Effectiveness Of Inquiry Based and Cooperative Learning- Based Approaches to The Performance of Grade 10 Students In Mathematics

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Abstract — This study aimed to evaluate the effectiveness of the inquiry-based and Cooperative Learning-based approaches to the performance of Grade 10 learners in Mathematics in Ipil National High School. The findings of the study were the bases for a Proposed Enhancement Plan. The study utilized random Sampling in identifying the respondents of the study. This also utilized the test of difference between scores in the pre-test and post-test of Grade 10 in Mathematics for both control and experimental group.

As shown in table 1-2, it reveals the scores of the respondents or the grade 10 learners responded the different learning competencies or their tasks before and after the integration of the cooperative problem solving based approaches in the delivery of the learning competencies in Mathematics. Based on the results in table 3, it was revealed that the pretest performance in the control group is lesser than the posttest performance. These 2 test results to the computed t value that is lower than the critical t value. So the hypothesis which states that there is no significant difference between the pretest and posttest performance of the Grade 10 students (control group) is rejected. Meanwhile, in the Experimental group, the pretest performance is lower than the posttest performance. These results of the respondents in the experimental group resulted to the computed t value which is greater than the critical t value and the hypothesis which states that there is no significant difference between the pretest and posttest performance before and after the integration of the intervention in the delivery of the most essential learning competencies in Cooperative problem solving based approaches is rejected.

Based on the results of the study in table 3, focuses on the control group results implies that when the Grade 10 learners really need to have another intervention considering that from the pretest to posttest almost the same performance were gained thus, they should let them exposed to the different strategies other than the present teaching strategies that the teacher offers in teaching the different learning competencies. There is really a need because from the time that they are

expose on the blended learning they are not really creating good learning performances. In the experimental group performance based on the table 3, it implies that the usage of intervention specially is really significant in improving their performances because it creates positive impact to the learning performances of the learners thus, it amplifies their positivity to learn new things with the new learning experiences using the new strategy that the teachers applied during the teaching and learning process in the teaching the mathematical skills.

Based on the results of the study in table 4, focuses on the control group and experimental group in the posttest performances implies integrating the cooperative problem solving based approached in delivering the different learning competencies are more significant compared to the other strategies applied by the teacher to the other group or to the control group, meaning, when the learners are already exposed to the strategies that are suitable to them it is really visible that they are more motivated to learn new things even if the lessons are quite challenging.

Keywords — Effectiveness, Inquiry Based, Cooperative Problem Solving Based Approach, Performance, Grade 10 Learners, Mathematics

I. Introduction

Inquiry-based learning, one of the main science education methods, aims to solve a problem they encounter by doing the necessary research (Wood, 2013). Besides, it is reported in the literature that inquiry-based learning makes a significant contribution to students' academic success and higher-order cognitive features such as scientific process skills and self-efficacy (Wilder & Shuttleworth, 2005, Duban, 2008; Seyhan, 2008; Akben, 2011; Ulu, 2011; Kocagül, 2013).

The researcher has been teaching Mathematics for almost 9 years of service in the Department of Education and it is undeniably one of the most hate subject of majority of the students. That is why teaching mathematics becomes more challenging to her. Sometimes she wonders: Is it she? Does she lack the skills? Does she really know how to teach the subject? Or they just really don’t have the interest in the subject because of its complexity.

That is why there should be something to be done to make students improve their performance in the subject Mathematics to help students and to reduce the stress of the Math Teachers like her. This study to be conducted would be a great help for her.

Math Teachers have something in common and for sure it is the concern of how our students could perform better in this subject. Recent survey reported that 37% of teens aged 13-17 found math to be harder than other subjects- the highest ranked overall. And according to asia news. network, Philippines rank 2nd to worst in math skills in South-East Asia, issue released January 27, 2023.

And to her school, low Math Academic performance is evident in our Numeracy Test Results and Mean Percentage Score (MPS). That is why if there should be an effective approach that she can use in her teaching to help her students, she would apply it and hope for better results.

Grade 10 students are expected to be all Numerates in the Regional Numeracy Test for students conducted Quarterly. But sad to say, there are still students considered as non-numerates. For this school year 2022-20233, in our pre-test results, there are 115/399 students that are non-numerates, while on the 2nd quarter there are still 59/399 Grade 10 students who were considered non-numerates.

