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Practical Work Approach Using Supplemental Learning Materials for Effective Teaching in Statistics and Probability

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***Abstract:* - Students have engrained in their minds that mathematics is a difficult subject. This makes the teachers thrown down the gauntlet on what effective pedagogy in Mathematics could make it easier for students to grasp Math lessons. Math teachers have been discovering effective teaching approaches that make sense to the students in improving their achievement and attitudes towards math. To test the effect of practical work approach (PWA) using supplemental learning materials (SLM's) on the achievement and attitudes of students towards Statistics and Probability, this study was conducted. Quasi-experimental research design was employed and 90 students served as respondents of the study. Mean Percentage Score (MPS), weighted mean and t-test were applied to describe data and make good inferences. Findings revealed that control and experimental groups had a comparable achievement and students in both groups displayed negative attitudes towards Statistics and Probability prior to the start of experimentation. After the exposures of control group with traditional approach and experimental group with PWA using SLM's, achievement of experimental group was significantly higher than control group. At the end of experimentation, students in control group still showed negative attitudes while students in experimental group demonstrated positive attitudes already towards Statistics and Probability. Thus, PWA using SLM's had a positive effect on the achievement and attitudes of students towards Statistics and Probability.**

Key words— Practical Work Approach, Supplemental Learning Materials and Effective Teaching

I. INTRODUCTION

Mathematics and Science instruction is the major target of incessant changes in the Philippine educational system. Many educators today are challenged on what pedagogical approaches could cater the individual needs of students to increase their understanding of mathematics and science concepts (Gegone, 2020). As part of the reform plan and a step towards globalizing the quality of basic education, the Philippines, for the first time in 2018, joined the Programme for International Student Assessment (PISA) to evaluate the status of the country's educational system in Mathematics, Science and Reading. PISA results revealed that the Philippines scored 353 in Mathematics, 357 in Science, and 340 in Reading; all belong to the bottom three (3) of the participating countries. Due to these very dismal results, the Department of Education (DepEd) is now leading the national effort for quality of basic education through *Sulong EduKalidad* by implementing aggressive reforms to improve the quality of instruction and to foster positive attitudes towards Mathematics, Science and Reading (DepEd, 2018; Abdullah, 2020).

To foster positive attitudes towards Mathematics means to let students overcome anxiety and apathy towards the subject. Mathematics is a form of reasoning. Thinking mathematically means reasoning in a logical manner. Demonstrating mathematical ability means logical recognition of appropriate formula, rational construction of diagrams and realistic conceptualization of physical models of phenomena (Simpal, 2016). It is a big challenge for the teachers to design pedagogical approaches to help students demonstrate mathematical ability in problem solving since it is one of the most hated topics in Mathematics due to its abstract theories. However, Paculanan (2013) stated that abstracting the concrete ideas or concretizing the abstract concept scan be made possible if a practical work approach (PWA) using supplemental learning materials (SLM's) is applied by Math teachers. Maliga (2018) emphasized that students' under achievement in Mathematics and Science is not just a concern of a particular school, but has become a national concern particularly the DepEd over the years.

In response to this national concern, the DepEd articulated the four (4) C's of 21st century skills such as critical thinking, communication, creativity and collaboration that should be embedded in the senior high school (SHS) curriculum across various tracks, strands and subjects. These

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skills are the designed outcomes that SHS graduates should possess to proceed to higher education, employment or entrepreneurship fully equipped with basic and advanced knowledge (Albacea et al., 2016). In Statistics and Probability as one of the two core Math subjects in SHS curriculum, the 4 C's are seriously emphasized. Statistical literacy is the ability to critically evaluate the results of investigation. Students are taught on how they communicate with statistical findings. Their creativity in collecting, organizing, summarizing, presenting, analyzing and interpreting data is enhanced. Since not all students are inclined in quantitative data, their collaboration to other students who are good in numbers is also developed. Aside from the 4 C's of this modern world, digital literacy and flexibility of students are developed if there is an effective teaching approach in Statistics and Probability.

Effective teaching attempts to involve all types of students and inspire them to learn rather than merely admitting that some are destined to do poorly. In Statistics and Probability, effective teaching can be evident if there is an improvement in the academic achievement and attitudes of students towards the subject. Miller (2004) stated that practical work approach (PWA) develops students' scientific knowledge to improve their academic performance. He added that in PWA, students can be more 'minds on" and 'hand on' when they are exposed to contextualized learning materials. Paculanan (2013), Simpal (2016) and Maliga (2018) emphasized that modern mathematics instruction can be more interesting if practical work approach (PWA) using supplemental learning materials(SLM's) is employed by the teachers.

To validate the claim of foregoing authors that PWA using SLM's improve both academic achievement and attitudes of students towards Math subject, this study was conducted in the case of Statistics and Probability.

Conceptual Framework

Most students are not able to cope up with the teacher's pedagogical approaches in Mathematics. In order to promote active participation of students, Math teachers should adjust their strategies in doing class activities to more learner-centered styles. As stated by Paghubasan (2017), the process of developing students' knowledge, skills, and attitudes (KSA) should require peer interaction and this can be effectively done through student-centered teaching approaches. Paculanan (2013), Simpal (2016) and Maliga (2018) identified practical work approach (PWA) using supplemental learning materials (SLM's) as one of the student-centered teaching approaches that make sense to the students.

Figure 1 shows the two groups under the study. The exposure of the two groups to traditional approach and practical work approach (PWA) using supplemental learning materials (SLM's) was an important aspect of the present study. The group exposed to traditional approach was designated as control group and the group subjected with PWA using SLM's was regarded as experimental group. The effect of these two pedagogical approaches in improving students' achievement and attitudes towards Statistics and Probability was determined by the pre-test/post-test and survey questionnaire, respectively.

