package. These are: (1) Cooperation, (2) Helpfulness, (3) Leadership, (4) Self-Motivation, and (5) Pride in Work.

By the arrival of the new millennium, the knowledge based in probability learning had burgeoned as a consequence of research undertaken during the 10-year period since probability and statistics became a mainstream strand (Jones, 2005; Jones et al., 2007). This emerging research on students’ understanding of probability highlighted the need for greater curriculum emphasis on fundamental elements like distribution and randomization.

Based on the students’ condition in teaching learning process, it is expected that using Team-Pair-Solo is adequate way of teaching numerical analysis to help the students promote critical thinking about what they read by solving problem first in team, then in pair and finally on their own. This method was designed to motivate students to tackle and succeed at problems, which are initially beyond their ability. In other words, by using Team-Pair-Solo in teaching mathematics, the student’s mathematical skill can be boosted.

**Statement of the Problem**

The general objective of this study was to enhance the mathematical performance of the grade 11 senior high respondents who were presently taking their Statistics and Probability subject for Academic Year 2018-2019 at Telesforo and Natividad Alfonso High School. The main lessons in this study were the random variables and discrete probability distribution that was taught using the Team-Pair-Solo Approach.
Specifically, the study sought answers to the following questions:

1. What is the experimental and control groups level of mathematical achievement on random variables and probability distributions before subjecting them to the team-pair-solo approach as based from their pre-test result?
2. What changes on experimental and control groups level of mathematical achievement on random variables and probability distributions occur after exposing them to the team-pair-solo approach as based from their post-test result?
3. Is there a significant difference in the experimental and control groups level of mathematical achievement on random variables and probability distributions before and after exposing them to the team-pair-solo approach as based from their pre-test and post-test results?
4. What is the perceived benefit of team-pair-solo approach to the respondents’ level of mathematical achievement in random variables and probability distributions?

Hypothesis

On the basis of the study framework presented and the preceding review of related literature, the hypothesis was formulated:

There is no significant difference in the experimental and control groups level of mathematical achievement on random variables and probability distributions before and after exposing them to the team-pair-solo approach as based from their pre-test and post-test results.

Significance of the Study

The importance of the study lies in the possibility that the findings of the research may help the following in the improvement of Mathematics instruction.

Teachers. This may help them in teaching Mathematics on how to deal with the different lesson presented using different kinds of activities so that teaching and learning process will be attainable and measurable. It is hoped that the results will be more beneficial to teachers to improve their mathematics instruction. It is important to give students experiences that help them develop their understanding in mathematics through the use of team-pair-solo approach.

Schools and Administrators. This study may help the schools and administrators to benefit from the effectiveness of team-pair solo approach in the field of Mathematics as on its effect to the academic performance of the respondents and gain insights on how they could be of help in dealing with this problem. It may also bring those ideas in motivating their teachers towards a better quality of education.

Future Researchers and Curriculum Developer. The findings of the study may serve as a basis in conducting a more profound study, specifically pertaining to team-pair-solo approach. Also, it serves as a guide for other researchers in conducting related and parallel studies. The ideas presented may be used as referenced data in testing the validity of other related findings and also may be used as a pattern on creating curriculum.

Scope and Limitations

The main objective of this research was to determine the effectiveness of team-pair-solo approach in enhancing grade eleven respondents’ level of mathematical achievement towards random variables and discrete probability distributions.

The scope of this study was the lessons in statistics and probability of the grade eleven respondents’ particularly random variables and discrete probability distributions. The study was limited for a 50-item multiple-choice type of test prepared by the researcher for the pre-test and post-test and was administered for about one month to test the effectiveness of the given approach. The researcher also provided perceived benefits likert scale for the experimental group to determine if their perceptions towards the approach predicted their mathematics performance. On the other hand, it is limited only for grade eleven students of Telesforo and Natividad Alfonso High School for the school year 2018-2019, second semester.

The grade 11 students who undergo in this study were those students who had achieved a grade of 75 to 79 for the first semester of the school year 2018-2019 in Mathematics. Only 15 students were considered for experimental group and another 15 for the control group. All the two sections were received the same benefit of the two treatments namely: team-pair-solo approach for the experimental group and conventional approach for the control group.
The confidentiality of the result in the study was obtained and made sure that the researcher never revealed the process of experimentation to the respondents in order to maintain both the internal and external validity of the study.