As to our Grade 10 Mean Percentage Score (MPS) of the Quarterly Assessment it showed that Math had the lowest MPS among other subjects that resulted 69.42% for the First Quarter. And still got the lowest MPS for the second quarter having 77% on the second quarter. Though there is an evident result of the interventions done by the Grade 10 Math Teachers yet it is still a challenge on how to improve the score performance of Grade 10 students.

Based from the results given, the researcher is eager to finish her study in order to improve the performance of the learners as well as to increase the teaching and learning process different strategies in the delivery of the most essential learning competencies.

This study evaluated the effectiveness of the inquiry-based Approach and Cooperative Learning-based approaches to the performance of Grade 10 learners in Mathematics in Ipil National High School. The findings of the study were the bases for the proposed Cooperative Problem-Solving Based Approach Plan.

Specifically, the study sought to answer the following questions:

1. What is the performance of the Grade 10 Students in Mathematics before the integration of inquiry-based Approach and Cooperative Learning-based approaches based on the two groups?

    1.1. Control group;

    1.2. Experimental group?

2. What is the performance of the Grade 10 Students in Mathematics after the integration of inquiry-based Approach and Cooperative Learning-based approaches based on the two groups?

3. Is there a significant difference in the performances of the Grade 10 Students in Mathematics before and after the integration of inquiry-based Approach and Cooperative Learning-based approaches based on the two groups?

4. What improvement plan can be proposed based on the findings of the study?

NULL HYPOTHESIS:

There is no a significant difference in the performance of the Grade 10 Students in Mathematics before and after the integration of inquiry-based Approach and Cooperative Learning-based approaches based on the two groups?

1.1 Control group;

1.2 Experimental group?

II. Methodology

Design. This study utilized the Quasi-Experimental research design to determine the Effectiveness of Cooperative Problem-Solving Based Approach and inquiry-based approach to the performance of the Grade 10 learners in Mathematics. The findings of the study based on the comparative analysis are basis for crafting Plan. particularly in the 4th grading period. The main local of the study is the Ipil National High School which is located under the Ormoc City District 2 in the Schools Division of Ormoc City. In the aforementioned locale where the study was conducted, the main respondents that was chosen by the teacher-researcher was the Grade 10 learners who were experienced the Effectiveness of Cooperative Problem-Solving Based Approach and inquiry-based approach to the performance of the Grade 10 learners in Mathematics. The findings of the study based on the comparative analysis are basis for crafting Plan. The different assessment was carefully done by the teacher-researcher herself which are the pretest and posttest performances in Mathematics. This is also the time that in between the pretest and posttest, the delivery of the most essential learning competencies in the Mathematics was then embedded with the Effectiveness of Cooperative Problem-Solving Based Approach and inquiry-based approach. This study is mainly focus on the results of the different tests to gather data: The pretest performance of the Grade 10 learners before the implementation of the Effectiveness of Cooperative Problem-Solving Based Approach and inquiry-based approach. The Posttest performance of the Grade 10 learners after the implementation of the Effectiveness of Cooperative Problem-Solving Based Approach and inquiry-based approach as well as the significant difference of the pretest and posttest before and after the implementation of the inclusion of the Effectiveness of Cooperative Problem-Solving Based Approach and inquiry-based approach. In the Quasi- experimental research design, the researcher prepared different Effectiveness of Cooperative Problem-Solving Based Approach and inquiry-based approach that were focused on the learning competencies which are difficult to pass by the respondents as well as facilitating in the giving of pretest and posttest to the identified respondents in order to gather necessary data that will be significant in the study; The proposed enhancement plan was crafted and taken based on the findings of the study as well as on the recommendations based on the Teacher-researcher findings from the results given by the Grade 10 learners .

Sampling. There are 72 total of respondents who are included in the study. 36 respondents of the study were Control group and 36 were belong to the experimental group. In gathering of data, the actual meeting of the respondents as well as the given the pretest and posttest assessment were given to the Grade 10 learners inside the classroom. Another way of contacting them are through cell phones of their respective parents for their awareness regarding the study being conducted.