Thus, the control group that was exposed to traditional approach and experimental group which was subjected with PWA using SLM's served as the independent variable of the study. On the other hand, Statistics and Probability achievement and attitudes of Grade 11 students were determined using the result of their pre-test/post-test and survey questionnaire before and after the experimentation, respectively. The results of the tests and survey questionnaire served as the dependent variables of the study.

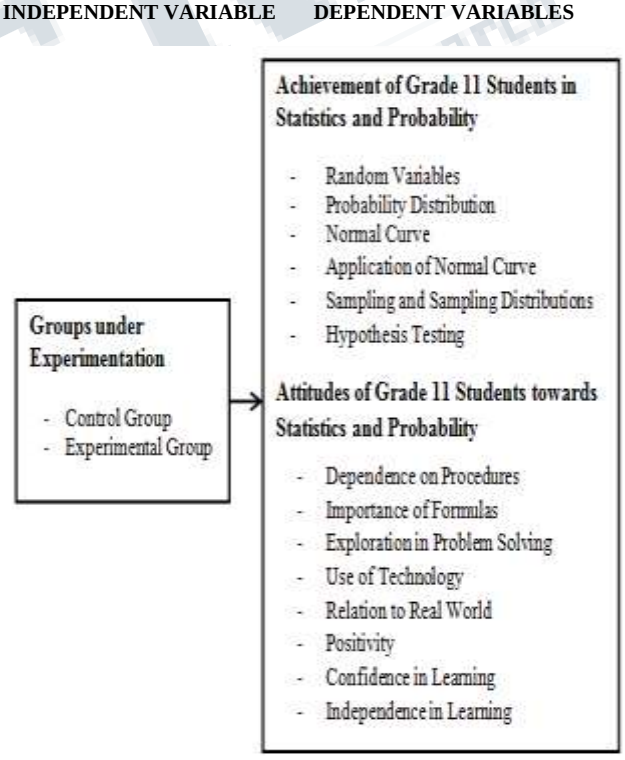

Figure 1. Research Paradigm

Objectives

This study aimed to determine the effect of practical work approach (PWA) using supplemental learning materials (SLM's) in improving students' achievement and attitudes

towards Statistics and Probability. Specifically, this study did the following:

1. Determine the Statistics and Probability achievement of students in control and experimental groups before and after the experimentation relative to:
   1.1 Random Variables;
   1.2 Probability Distribution;
   1.3 Normal Curve;
   1.4 Application of Normal Curve;
   1.5 Sampling and Sampling Distributions; and
   1.6 Hypothesis Testing.
2. Determine the attitudes of students towards Statistics and Probability in control and experimental groups before and after the experimentation in terms of:
   2.1 Dependence on Procedures;
   2.2 Importance of Formulas;
   2.3 Exploration in Problem Solving;
   2.4 Use of Technology;
   2.5 Relation to Real World;
   2.6 Positivity;
   2.7 Confidence in Learning; and
   2.8 Independence in Learning.
3. Determine if there is a significant difference in the Statistics and Probability achievement of students in control and experimental groups before and after the experimentation.
4. Determine if there is a significant difference in the attitudes of students towards Statistics and Probability in control and experimental groups before and after the experimentation.

II. METHODOLOGY

Research Design

A quasi-experimental research design was applied to investigate the effect of practical work approach (PWA) using supplemental learning materials (SLM's) in improving students' achievement and attitudes towards Statistics and Probability. Before and after the experimentation, pre-test and post-test were administered to determine the difference in the Statistics and Probability achievement of students and survey questionnaire was distributed to describe their attitudes towards the subject. Control group was subjected to traditional instruction using chalk and talk method while experimental group was exposed to PWA using SLM's. SLM's are in the form of power-point presentation and simplified worksheets with various practical work activities. Activities were done individually, by pair or by group. The protected data file (pdf) form of SLM's is an aid to modern mathematics instruction. It can be displayed and manipulated in the smart phones of students. Same topics were introduced to two groups under the study. Pure traditional approach with no learning materials was subjected to control group. Power-point presentation and simplified worksheets with different practical work activities were exposed to experimental group. Leakage and contamination of the two teaching approaches and materials used were avoided since the two groups under experimentation were located in two far different buildings.

Respondents

Grade 11 Humanities and Social Sciences (HUMSS)students of Esperanza National High School, Poblacion, Esperanza, Sultan Kudarat, Region XII, Philippines, for the School Year 2019-2020 served as the respondents of this study. Two (2) out of seven (7) Grade 11 HUMSS sections were randomly selected. These two sections with 45 students each class automatically served as the control group and experimental group under study.

Sampling Technique

There were seven (7) Grade 11 sections of HUMSS strand of SHS curriculum of Esperanza National High School. These sections were heterogeneously grouped. This means that the academic performance of students from these sections was comparable. Thus, simple random sampling using fishbowl method was applied to choose two (2) sections that served as the control group and experimental group. Simple random sampling was applied to increase the generality of the results of the experimentation. Random assignment of the control and experimental groups was done. However, random selection of students was not possible since all students in both control and experimental groups were included as respondents of the study. Each group had 45 students with a total of 90 students who served as the respondents of the study. The two sample sections represented all the twenty three (23) sections from different tracks and strands with a grand total of 1,053 Grade 11 students.

Research Instrument

Two sets of research instrument were employed to collect data needed in the study. To determine the extent of students' achievement in Statistics and Probability before and after the experimentation, a researcher-made test which was validated by the Mathematics experts was used. To describe the attitudes of students towards Statistics and Probability before and after the experimentation, modified survey questionnaire of Paghubasan (2017) was employed. Since the survey questionnaire had undergone modification, research experts were consulted for its content, grammar and face validity. Multiple-Choice Test (Pre-Test/Post-Test), 10 items per topic with a total of 60 items, was pilot-tested to determine its

reliability coefficient using Kuder-Richardson Formula 20. Survey questionnaire on attitudes of students towards Statistics and Probability, composed of 8 indicators with 6 statements each indicator, was also pilot-tested to describe its internal consistency using Cronbach's alpha. Validity and reliability of the two sets of research instrument were ensured before the start of the study. Grade 12 HUMSS students of the same school served as the initial respondents of the study during the conduct of pilot-testing.