II. METHODS

Research Design

The pre-test post-test control group true-experimental research design was used in this study to determine the effectiveness of the given technique and to attain its objectives. For many true experimental designs, pre-test post-test design was the most popular to compare the results from the respondents and to determine the degree of changes based from the treatment or intervention made from the experimentation.

Christensen (2001) states that true-experimental research approach was a quantitative approach designed to ferret out cause-effect relationships. This research enables the researcher to identify causal relationships because this approach allows the researcher to observe the effects of systematically changing one or more variables. Widi (2010) also states that a true-experimental research can be defined as a method, which was done by doing some treatments. It means that this research was done to know the effect after one or some treatments were done. It can be inferred that a true-experimental research describes what will happen with particular variables when there are certain treatments given to them. Therefore, this study used a true-experimental study, as one form of quantitative research to investigate the possible relationship between the use of team-pair-solo and the eleventh graders perceived benefits based from their mathematical achievement in random variables and probability distributions.

Respondents

The respondents of this study were the grade 11 students particularly (General Academic Strand) GAS – A (15 students), heterogeneous section - the control group, and (General Academic Strand) GAS – B (15 students), heterogeneous section - the experimental group Senior High School at Telesforo Natividad Alfonso High School located in Sta. Ana, Pampanga who were enrolled on the school year 2018 – 2019. Moreover, the researcher did not explained and revealed to all respondents’ research purposes.

Sampling Method

The sampling method that was used in this study were purposive sampling and random sampling particularly, lottery sampling. From the total population of 41 students in general academic strand B, 23 of them got 75 to 79 grades in General Mathematics subject during the first semester of the school year 2018-2019. While, from the total population of 40 general academic strand A, 25 of them got a grades from the range of 75 to 79. Since the numbers of the respondents from the two groups are not equal, the researcher decided and chose 15 from each group. From the experimental group, the number of male was 5 and female was 10, while from the control group the number of male was 8 and female was 7. All the 41 and 40 students from the two sections received the treatment for both control and experimental group yet the subject of this research was already selected before the implementation of the treatments.

Proposed Innovation/ Intervention/ Strategy

The proposed strategy used in this research was a team-pair-solo approach. It came from a theory of gradual released of responsibility where student will experience first the collaboration of work with their team down from a partner brainstorming and lastly, individualistic approach.

Team

The team in this research was a group of students working together in doing their task. Each group composed of 4 members so that it will be easier for the researcher to cut the group into pair for the next stage of the given strategy.

Moreover, the advantages of working as a team of four are stated by Lie (2002) such as: (1) Many ideas to share, (2) More tasks that can be done, (3) Easy to divide into pairs, and (4) Easy to monitor.

Pair

After working in a group, the next stage was to divide them into pair. A pair was the next stage where individuals of two share their ideas and work together to fulfill the given task from the worksheet. Lie (2002) also states some advantages of working in pairs. Among of them are: (1) Increasing participation, (2) More chances to give contribution, and (3) Easier interactions.

Solo

After working with team, and then with pair, then it’s the time that the respondents will do individualistic
approach wherein each one will do task alone. This approach was based from the theory of Vygotsky that an individual will learn if he can explore their knowledge based from their experiences and understanding from the previous lesson done through team and then with pair.

These were the three stages where students were exposed from the entire duration of the experimental research.

**Instruments**

The primary instruments that were used for the gathering of data were the pre-test and post-test papers that were provided by the researcher. The test paper was a 50-item multiple-choice type of test. Also, the researcher provided different lessons using multimedia and different materials such as worksheets with team-pair-solo approach for the experimental group. And for the control group, the researcher used a conventional method. Also, the researcher used a self-made questionnaire to determine respondents’ perceptions as regards to the usefulness of team-pair-solo approach and as to its relationship to the grade eleven respondents’ mathematical performance. Validity and reliability of the questionnaire and examination was maintained in cooperation with the experts in the same field of teaching.

**Data Collection and Procedure**

In doing this research, the researcher asked permission from the principal of the school to conduct his action research. After the Division Office approved the proposal endorsed by the school principal, the researcher continues the study.

The researcher first administered a pre-test for both the control and experimental groups. After the checking, the researcher tallied and analyzed the given data for the first part of the research.

The researcher used the team-pair-solo approach in teaching random variables and probability distributions to the experimental group using the activities developed by the researcher by following his matrix in congruence to the purpose of the study.

For the control group, the researcher used the lecture-discussion method or conventional method in teaching mathematics. This was done throughout the whole month. Then, the researcher administered a post-test for both the experimental and the control groups. After collecting all the necessary data, the researcher tabulated and analyzed the data based on the objectives of the study.