Research Procedure. The researcher prepared the Quasi-experimental research design that was used before and after the integration of the study. The Cooperative Problem-Solving Based Approach and inquiry-based approach in Mathematics as well as the test questionnaire are the tools utilized in the study. The different tools prepared by the Teacher-researcher were the ff: validated Summative Test Questionnaire in Math from the Self Learning Modules of the aforementioned subject that were focused on the different competencies in the 4th grading period. The test questions were used before the inclusion of the Effectiveness of Cooperative Problem-Solving Based Approach and inquiry-based approach to the performance of the Grade 910 students in Math particularly in the 4th grading period were given to the learners. After one month of the intervention of the inclusion of the Effectiveness of Cooperative Problem-Solving Based Approach and inquiry-based approach to the performance of the Grade 10 students in Math, posttest was given to the grade 10 learners with the same test questionnaire given in the pretest assessment. Prior to the preparation of all validation tools which will be used by the teacher-researcher in determining their performances before and after the integration of the intervention together with the different inclusion of the Effectiveness of Cooperative Problem-Solving Based Approach and inquiry-based approach to the performance of the Grade 10 students in Math particularly in the 4th grading period which were utilized for the identified approach in teaching, The Approval and recommendation from the Office of the Schools Division Superintendent, as well as to the Assistant Schools Division Superintendent being the Chairman of the Schools Division Research Committee through the Senior Education Program Specialist in Planning and Research. After the Approval of the Schools Division Research Committee, the Approved or endorsement letter from the body together with the approved letter of intent were forwarded to the Office of the Public School District Supervisor as well as to the office of the School principal in order to get full support on the conduct of the study as well as to get also approval from their end. The proposed title and design was submitted to the School Division Office for approval. Upon approval, the Division released endorsement to the District Office. When the research was approved by the Schools Division Office and District Office, the researcher began the process of data gathering. Validation of the instruments through the different Experts from the Schools Division Office, District Office and to the Schools where the available personnel such as the Master Teacher and in coordination with the school head were sought. Orientation of the participants was done. Answering and retrieval of the research tool followed. Tallying of results and treatment of data. Analysis and Interpretation of Data. Making of Proposed Enhancement Plan.

Ethical Issues. The right to conduct the study was strictly adhered through the approval of the principal, approval of the Superintendent of the Schools Division Office. Orientation of the respondents both the learners and the teachers including the School Principal was done.

Treatment of Data. The Effectiveness of inclusion of the Effectiveness of Cooperative Problem-Solving Based Approach and inquiry-based approach to the performance of the Grade 10 students in Mathematics particularly in the 4th grading period are the area of focused was treated through a Simple percentage, weighted mean and T-Test of Mean Difference respectively.

III. Results and Discussion

TABLE 1
PRE-TEST PERFORMANCE OF GRADE 10 STUDENTS IN MATHEMATICS

Score Range	Description	Control Group		Experimental Group	
		Frequency	%	Frequency	%
33-40	Excellent	2	6	0	0
25-32	Very Good	9	25	13	36
17-24	Good	10	28	16	44
9-16	Fair	10	28	5	14
1-8	Poor	5	13	2	6
Total		36	100	36	100
Weighted Mean		**19.17**	**Good**	**21.25**	**Good**

Table 1 presents the pre-test performance of Grade 10 Learners in Mathematics Subject. This results was based from the learnings or skills of the respondents based on the things that they have learned from the variety of strategies included by the teacher-researcher during the delivery of the most essential learning competencies in mathematics. This set of results gained by the Grade 10 learners in Grade 10 is merely focused on the learnings that they have gained or harvest before they were in the cooperative problem solving based approaches will be embedded in the teaching ang learning process during the fourth Grading period based on the different most essential learning competencies which should be lasted for 4 weeks or 1 month of implementation of the intervention. Based from the table in Table 1m It was revealed on the table that pre-test performances of the Grade 10 learners in Mathematics particularly in the Control group has a weighted mean of 19.17 which is interpreted as good. The good level of performances are based from the different sets of performances or level of performances or numeracy performances that shows as follows. in the Excellent level of performance having the scores from 33 to 40, there were none of the total respondents who took the pretest examination particularly in the control