Statistical Treatment

Students' achievement in Statistics and Probability was determined using Mean Percentage Score (MPS). In describing the attitudes of students towards Statistics and Probability, weighted mean was applied. To determine if there is a significant difference in the achievement and attitudes of students towards Statistics and Probability before and after the experimentation, t-test was employed.

Achievement of students in Statistics and Probability was determined using their pre-test and post-test scores which were converted into MPS and was dichotomously categorized, described and interpreted following the criteria adopted from National Educational Testing Research Council (NETRC).

Ethical Consideration

The researcher informed the respondents and their parents about the purpose, expected duration, and the benefits of the research. To appropriately choose the two (2) HUMSS sections, systematic sampling procedure was employed. Protection of respondents' human rights was the top ethical consideration of this research. The researcher ensured that all research activities particularly in a 4-moth experimentation stage as well as distribution of survey questionnaires, tabulation and statistical treatment of the collected data conformed to the highest degree of research ethical standards. The researcher guaranteed that respondents were protected from unintended harm, especially in the areas of confidentiality and informed consent. He assisted them in avoiding errors or oversights that can result in unjustifiable actions. Human dignity, inherent to all respondents, irrespective of place of residence, gender, ethnic origin, religion, language, or any status, was carefully safeguarded. Every respondent was equally entitled to human rights in participating in this study without discrimination. Respecting respondents' rights, preventing them from violating their rights and providing positive assistance or services during the conduct of the study were some of the researcher's utmost concerns. Participation to this research was voluntary. No one was forced to partake in the study. Plagiarism is a violation of the Intellectual Property Rights. Thus, proper referencing, citations and paraphrasing were strictly observed.

III. RESULTS AND DISCUSSION

Statistics and Probability Achievement of Grade 11 HUMSS Students before and after the Experimentation

Pedagogy is a systematic method and practice of imparting knowledge, skills and attitudes (KSA) to the students. Critical mathematics pedagogy requires systematic selection of instructional approaches so that students' KSA can be improved. Effective math teachers believe that every student is able to reach triumph at school and they do everything to find ways of making each student successful. To help each student achieve his success, Math teachers should always look into a better teaching approach. To test the effect of practical work approach (PWA) using supplemental learning materials (SLM's) in improving the achievement and attitudes of students towards Statistics and Probability, experimentation of four (4) months was conducted. Before the conduct of the experimentation, pre-test was administered to the Grade 11 HUMSS students. After all major topics included in the power-point and worksheets were tackled, post-test was administered. Descriptive results of the tests are presented in Tables 1 and 2.

Table 1 shows the extent of Statistics and Probability achievement of students before the experimentation. As revealed, control group obtained an overall Mean Percentage Score (MPS) of 28.88% described as "Low Mastery" in the pre-test. This means that prior to the start of the experimentation; students in control group had a poor performance in Statistics and Probability. In other words, they lacked prior knowledge in the collection, organization, summary, presentation, analysis and interpretation of data before the conduct of the study. In particular, the highest MPS of 36.67% was registered by the topic "Random Variable" while the lowest MPS of 20.00% was acquired by the topic "Hypothesis Testing".

As also shown in Table 1, an overall MPS of 28.61% with a description of "Low Mastery" was registered by the experimental group during the pre-test. This means that students in experimental group had a very limited knowledge in Statistics and Probability. Although, control group registered a little bit higher MPS compared with experimental group, both groups demonstrated a poor achievement in Statistics and Probability before they were subjected to two different teaching approaches. Specifically, the topic "Random Variable" got the highest MPS of 38.33% while the topic "Hypothesis Testing" obtained the lowest MPS of 21.67%. Considering the results of pre-test of students in both control and experimental groups, the most

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difficult topic in Statistics and Probability was "Hypothesis Testing" and little bit prior knowledge of students was observed in the topic "Random Variable".

Table 1. Extent of Statistics and Probability Achievement of Students before the Experimentation

	Statistics and Probability Topics	MPS of Control Group (%)	Verbal Description	MPS of Experimental Group (%)	Verbal Description
1	Random Variables	36.67	Average Mastery	38.33	Average Mastery
2	Probability Distribution	33.33	Low Mastery	30.00	Low Mastery
3	Normal Curve	30.00	Low Mastery	31.67	Low Mastery
4	Application of Normal Curve	28.33	Low Mastery	26.67	Low Mastery
5	Sampling and Sampling Distributions	25.00	Low Mastery	23.33	Low Mastery
6	Hypothesis Testing	20.00	Low Mastery	21.67	Low Mastery
	Overall MPS	**28.88**	**Low Mastery**	**28.61**	**Low Mastery**

Legend: 96 – 100 – Mastered; 86 – 95 – Closely Approximating Mastery;
66 – 85 – Moving Towards Mastery; 35 – 65 – Average Mastery;
15 – 34 – Low Mastery; 5 – 14 – Very Low Mastery; 0 – 4 – Absolutely No Mastery

Gegone (2019) has a similar finding with this study. Before the start of his experimentation, he gave a pre-test to the control and experimental groups. He found out that students in control group received a little bit higher MPS compared with students in experimental group. He suggested that aside from the pre-test, Math and Science teachers who want to test the efficacy of instructional approach; they should give first a standardized test so that two or more sections under study should have a comparable academic preparation before the conduct of the study. He stated that time-frame of the experimentation stage will be definitely affected if the pre-test results of the selected control and experimental groups were significantly different. That's why, standardized should be administered first before creating work plan and session guides for the experimentation.