**Ethical Consideration**

Confidentiality was maintained throughout the procedures by utilizing pseudonyms (e.g. Student 1, Student 2 ... Student 9) to de-identify the data. Also, the respondents do not even know that they were studied in experimentation to avoid the changes on the data. Since the respondents of the study were the grade eleven students, there was an emphasis on the ethical obligations to protect the rights of the respondents.

**Data Analysis**

The following statistical tools was used to analyze and interpret the quantitative data that was gathered from the study:

The Mean formula was used to determine the arithmetic average among the pre-test and post-test results of the respondents, and their perceptions towards team-pair-solo approach.

*T-test for Independent Samples* was used to determine the significant difference between mathematical performance of the respondents before and after the instruction through pre and post test results.

*Linear Regression* was used in order to determine the correlational coefficient prediction of the respondents’ mathematical performance to their perceptions in team-pair-solo approach.

Since significant difference has been established, the *Least Significant Difference (LSD)* was employed to determine which between the two approaches is best in terms of students’ achievement.

In order to determine the respondents’ perceptions towards team-pair-solo approach, the Likert Scale was used.

**Numerical Rating Descriptive Rating**

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.50 – 5.00</td>
<td>Always (A)</td>
</tr>
<tr>
<td>3.51 – 4.50</td>
<td>Very Often (VO)</td>
</tr>
<tr>
<td>2.51 – 3.50</td>
<td>Often (O)</td>
</tr>
<tr>
<td>1.51 – 2.50</td>
<td>Sometimes (S)</td>
</tr>
<tr>
<td>1.00 – 1.50</td>
<td>Never (N)</td>
</tr>
</tbody>
</table>

The interpretation for the test results on mathematical performance was organized, tabulated, and interpreted:

**Raw Scores**

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>39.50 – 50.00</td>
<td>Excellent (E)</td>
</tr>
<tr>
<td>29.50 – 39.49</td>
<td>Satisfactory (S)</td>
</tr>
<tr>
<td>19.50 – 29.49</td>
<td>Good (G)</td>
</tr>
<tr>
<td>9.50 – 19.49</td>
<td>Fair (Fa)</td>
</tr>
<tr>
<td>0 – 9.49</td>
<td>Failed (F)</td>
</tr>
</tbody>
</table>
III. RESULTS AND DISCUSSIONS

This part presents the results, analysis, and interpretation of data gathered. The results were presented, analyzed, and interpreted to respond to the objectives and hypothesis of the study.

I. Pre-test Results of the Control and Experimental Groups

Table 1 shows the pre-test results of both the control and experimental groups. Based from the result of the first implementation of test, control group from this research got a mean score of 14.400, which was Fair (Fa) with a standard deviation of 4.320 while, the experimental group got a mean score of 12.667 which was Fair (Fa) with a standard deviation of 5.514.

This means that both groups had a little idea in terms of random variables and discrete random probability distribution. At the same time, it shows clearly that control group had greater idea in the said topics using least significant difference of 1.733.

<table>
<thead>
<tr>
<th>Respondents</th>
<th>Mean Score</th>
<th>Descriptive Rating</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>14.400</td>
<td>Fair (Fa)</td>
<td>4.320</td>
</tr>
<tr>
<td>Experimental</td>
<td>12.667</td>
<td>Fair (Fa)</td>
<td>5.514</td>
</tr>
</tbody>
</table>

II. Difference between the Pre-test Results of the Control and Experimental Groups.

Table 2 shows the difference between the pre-test results of the control and experimental groups. Using T-test for independent samples as an indicator the result was -0.895 with a p-value of 0.386 and interpreted as not significant.

This means that there is no significant difference between the results of the pre-test of both control and experimental groups in random variables and discrete random probability distribution.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Indicator</th>
<th>Result</th>
<th>P-value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group vs. Experimental Group</td>
<td>t-test</td>
<td>-0.895</td>
<td>0.386</td>
<td>Not Significant</td>
</tr>
</tbody>
</table>

III. Post-test Results of the Control and Experimental Groups

Table 3 shows the post-test results of both the control and experimental groups. Based from the result of the second implementation of test, control group from this research got a mean score of 27.867, which was Good (G) with a standard deviation of 5.153 while, the experimental group got a mean score of 35.200 which was Satisfactory (S) with a standard deviation of 4.229.

This means that both groups had learned random variables and discrete random probability distribution from the two given strategies (team-pair-solo approach and conventional teaching). At the same time, it shows clearly that experimental group had greater mean in the said topics using least significant difference of 7.333.