group. In the very good level of performance having scores ranges from 25-32, there 9 respondents with an equivalent percentage of 25 percent and considered to be in the quarter portion of the total number of respondents being tested . While in the good level of performance, which is considered as the average rating of performance, it has composed of 10 respondents or having a percentage of 28 percent in which the total number of respondents in this level of performance has the same number of respondents on the fair level of performance having the scores ranging from 9-16. Lastly, on the poor level performance having the scores ranging from 1-8, it was revealed that there were 5 total number of respondents who were belong to this level or has an equivalent percentage of 13 percent out of the 36 total number of respondents being tested in terms of skills prior to the integration of the intervention in the delivery of the lessons for the 4th grading period. On the other hand, It was revealed on the same table that the pre-test performance of the Grade 10 learners who are considered and set as the group for experimental studies having the weighted mean of 21.25 which is interpreted as good. As the results shown, it was revealed that it has the same performance of the learners in the control group which means that majority of the respondents in the experimental group has gained scores having the average learning experiences. From the Experimental group, it was shown that in the Excellent level of performance having the scores ranging from 33 to 40, it was found out that there were none from the respondents who took the pretest examination particularly in this group, meaning all of the learners in Grade 10 level have not yet mastered the specific skills in mathematics. In the very good level of performance having scores ranges from 25-32, there were 13 total number of respondents or it has an equivalent percentage of 36 percent which also considered as second to the highest number of respondents responded during the pre-assessment of performances . In the good level of performance, it can be shown that it has the majority among all the other level of performance having composed of16 total number of respondents or percentage of 44 percent. With the score ranging from 17-24. In the fair level having the score ranging from 9-16, there were 5 total number of respondents in this level having 14 percent. Lastly, in the Poor level of performance with the scores ranging from 1-8, there was only 2 respondents or 6 percent out of the 36 total number of respondents.

The result in table 1 which focuses on the pretest performance of the Grade 10 learners in Mathematics for both control and experimental groups implies that based on their scores given in the control group, even though they are on the good level of performance, there are still respondents in the control group who are belong to the fair and poor level of performance which means that they really need also special attention in order for their performances to be improved or increased the same thing with the experimental group that also having composed of poor and fair level of performances that also needs intervention to improve learning or performances.

TABLE 2
POST TEST PERFORMANCE OF GRADE 10 STUDENTS IN MATHEMATICS

Score Range	Description	Control Group		Experimental Group	
		Frequency	%	Frequency	%
33-40	Excellent	2	6	0	0
25-32	Very Good	9	25	13	36
17-24	Good	10	28	16	44
9-16	Fair	10	28	5	14
1-8	Poor	5	13	2	6
Total		36	100	36	100
Weighted Mean		**19.17**	**Good**	**21.25**	**Good**

Table 2 presents the pre-test performance of Grade 10 Learners in Mathematics Subject. This results was based from the learnings or skills of the respondents based on the things that they have learned from the intervention which is cooperative problem based approach delivery of the most essential learning competencies in mathematics. This set of results gained by the Grade 10 learners in focused on the learnings that they have gained after they were exposed to the cooperative problem solving based approaches which was embedded in the teaching ang learning process during the fourth Grading period which was lasted for 4 weeks or 1 month of implementation of the intervention. Based from the table 2 was revealed on the table that posttest performances of the Grade 10 learners in Mathematics particularly in the Control group has a weighted mean of 20.75 which is interpreted as good which is the same in the pretest performances. The good level of performances gained by the respondents are based from the responses gained from the respondents. in the Excellent level of performance having the scores from 33 to 40, there were 5 respondents or 14 percent out of the 36 total respondents who took the posttest examination particularly in the control group. In the very good level of performance having scores ranges from 25-32, there 7 respondents with an equivalent percentage of 19 percent. While in the good level of performance, which is considered as the average rating of performance, it has composed of 13 respondents or having a percentage of 36 percent in which the total number of respondents. In the fair level of performance with the scores ranging from 9-16, there were 11 total number of respondents or 31 percent. Lastly, on the poor level performance having the scores ranging from 1-8, it was revealed that there were none from the respondents belong in this level from the total number of respondents who were belong to this level in the delivery of the lessons for the 4th grading period. On the other hand, It was revealed on the same table that the pre-test performance of the Grade 10 learners who are considered and set as the group for experimental studies having the weighted mean of 31.28 which is interpreted as very good. As the results shown, it was revealed that it has increased in performance of the learners compared in the control group which means that majority of the respondents in the experimental group has gained scores having the improved