Paculanan (2013) found out that control group received a low performance in Mathematics prior to the conduct of his experiment. In relation to this, Maliga (2018) ascertained that students in control group had a very minimal idea in Math topics before he started the experimentation stage of his study. The two researchers agreed that receiving low scores in the pre-test is just a normal case of experimental research since most students have no idea yet about the topics.

Table 2 presents the extent of Statistics and Probability achievement of students after the experimentation. As shown, control group acquired an overall MPS of 73.06% with a description of "Moving Towards Mastery" in the post-test. This statistical finding was substantiated by the six topics that all received a verbal description of "Moving Towards Mastery". This means that students exposed in the traditional approach improved their achievement in Statistics and Probability from "Low Mastery" (MPS = 28.88%) to "Moving Towards Mastery" (MPS = 73.06%). This implies that students who were taught with traditional instruction learned appropriate techniques in solving problems in Statistics and Probability. In other words, students who were subjected to chalk and talk method of instruction improved their knowledge and skills in collecting, organizing, summarizing, presenting, analyzing and interpreting statistical data. Specifically, the highest MPS of 76.67% with a description of "Moving Towards Mastery" was registered by the topic "Random Variables" and the lowest MPS of 66.67% was obtained by the topic "Hypothesis Testing".

As presented also in Table 2, experimental group generated an overall MPS of 90.83% described as "Closely Approximating Mastery". This means that students' achievement in experimental group really improved and it was attributed to the use of practical work approach (PWA) using supplemental learning materials (SLM's). Exposure of students to PWA using SLM's enhanced their academic achievement from "Low Mastery" (MPS = 28.61%) to "Closely Approximating Mastery" (MPS = 90.83%). In other words, PWA using SLM's gave students great opportunities to acquire different problem solving approaches, thus,

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improving their knowledge and skills in Statistics and Probability.

Table 2. Extent of Statistics and Probability Achievement of Students after the Experimentation

	Statistics and Probability Topics	MPS of Control Group (%)	Verbal Description	MPS of Experimental Group (%)	Verbal Description
1	Random Variables	76.67	Moving Towards Mastery	93.33	Closely Approximating Mastery
2	Probability Distribution	75.00	Moving Towards Mastery	91.67	Closely Approximating Mastery
3	Normal Curve	73.33	Moving Towards Mastery	90.00	Closely Approximating Mastery
4	Application of Normal Curve	71.67	Moving Towards Mastery	90.00	Closely Approximating Mastery
5	Sampling and Sampling Distributions	75.00	Moving Towards Mastery	91.67	Closely Approximating Mastery
6	Hypothesis Testing	66.67	Moving Towards Mastery	88.33	Closely Approximating Mastery
	Overall MPS	**73.06**	**Moving Towards Mastery**	**90.83**	**Closely Approximating Mastery**

Legend: 96 – 100 – Mastered; 86 – 95 – Closely Approximating Mastery;
66 – 85 – Moving Towards Mastery; 35 – 65 – Average Mastery;
15 – 34 – Low Mastery; 5 – 14 – Very Low Mastery; 0 – 4 – Absolutely No Mastery

Taking the data singly, both control and experimental groups acquired a highest MPS of 76.67% and 93.33% in the topic "Random Variables" and obtained a lowest MPS of 66.67% and 88.33% in the topic "Hypothesis Testing", respectively. The result of the post-test is consistent with the result of the pre-test that the topic "Hypothesis Testing" is the most difficult among the six topics included in the study. Although, students both from control and experimental groups learned the steps in hypothesis testing, teachers should give more emphasis in this lesson since it is very applicable in the Quantitative Research and Culminating Research subject of Grade 12 senior high school students. Particularly, the highest MPS of 93.33% with a description of "Closely Approximating Mastery" and the lowest MPS of 88.33% with a description of "Closely Approximating Mastery" was generated by the topic "Hypothesis Testing". This study proved that hypothesis testing was the most difficult topic in Statistics and Probability as revealed by both pre-test and post-test results in Tables 1 and 2.

Simpal (2016) supports the above data and his experimental research revealed that the use of visual representations such as power-point and other concrete objects helped the students in experimental group in improving their problem solving skills in Physics. He also stressed that abstract ideas in Physics can be made meaningful to the students if concrete illustrations such as pictures and mathematics models are displayed.

The study of Paghubasan (2017) revealed that students in experimental group registered higher improvement in their performance and retention in Mathematics after their exposure to game-based and activity-oriented instruction. She also concluded that although students exposed with both traditional instruction and game-based and activity-oriented instruction recorded an increase in their Mathematics performance and retention, experimental group had a higher mean gain score compared with the control group.

Similar research finding is also stressed by Maliga (2018). His study found out that students exposed with supplemental

learning materials in Grade 10 Mathematics had a better Mathematics performance after the experimentation compared with the control group subjected with traditional method of instruction. He suggested that Mathematics teachers should expose their students in different modern collaborative learning approaches supplemented with contextualized instructional materials (IM's).

Attitudes of Grade 11 HUMSS Students towards Statistics and Probability before and after the Experimentation

Attitudes are complex psychological constructs that are learned through experiences. Whether positive or negative, students' attitudes towards mathematics often reflect their value, self-confidence, enjoyment, motivation and anxiety levels when it comes to the subject (Kennedy, 2019). Developing students' positive attitudes towards Mathematics is one of the major responsibilities of modern Mathematics teachers so that every learner is given equal opportunity to improve his Mathematics achievement. Before the start of experimentation, survey questionnaire on the attitudes of students towards Statistics and Probability was distributed to the Grade 11 HUMSS students from both control and experimental groups. Presented in Tables 3 and 4 are the results of descriptive statistical treatment.