<table>
<thead>
<tr>
<th>Respondents</th>
<th>Mean Score</th>
<th>Descriptive Rating</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
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<td>Good (G)</td>
<td>5.153</td>
</tr>
<tr>
<td>Experimental</td>
<td>35.200</td>
<td>Satisfactory (S)</td>
<td>4.229</td>
</tr>
</tbody>
</table>
IV. Difference between the Pretest and Posttest Results of the Control and Experimental Groups.

Table 4 shows the difference between the pre-test and post-test results of both control and experimental groups. Using t-test for paired sample statistics, the result obtained for the pre-test and post-test difference of the experimental group was -11.770 with a p-value of 0.000 and interpreted as significant. While, the result obtained for the pre-test and post-test difference of the control group was -8.036 with a p-value of 0.000, which was interpreted as significant. This simply means that both conventional teaching and team-pair-solo approach were effective in teaching random variables and discrete probability distributions.

<table>
<thead>
<tr>
<th>Experimental Group</th>
<th>Indicator</th>
<th>Result</th>
<th>P-value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest vs. Posttest</td>
<td>T-test (Paired Sample Statistics)</td>
<td>-11.770</td>
<td>0.000</td>
<td>Significant</td>
</tr>
</tbody>
</table>

Control Group

| Pretest vs. Posttest| T-test (Paired Sample Statistics) | -8.036 | 0.000 | Significant |

V. Difference between the Post-test Results of the Control and Experimental Groups.

Table 5 shows the difference between the post-test results of the control and experimental groups. Using the t-test for independent samples as an indicator the value obtained between the two variables were 5.227 with a p-value of 0.000, which was respectively significant.

This means that there was a significant difference between the post-test results of the control group and the experimental group. From the result of the mean score for the experimental group during the pre-test which was 12.667 and interpreted as fair (Fa) it was turned into 35.200 mean score and interpreted as satisfactory (S) with the increase on the level of assessment which is equal to 45.066% significantly showing that the team-pair-solo approach in teaching random variables and discrete probability distribution was also effective.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Indicator</th>
<th>Result</th>
<th>P-value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group vs. Experimental Group</td>
<td>T-test</td>
<td>5.227</td>
<td>0.000</td>
<td>Significant</td>
</tr>
</tbody>
</table>

VI. Perceived Benefits of Eleventh Graders in the Used of Team-Pair-Solo Approach

Table 6 shows the perceived benefits of eleventh graders in the used of team-pair-solo approach after the implementation of the said strategy. The three highest mean were item 1: I think that by doing team-pair-solo activities I can easily understand random variables and probability distributions concepts (*4.133, **0.516, ***Very Often), item 2: I learned better in solving random variables and probability distribution concepts using team-pair-solo approach (*4.267, **0.596, ***Very Often), lastly item 5: I think through team-pair-solo approach I can complete my assignments in Math (*4.267, **704, ***Very Often).
Table 6: Perceived Benefits of Eleventh Graders in the Use of Team-Pair-Solo Approach

<table>
<thead>
<tr>
<th>Items</th>
<th>*Mean</th>
<th>**SD</th>
<th>***Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I think that by doing team-pair-solo activities I can easily understand random variables and probability distribution concepts.</td>
<td>4.133</td>
<td>0.516</td>
<td>VO</td>
</tr>
<tr>
<td>I learned better in solving random variables and probability distribution concepts using team-pair-solo approach.</td>
<td>4.267</td>
<td>0.594</td>
<td>VO</td>
</tr>
<tr>
<td>I feel confident enough to ask questions in Math class through team-pair-solo approach.</td>
<td>3.933</td>
<td>0.704</td>
<td>VO</td>
</tr>
<tr>
<td>I enjoy Math class because of team-pair-solo approach.</td>
<td>3.867</td>
<td>0.915</td>
<td>VO</td>
</tr>
<tr>
<td>I think that through team-pair-solo approach I can complete all my assignments in Math.</td>
<td>4.267</td>
<td>0.704</td>
<td>VO</td>
</tr>
<tr>
<td>I believe that through team-pair-solo approach, I will be able to use Math in my future career when needed.</td>
<td>4.067</td>
<td>0.799</td>
<td>VO</td>
</tr>
<tr>
<td>I feel confident when taking mathematics test because of team-pair-solo approach.</td>
<td>3.867</td>
<td>0.743</td>
<td>VO</td>
</tr>
<tr>
<td>I feel confident when using Mathematics outside of school because of team-pair-solo approach.</td>
<td>3.467</td>
<td>0.834</td>
<td>S</td>
</tr>
<tr>
<td>I think using team-pair-solo approach, affects the conceptual understanding of Mathematics that I have. When I team-pair-solo approach, I like to discuss my ideas with my classmates.</td>
<td>3.867</td>
<td>0.743</td>
<td>VO</td>
</tr>
<tr>
<td></td>
<td>4.000</td>
<td>0.756</td>
<td>VO</td>
</tr>
<tr>
<td><strong>Grand Mean</strong></td>
<td>3.973</td>
<td>0.708</td>
<td>Very Often</td>
</tr>
</tbody>
</table>