learning experiences after they already exposed the intervention. From the Experimental group, it was shown that in the Excellent level of performance having the scores ranging from 33 to 40, it was found out that there were 14 total number of respondents or 39 percent, meaning some of the learners in Grade 10 level have mastered the specific skills in mathematics in the 4th grading period. In the very good level of performance having scores ranges from 25-32, there were 21 total number of respondents or it has an equivalent percentage of 58 percent which also considered as second to the highest number of respondents responded during the posttest assessment of performances . In the good level of performance, it can be shown that it has composed of only 1 total number of respondents or percentage of 3 percent with the score ranging from 17-24. In the fair level having the score ranging from 9-16 and from 1-8, with the equivalent performance of fair and poor level of performances, there were none respondent or 0 percent out of the 36 total number of respondents in these level respectively.

The result in table 2 which focuses on the posttest performances of the Grade 10 learners in Mathematics for both control and experimental groups implies that based on their scores given in the control group, it shows that they have maintain their performance level which means that they are really learning based on the things that they have learned from the teachers using a variety of learning strategies, In other word there are still respondents in the control group who are belong to the fair level of performance which means that they really need also special attention in order for their performances to be improved. While in the experimental group, it was found that the intervention is very effective considering that there was an increase in terms of test performance because it has improved from good to very good. Meaning, the utilization of the intervention is quite good to the fact that the learners are really improving their performances. The teachers should continue to create avenue in learning using the different materials following the norms in the cooperative problem solving based approaches in the delivery of the most essential learning competencies.

TABLE 3
TEST OF DIFFERENCE BETWEEN THE SCORES IN THE PRE-TEST AND POST-TEST OF GRADE 10 STUDENTS IN MATH

Groups	Test Scores		Computed T	Critical T	Decision	Interpretation
Grade 10 Learners Control	Pre Post	19.17 20.75	0.212	0.636	Failed to Reject Ho	Not Significant
Grade 10 Learners Experimental	Pre Post	21.25 31.28	1.641	0.636	Reject Ho	Significant

Table 3 presents the test of difference between the scores in the pre-test and post-test of Grade 10 in Mathematics for both control and experimental group. In this table, it reveals how the respondents or the grade 10 learners responded the different learning competencies or their tasks before and after the integration of the cooperative problem solving based approaches in the delivery of the learning competencies in Mathematics. Based on the results in table 3, it was revealed that the pretest performance in the control group which is equal to 19.17 which is lesser than the posttest performance which is equal to 20.75. These 2 test results to the computed t value of 0.212 is lower than the critical t value of 0.636. So the hypothesis which states that there is no significant difference between the pretest and posttest performance of the Grade 10 students (control group) is rejected. Meanwhile, in the Experimental group, there pretest performance is equal to 21.25 which is lower than the posttest performance which is equal to 31.28. These results of the respondents in the experimental group resulted to the computed t value which is equal to 1.641 which is greater than the critical t value of 0.636 and the hypothesis which states that there is no significant difference between the pretest and posttest performance before and after the integration of the intervention in the delivery of the most essential learning competencies in Cooperative problem solving based approaches is rejected.

Based on the results of the study in table 3, focuses on the control group results implies that when the Grade 10 learners are really need to have another intervention considering that from the pretest to posttest almost the same performance were gained thus, they should let them exposed to the different strategies other than the present teaching strategies that the teacher offers in teaching the different learning competencies. There is really a need because from the time that they are expose on the blended learning they are not really creating good learning performances. In the experimental group performance based on the table 3, it implies that the usage of intervention specially really significant in improving their performances because it creates positive impact to the learning performances of the learners thus, it amplifies their positivity to learn new things with the new learning experiences using the new strategy that the teachers applied during the teaching and learning process in the teaching the mathematical skills.