As shown in Table 3, negative attitudes towards Statistics and Probability of students in control group before the conduct of experimentation was manifested by the overall mean of 2.22. This means that students in control group didn't like Statistics and Probability prior to the experimentation. They already thought that Statistics and Probability is a difficult subject since Statistics lessons in junior high school are usually in the later chapter and only few lessons are taken up. These negative attitudes of students towards Statistics and Probability were justified by the seven indicators that all received a "Negative" remark and only one indicator getting a rating of "Moderately Positive".

Table 3 also shows that the overall mean of 2.24 with a description of "Negative" indicates that students in experimental group disliked Statistics and Probability prior to the experimentation. This means that they didn't appreciate the essence of collection, organization, summary, presentation, analysis and interpretation of data in their daily life activities. In other words, they already considered that Statistics and Probability is like other Mathematics subjects that are very hard to comprehend. These negative attitudes of students in experimental group were strongly collaborated by the seven indicators that all received a descriptive rating of "Negative" and only one indicator that was described as "Moderately Positive".

Table 3. Extent of Students' Attitudes towards Statistics and Probability before the Experimentation

	Students' Attitudes towards Statistics and Probability	Mean	Verbal Description	Mean	Verbal Description
1	Dependence on Procedures	2.70	Moderately Positive	2.68	Moderately Positive
2	Importance of Formulas	2.46	Negative	2.45	Negative
3	Exploration in Problem Solving	2.45	Negative	1.88	Negative
4	Use of Technology	2.26	Negative	2.32	Negative
5	Relation to Real World	2.18	Negative	2.15	Negative
6	Positivity	2.15	Negative	2.39	Negative
7	Confidence in Learning	1.88	Negative	1.80	Negative
8	Independence in Learning	1.70	Negative	2.25	Negative
	Overall Mean	**2.22**	**Negative**	**2.24**	**Negative**

Legend: 4.20 – 5.00 – Highly Positive; 3.40 – 4.19 – Positive;
2.60 – 3.39 – Moderately Positive; 1.80 – 2.59 – Negative;
1.00 – 1.79 – Highly Negative

More specifically, the highest mean of 2.70 described as "Moderately Positive" was obtained by both control and experimental groups in the indicator "Dependence on Procedures". This indicates that students were able to solve

some problems in Mathematics if the systematic steps were illustrated by the teacher. On the other hand, control group acquired a lowest mean of 1.70 described as "Negative" in the indicator "Independence in Learning" while experimental group got a lowest mean of 1.80 described as "Negative" in the indicator "Confidence in Learning". This implies that students were not interested in learning mathematics concepts particularly in Statistics and Probability. They lacked confidence to solve math problem and they could not do it alone.

Khaji (2019) supports this study when she stressed that students cannot pass mathematics on their own efforts, they need to be guided. At school, it's a bit easier due to the presence of teachers, but at home, parents need to take up role – most don't. She added that some parents don't have the culture of monitoring their children's progress at school, the students are given homework, but some don't even do the homework, and the parents don't even check to see how the children are coping with studies. She also emphasized that students already engrained in their minds that mathematics is a difficult subject.

This study is consistent with the finding of Garner-O'Neale and Cumberbatch (2016) who conducted a study to determine the attitudes of Chemistry students towards Mathematics. They found out that many students disliked Mathematics which triggered them to be uninterested also in quantitative Chemistry that involves problem solving using mathematical concepts. They concluded that Mathematics, Physics and Chemistry are the three abysmally disliked subjects in secondary schools. They further noted that Math and Science teachers can play a role in improving the positive attitudes of students towards Mathematics and later become very optimistic in performing problems with regards to Physics and Chemistry subjects.

Simpal (2016) and Gegone (2019) supports the above finding when they emphasized that students got intimidated if Physics and Chemistry lessons involved numbers. They further suggested that Physics and Chemistry teachers should motivate first the students to love mathematics and further get interested with Physics and Chemistry lessons.

Table 4. Extent of Students' Attitudes towards Statistics and Probability after the Experimentation

	Students' Attitudes towards Statistics and Probability	Mean	Verbal Description	Mean	Verbal Description
1	Dependence on Procedures	2.75	Moderately Positive	3.79	Positive
2	Importance of Formulas	2.62	Moderately Positive	3.77	Positive
3	Exploration in Problem Solving	2.50	Negative	3.73	Positive
4	Use of Technology	2.27	Negative	3.75	Positive
5	Relation to Real World	2.26	Negative	3.91	Positive
6	Positivity	2.25	Negative	3.92	Positive
7	Confidence in Learning	2.16	Negative	3.79	Positive
8	Independence in Learning	2.14	Negative	3.76	Positive
	Overall Mean	**2.37**	**Negative**	**3.80**	**Positive**

Legend: 4.20 – 5.00 – Highly Positive; 3.40 – 4.19 – Positive; 2.60 – 3.39 – Moderately Positive; 1.80 – 2.59 – Negative; 1.00 – 1.79 – Highly Negative

Table 4 presents the extent of students' attitudes towards Statistics and Probability after the experimentation. As shown, attitudes of students towards Statistics and Probability in control group after the experimentation were still "Negative" as justified by the overall mean of 2.37. Students in control group had a little increase of overall mean after the experimentation. However, still negative attitudes towards Statistics and Probability were evident. This means that traditional approach was not able to change students' negative attitudes to positive perception towards Statistics and Probability. As a matter of fact, before the conduct of the experimentation, students' negative attitudes towards Statistics and Probability were evident by the overall mean of 2.22. After the exposure of students in control group with traditional approach, a little bit increase of overall mean to 2.37 was still interpreted as "Negative". In other words, although there was an increase of the mean, students' perception about Statistics and Probability as a difficult

subject was not changed by traditional approach. Before and after the exposure of control group to traditional instruction, students still displayed negative attitudes towards the subject.