Legend:
**SD** – Standard Deviation
***Likert Scale
Numerical Rating Descriptive Rating
4.51 – 5.00 Always (A)
3.51 - 4.50 Very Often (VO)
2.51 – 3.50 Often (O)
1.51 - 2.50 Sometimes (S)
1.00 - 1.50 Never (N)

VII. Relationship of Students’ Perceived Benefits and Post-test Result
Table 7 shows the relationship of students’ perceived benefits and post-test results in team-pair-solo approach. Using Linear Regression, the F-value was 2.583 and T-value was -1.607 with a p-value of 0.132 shows significant results. This simply means that team-pair-solo approach predicts students’ mathematics performance.

Table 7. Relationship of Students’ Perceived Benefits and Post-test Result

<table>
<thead>
<tr>
<th>F-value</th>
<th>T-value</th>
<th>R-square</th>
<th>P-value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.583</td>
<td>-1.607</td>
<td>0.166</td>
<td>*0.132</td>
<td>Significant</td>
</tr>
</tbody>
</table>

Legend:
*Level of Significance @ 5%
Dependent Variable: Students Perceived Benefits Likert Scale
Predictor: Experimental Group’s Post-test Result
IV. CONCLUSIONS

The following conclusions were drawn from the findings:
1. Both groups had a little idea in terms of random variables and discrete random probability distribution. At the same time, it shows clearly that control group had greater idea in the said topics with a least significant difference of 1.733.
2. There is no significant difference between the pre-test result of both control and experimental groups in random variables and discrete random probability distribution.
3. Both groups had learned random variables and discrete random probability distribution from the two given strategies (team-pair approach and conventional teaching). At the same time, it shows clearly that experimental group had greater mean in the said topics with a least significant difference of 7.333.
4. The result obtained for the pre-test and post-test difference of the experimental group was -11.770 with a p-value of 0.000 and interpreted as significant. While, the result obtained for the pre-test and post-test difference of the control group was -8.036 with a p-value of 0.000, which was interpreted as significant. This simply means that both conventional teaching and team-pair-solo approach were effective in teaching random variables and discrete probability distributions.
5. There was a significant difference between the post-test results of the control group and the experimental group. From the result of the mean score for the experimental group during the pre-test which was 12.667 and interpreted as fair (Fa) it was turned into 35.200 mean score and interpreted as satisfactory (S) with the increase on the level of assessment which is equal to 45.066% significantly showing that the team-pair-solo approach in teaching random variables and discrete probability distribution was also effective.
6. The F-value was 2.583 and T-value was -1.607 with a p-value of 0.132 shows significant results. This simply means that team-pair-solo approach predicts students’ mathematics performance.

V. RECOMMENDATIONS

1. This may help teachers in teaching Mathematics on how to deal with the different lesson presented using different kinds of activities so that teaching and learning process will be attainable and measurable. It is hoped that the results will be more beneficial to teachers to improve their mathematics instruction. It is important to give students experiences that help them develop their understanding in mathematics through the use of team-pair-solo approach.
2. This study may help the schools and administrators to benefit from the effectiveness of team-pair solo approach in the field of Mathematics as on its effect to the academic performance of the respondents and gain insights on how they could be of help in dealing with this problem. It may also bring those ideas in motivating their teachers towards a better quality of education.
3. The findings of the study may serve as a basis in conducting a more profound study, specifically pertaining to team-pair-solo approach. Also, it serves as a guide for other researchers in conducting related and parallel studies. The ideas presented may be used as referenced data in testing the validity of other related findings and also may be used as a pattern on creating curriculum.

REFERENCES

of research on mathematics teaching and learning: A project of the National Council of Teachers of Mathematics (pp. 909-955). Charlotte, NC: Information Age Publishing.