TABLE 4

TEST OF DIFFERENCE BETWEEN THE POST TEST SCORES OF THE CONTROL AND EXPERIMENTAL GROUPS

Groups	Test Scores		Computed T	Critical T	Decision	Interpretation
Grade 10 Learners	Control Experimental	20.75 31.28	1.021	0.861	Reject Ho	Significant

Table 4 presents the test of difference between the scores in the post-test of Grade 10 in Mathematics both control and experimental group. In this table, it shows the significant difference of the two groups after they exposed to the different learning experiences using the different strategies in teaching. Based on the results, it was revealed that the posttest performance in the control group which is equal to 20.75 is lesser than the posttest performance in the experimental group which is equal to 31.28 which resulted to the computed t value of 1.021 which is lower than the critical t value which is equal to 0.861. So the hypothesis which states that there is no significant difference between the posttest performances of the Grade 9 students in the control group and experimental group is rejected.

Based on the results of the study in table 4, focuses on the control group and experimental group in the posttest performances implies integrating the cooperative problem solving based approached in delivering the different learning competencies are more significant compared to the other strategies applied by the teacher to the other group or to the control group, meaning, when the learners are already exposed to the strategies that are suitable to them it is really visible that they are more motivated to learn new things even if the lessons are quite challenging.

IV. Conclusion

Based from the results of the study on the integration of the inquiry-based Approach and Cooperative Learning-based approaches in the delivery of the most essential learning competencies during the fourth grading period in Mathematics 10 is significantly effective in improving the test performance of the learners as well as enhanced their Numeracy or mathematical skills. Furthermore, the utilization of these approaches really gave the chance to learners in learning from their own pace through discovery as well as they teach them how to learn the things cooperatively with groups.

V. Recommendations

The researcher offered the following recommendations to improve the performance of the Grade 9 learners in Technology and Livelihood Education.

1. The proposed enhancement plan should be embedded during the teaching and learning process specially during the delivery of the most essential learning competencies in Mathematics.

2. The Education Program Supervisors in-charge on the Mathematics should monitor on the utilization of the intervention as bases for the giving of Technical Assistance during the rounds of the different program experts to the field.

3. 3. The school head through the approval of the Public Schools District Supervisor should conduct In-service training or School LAC focusing on the inclusion of the different learning strategies in delivering the different lessons in Mathematics.

4. The teachers should monitor the efficacy of the intervention to validate whether it is still helpful to the teachers' vis a vis to the performance of the learners in every assessment conducted by the teacher handling the subject taken.

5. In relation to the abovementioned, the researcher is giving the authority to those future researchers to assess the effectiveness of the intervention in terms of performance of the learners.

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AUTHOR'S PROFILE

NOIMIE L. GARBO

The author is born on August 18, 1992 at Ormoc City, Leyte, Philippines. She finished her Bachelor's degree in Secondary Education major in Mathematics at Eastern Visayas State University –Ormoc City Campus, Magna Cum Laude. She had her Secondary education at New Ormoc City National High School, First Honorable Mention- BEC. She spent her primary education at Sto. Niño Elementary School, First Honors. She had been a consistent academic achiever during her school days. Also, during her college days, she was the president of the organization, Math Wizards' Club and also an SSG Officer- Education Representative. With that experience she believes that someday she can be a potential leader in God's will. She first took up Masters of Education major in Mathematics at Leyte Normal University but unfortunately, she did not pursue it and earned only 30 units. She took another path and now finishing her Masters of Education major in Administration and Supervision at Western Leyte College of Ormoc.

She is currently a Teacher II in the Department of Education and a Grade – 10 Mathematics Teacher at Ipil National High School at Barangay Ipil, Ormoc City, Leyte, Philippines. She has been teaching for almost 9 years now for she started teaching at the age 21. She was first assigned at Pedro G. Bañez National High School, Brgy. Tongonan, Ormoc City, Leyte, Philippines. She was a former SSG adviser and a Grade 7&8 Math Teacher. After almost 5 years of teaching at far-flung place she applied for Transfer and got transferred to Ipil National High School. Now, she is a Numeracy coordinator, SBM indicator leader and an adviser. She has harmonious relationship with her colleagues, parents and students.

She is happily married to Jayme Martine M. Garbo and has two sons namely, Zion Harry and Zaime Henry. She dedicates her work to her great inspirations, her beautiful family. She is always thankful to the Lord for her journey though it took her long time to finish her Graduate Studies. She believes that it is better to be late than never. Isaiah 60:22, "When the time is right, I, The Lord will make it happen."