As presented also in Table 4, experimental group obtained an overall mean of 3.80 with a description of "Positive". These optimistic attitudes were supported by the 8 indicators that all received a rating of "Positive". This means that after the exposure of students in experimental group with practical work approach (PWA) using supplemental learning materials (SLM's), their attitudes towards Statistics and Probability increased from the overall mean of 2.24 described as "Negative" to 3.80 interpreted as "Positive" already. In other words, PWA using SLM's gave the students an optimistic perception towards Statistics and Probability. They started to love the subject due to PWA using SLM's designed for both the slow and fast learners.

Remarkably, control group obtained a highest mean of 2.75 described as "Moderately Positive" in the indicator "Dependence on Procedures" while experimental group registered a highest mean of 3.92 interpreted as "Positive" in the indicator "Positivity". In control group, the lowest mean of 2.14 described as "Negative" was registered by the indicator "Independence in Learning". In experimental group, the lowest mean of 3.73 described as "Positive" also was acquired by the indicator "Exploration in Problem Solving".

This study is consistent with the idea of Paculanan (2013) and Simpal (2016) when they emphasized that modern teaching approaches and learning materials encourage the students to relate Mathematics principles to practical situations happening in the community. They also noted that use of modern technology should be emphasized to the students so that they will not become ignorant of the recently invented devices and mobile applications which are very relevant to the modern world. They further emphasized that concretizing abstract ideas increases the positivity of students towards mathematics.

Gegone (2020) stressed that most students don't like Mathematics as they consider it as irrelevant and very abstract in nature. They are not eager to perform mathematical equations the way they get interested about other subjects such as English, Filipino, Biology, General Science, History and Music, Arts, Physical Education and Health (MAPEH). They think Mathematics causes them debilitating feelings of fear and failure that hurt their ability to perform. All of these negative perceptions about Mathematics turn students to dislike quantitative Chemistry and Physics due to several mathematical formulas to memorize.

Kennedy (2019) emphasized that getting students in practical work approach that encourages positive disposition as early as possible is the best way to prevent long-lasting negative attitudes towards mathematics. She also stressed that positive attitudes towards Mathematics can lead to higher achievement, and high achievement can result in more favorable attitudes.

Analysis on the Difference of Statistics and Probability Achievement of Grade 11 STEM Students in Control and Experimental Groups

To determine if there is a significant difference on the Statistics and Probability achievement of Grade 11 HUMSS students exposed in the traditional instruction and practical work approach (PWA) using supplemental learning materials (SLM's), Tables 5 through 8 present the results of the t-test analysis.

Table 5. t-test Analysis on the Statistics and Probability Achievement of Students before the Experimentation

Groups	MPS (%)	Comp t-value	Critical t-value
Control Group	28.88	0.228	1.989
Experimental Group	28.61		
MPS Difference	**0.27^{ns}**		

ns – not significant @ 0.05 level

As shown in Table 5, the Mean Percentage Score (MPS) of control and experimental groups were 28.88% and 28.61%, respectively. It further shows that the MPS of control group is little bit higher than the MPS of experimental group. The MPS difference of 0.27% was proven not significant as the t-test analysis affirms it at 5% level of significance since the computed t-value of 0.228 is less than the critical t-value of 1.989. This finding led to the confirmation that the two groups under experimentation were comparable. This implies that students in control group, most likely, were as good as those in experimental group in terms of Statistics and Probability achievement. Further, the data signify that control and experimental groups were not significantly different.

This study is supported by Paculanan (2013) and Paghubasan (2017). They stressed that to have valid and reliable results of the study, comparable academic preparation of the two groups under experimentation must be ensured by giving them an IQ or standardized test before they will be given pre-test. Further, in their study, Simpal (2016) and Maliga (2018) considered two groups that had the same level of academic performance before they started with the experimentation to ensure the reliability of their experiment results.

As shown in Table 6, the computed t-value of 15.637

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exceeds the critical t-value of 2.633 at 1% level of significance. This indicates that through the exposure of students to traditional instruction, control group garnered a higher MPS of 73.06% in the post-test compared with the MPS of 28.88% in the pre-test. This further means that students gained a significant increase of 44.18% in their Statistics and Probability achievement due to their exposure to traditional approach. In other words, students solely exposed to traditional instruction registered a significant MPS gain.

Table 6. t-test Analysis on the Statistics and Probability Achievement of Students in Control Group before and after the Experimentation

Control Group	MPS (%)	Comp t-value	Critical t-value
Pre-Test	28.88	15.637	2.633
Post-Test	73.06		
MPS Gain	**44.18****		

** – significant @ 0.01level

The above statistical analysis is supported by Hagos (2009). He concluded that students solely confined with traditional mathematics instruction registered a significant progress in their problem solving performance. He added that traditional instruction has been proven effective in improving the academic performance of students over the years.

Table 7. t-test Analysis on the Statistics and Probability Achievement of Students in Experimental Group before and after the Experimentation

Experimental Group	MPS (%)	Comp t-value	Critical t-value
Pre-Test	28.61	24.046	2.633
Post-Test	90.83		
MPS Gain	**62.22****		

** – significant @ 0.01 level

Table 7 presents the t-test result on the Mean Percentage Scores (MPS) of experimental group in the pre-test and post-test. As revealed, the MPS gain of 62.22% which was higher than control group's MPS gain of 44.18% was proven highly significant as the t-test confirms since the computed t-value of 24.046 is greater than the critical t-value of 2.633 at 1% level of significance. This means that students were really motivated to improve their problem solving skills, thus, giving them a chance to significantly increase their MPS from 28.61% to 90.83%. In other words, practical work approach (PWA) using supplemental learning materials (SLM's) allowed students to explore their wild cognitive reasoning to apply various approaches to improve their achievement in Statistics and Probability.

In support to this study, Gegone (2019) found out that experimental group exposed with reciprocal peer tutoring (RPT) instruction registered a higher gain score in Chemistry compared with control group. Maliga (2018) also proved that supplemental learning materials exposed to experimental group really motivated the Grade 10 students to solve math problems and further improved their math achievement.

Tables 6 and 7 strongly confirmed that both traditional approach sing chalk and talk method and PWA using SLM's were highly effective in improving the achievement of students in Statistics and Probability. However, higher MPS gain of 62.22% was recorded by the experimental group compared with the control group that acquired only a MPS gain of 44.18%. To determine if there is a significant difference in the MPS gains of control and experimental groups, Table 8 presents the result of the t-test analysis.

Table 8. t-test Analysis on the Statistics and Probability Achievement of Students in Control and Experimental Groups after the Experimentation

Groups	MPS (%)	Comp t-value	Critical t-value
Control Group	73.06	10.977	2.633
Experimental Group	90.83		
MPS Difference	**17.77****		

** – significant @ 0.01 level

Table 8 presents t-test analysis on the Statistics and Probability achievement of students in control and experimental groups after the experimentation. As shown, experimental group's MPS of 90.83% is higher than the MPS of 73.06% earned by control group, marking a difference of 17.77%. This difference was proven highly significant as the t-test exhibits since the computed t-value of 10.977 is greater than the critical t-value of 2.633 at 1% level of significance. This means that there was a significant difference between the post-tests' MPS of the two groups in favor of the experimental group that was exposed to practical work approach (PWA) using supplemental learning materials (SLM's) which encouraged both the slow and fast learners to enhance their critical thinking abilities, thus, improving their achievement in Statistics and Probability. In short, PWA using simplified SLM's was far more effective than

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traditional approach using chalk and talk method in improving the achievement of students in Statistics and Probability.

Three previous tables revealed that the two teaching approaches used in this study both improved the achievement of students of control and experimental groups in Statistics and Probability. However, PWA using SLM's was proven more effective than traditional mathematics instruction. Thus, PWA using SLM's was very effective in improving students' achievement in Statistics and Probability.

Ifamuyiwa and Akinsola (2008) support the above findings when they emphasized that traditional instruction limits the opportunities of the students to learn. They added that students' achievement can be increased using a learner-centered instructional paradigm that engages students in best practices fostering interactive inquiry, nurture positive self-concepts, and facilitate collaboration and teamwork. That's why, Paculanan (2013), Paghubasan (2017) and Maliga (2018) stated that modern mathematics instruction using supplemental learning materials (SLM's) with various practical work activities is a form of collaborative learning that enables students to reason out with mathematical propositions which are contained within the numerous differentiated activities, thus making them to become critical thinkers and wise decision-makers.

Analysis on the Difference of Attitudes of Grade 11 HUMSS Students towards Statistics and Probability in Control and Experimental Groups

Mathematics is one of the tool subjects that are frequently applied in day-to-day activities. However, many high school teachers consider Mathematics as a very difficult subject to teach. Most students have negative attitudes towards it. To determine the effect of practical work approach (PWA) using supplemental learning materials (SLM's) on the attitudes of students towards Statistics and Probability and to validate the findings of other researchers, Tables 9 to 12 present the results of the t-test analysis.

Table 9.t-test Analysis on the Attitudes of Students towards Statistics and Probability before the Experimentation

Groups	Mean	Comp t-value	Critical t-value
Control Group	2.22	0.113	1.989
Experimental Group	2.24		
Mean Difference	**0.02^{ns}**		

ns – not significant @ 0.05 level

As shown in Table 9, the computed t-value of 0.113 which is less than the critical t-value of 1.989 at 5% level of significance signifies that the mean difference of 0.02 was proven not significant. This means that the negative attitudes of students towards Statistics and Probability in control group were comparable with the negative attitudes of students in experimental group. This further indicates that students from both groups disliked Statistics and Probability prior to the start of experimentation. In other words, their low level of appreciation to the importance of Statistics and Probability was of comparable results. Both students showed dismayed attitudes towards Statistics and Probability before the experimentation was conducted.

This finding is affirmed by the study of Paculanan (2013) who stressed that students might display negative attitudes towards the subject if they don't see its practical application to the real world experiences. He added that it is normal for the students to have apprehension towards the subject if they have no idea yet what to be discussed particularly in Mathematics subjects.

Table 10. t-test Analysis on the Attitudes of Students towards Statistics and Probability in Control Group before and after the Experimentation

Attitudes of Students	Mean	Comp t-value	Critical t-value
Before	2.22	1.047	1.989
After	2.37		
Mean Gain	**0.15^{ns}**		

ns – not significant @ 0.05 level

As shown in Table 10, there was no significant difference between the attitudes of students towards Statistics and Probability in control group before and after the experimentation. Although, there was a little bit increase of 0.15 in the mean score of students after the conduct of the study, this increase was proven not significant as the computed t-value of 1.047 is less than the critical t-value of 1.989 at 5% level of significance. This means that traditional approach didn't help the students to improve their attitudes towards Statistics and Probability. Although, students learned a lot in traditional instruction and it was indicated by the significant MPS gain score of 44.18% presented in Table 6, their negative attitudes towards Statistics and Probability were still comparable with their negative attitudes before the start of experimentation. In layman's terms, traditional instruction had nothing to do in letting the students to appreciate the importance of Statistics and Probability.

Paculanan (2013) supports the above finding when he found out that negative attitudes towards Mathematics are

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evident among students when teachers just only confine themselves with traditional instruction without integration of other interactive teaching approaches and without the use of contextualized instructional materials. He added that traditional instruction doesn't give students opportunities to teach their classmates since the teacher just only monopolizes the task of imparting knowledge. Traditional instruction often times makes the students bored since monopoly of class discussion is evident among traditional teachers.

Paghubasan (2017) has a similar finding with the above data when she proved that traditional instruction and assessment didn't boost students' problem solving skills in Mathematics. She further recommended that modern instruction and assessment tools such as game-based and activity-oriented instruction and assessment strategies should be exposed to the students to improve their problem solving skills.

Table 11. t-test Analysis on the Attitudes of Students towards Statistics and Probability in Experimental Group before and after the Experimentation

Attitudes of Students	Mean	Comp t-value	Critical t-value
Before	2.24	14.679	2.633
After	3.80		
Mean Gain	**1.56****		

** – significant @ 0.01 level

As shown in Table 11, the computed t-value of 14.679 is greater than the t-critical value of 2.633 at 1% level of significance. This means that there was a significant difference (Mean Gain = 1.56) between the attitudes of students before and after the conduct of the study in the experimental group. This connotes that practical work approach (PWA) using supplemental learning materials (SLM's) significantly increased students' attitudes towards Statistics and Probability from negative to positive. In other words, there was a positive effect of PWA using SLM's on the attitudes of students in Statistics and Probability.

This finding is substantiated by Kasimu and Imoro (2017) when they stressed that Mathematics is learning by doing. They also added that to make Mathematics accessible to every student, educators must create situations that would increase student involvement. Increasing student participation can be best facilitated if there are practical work approaches and localized instructional materials that allow each learner to express his personal outlooks in life.

Maliga (2018) emphasized that Mathematics teaching can be made meaningful by allowing students to explore and discover new ideas and concepts which eventually develop their logical and reasoning abilities. This can be done if various practical work activities are found in the contextualized instructional materials for the students.

Table 12. t-test Analysis on the Attitudes of Students towards Statistics and Probability after the Experimentation

Groups	Mean	Comp t-value	Critical t-value
Control Group	2.37	17.097	2.633
Experimental Group	3.80		
Mean Difference	**1.43****		

** – significant @ 0.01 level

It is shown in Table 12 that the mean difference of 1.43 was proven highly significant since computed t-value of 17.097 is greater than the critical t-value of 2.633 at 1% level of significance. This means that after the exposure of students in experimental group with practical work approach (PWA) using supplemental learning materials (SLM's), their attitudes towards Statistics and Probability significantly improved from negative to positive. Unlike with control group exposed with traditional approach, as shown in Table 10, students' attitudes towards Statistics and Probability didn't significantly improve. In other words, their negative attitudes remained the same after the experimentation. This t-test analysis strongly confirms that PWA using SLM's was very effective in improving the attitudes of students towards Statistics and Probability.

In relation to this finding, Simpal (2016) found out that lack of background in Mathematics and poor study habits were the top problems encountered during the conduct of his experimentation and these problems were easily overcome by the students in the experimental group due to the advantages given by the use of visual representations such as pictures and power-point presentations as supplemental learning materials in solving problems. Practical exercises also gave a positive response to the students. That's why; he suggested that Mathematics and Physics teachers should devise a teaching approach that makes the abstract ideas concrete. By this way, positive attitudes of students towards Mathematics and Physics can be manifested. Paculanan (2013) also insisted that mathematics instruction can be meaningful if there is a proven effective teaching approach that arouses the interest of students in numbers. The foregoing authors recommended that Math and Science teachers should not stop discovering new teaching approaches that make sense to the students. They emphasized that there is no single teaching

approach that fits all types of learners. Innovative teachers are those who don't just only confine themselves in one teaching approach.

Henson (2009) also supports the above data when he emphasized that exposing students in practical work approach such as reciprocal peer tutoring (RPT) encourages students to maximize their engagement opportunities to their peers. Maliga (2018) added that the use of supplemental learning materials increases academic achievement while it decreases disruptive behavior. The two authors strongly believed that practical work approach (PWA) using supplemental learning materials (SLM's) both improve the academic achievement and attitudes of students towards Mathematics.

Thus, this study finally proved the notion of many researchers that Practical Work Approach Using Supplemental Learning Materials for Effective Teaching in Statistics and Probability is true.

IV. CONCLUSIONS

Before the start of experimentation, students from both control and experimental groups had a comparable achievement in Statistics and Probability. After their exposure into two respective teaching approaches, students from experimental group subjected with practical work approach (PWA) using supplemental learning materials (SLM's) obtained a higher extent of achievement in Statistics and Probability compared with the control group solely taught with traditional instruction using chalk and talk method.

Prior to the experimentation, students from both control and experimental groups displayed negative attitudes towards Statistics and Probability. After the experimentation, students in control group still displayed negative attitudes while students in experimental group already exhibited positive attitudes towards the Statistics and Probability.

The exposure of students in PWA using SLM's had a positive effect on the achievement and attitudes of students towards Statistics and Probability. It is finally validated that Practical Work Approach Using Supplemental Learning Materials is not only effective in basic Mathematics, Physics and Chemistry subjects but also effective in improving the achievement and attitudes of students towards Statistics and Probability.

V. RECOMMENDATIONS

Based on the findings and conclusions of the study, the researcher presents the following recommendations:

1. To provide an optimal educational learning experience in Statistics and Probability, teachers should consider students' individual differences. In this regard, they should employ practical work approach (PWA) supplemented with contextualized instructional materials to improve the academic achievement and attitudes of students towards Statistics and Probability.
2. Mathematics teachers should always expose their students to situational problem solving which encourages both the slow and fast learners to be participative in every teaching-learning interaction. PWA using SLM's should be intensified to maximize the learning opportunities of students.
3. The developed SLM's in this study should be adopted as a means of enhancing the achievement and attitudes of students towards Statistics and Probability.
4. Mathematics teachers should continue discovering effective pedagogy in mathematics to change the perceptions of students towards mathematics from difficult subject to interesting and relevant one.
5. Survey questionnaire developed in this study to determine the attitudes of students towards mathematics should be adopted. If there is a researcher who is interested to get a pdf copy of the developed survey questionnaire, the email address of the author is samsudinabdullah42@yahoo.com.

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