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CONCEPT-BASED INSTRUCTION TOWARDS STUDENT'S PERFORMANCE IN MATHEMATICS

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Abstract: **What are the approaches in teaching that would help students gain interest in studying math? This study evaluated the status of Concept-based Instruction of Grade nine (9) Math students of Gelacio C. Babao Sr. Memorial National High School for the school year 2019 – 2020, with the use of pre-test and post-test score distribution in illustrating the six trigonometric ratios, finding the trigonometric ratios of special angles, illustrating angles of elevation and angles of depression and using trigonometric ratios to solve real life-problems involving right triangles. This study also examined the possible significant mean difference in the pre-test and post-test of the experimental group and the controlled group and the possible significant mean difference in the mean gain of both groups. The quasi-experimental research was done using modified questionnaire from the summative test of the Grade nine Learner's Material. A pilot test was administered also in the Grade ten students and internal consistency for each scale was measured using Kuder-Richardson 20 (KR-20) & 21 (KR-21) which obtained 0.87202, which means that it fell under the acceptable range. The respondents were the 99 students of grade nine, 47 from the experimental and 52 from the controlled group. It was found out that there is a significant difference between the pre-test and post-test scores on both groups of the student's achievement in the experimental and there is a significant difference in the mean gain which means that the use of concept-based instruction is more effective compared to the lecture-discussion method or the traditional way of teaching in certain competencies for the Grade 9 students. Thus, the output of this study is hereby recommended for adoption.**

Keywords: **Teaching Mathematics, Concept-based instruction, Kuder –Richardson, Quasi-experimental.**

I. INTRODUCTION

The ability to view the world with a more flexible mind is more irreplaceable. Advance knowledge and skills along with the global standard are the logo for being fully equipped for the 21st century workplace. The level of mathematical thinking and problem solving needed in the workplace has increased dramatically in which teachers need more extensive use of strategy and approaches that would be effective in teaching mathematics.

The Common Core Standards in Mathematics stress the importance of conceptual understanding as a key component of mathematical expertise. Math can be difficult, and for those with high levels of mathematics-anxiety (HMAs), math is associated with tension, apprehension, and fear (Ian M. Lyons and Sian L. Beilock, 2012). However, computations, for mathematicians, is merely a tool for comprehending structures, relationships and patterns of mathematical concepts, and therefore, producing solutions for a complex real life problem.

Trends in Mathematics and Science Study (TIMSS) in 2013 reported that the Philippines have paved its way to the bottom part of the rank. The country is in 41st place among 45 participating countries in the Mathematics test. Also, the Philippines never joined the international assessment for mathematics and science after that. Furthermore, a concrete manifestation of low performance is the National Achievement Test (NAT).

This only implies that the students just possess the factual knowledge and there is a need to change the way of teachers' practices in teaching mathematics and building instructions. As being revealed in the study of Saritas and Akdemir

(2009), that in instructional strategies and methods, teacher competency in mathematics education and motivation or concentration is the most influential factors that should be considered in the design hearing. Learning theories provide instructional designers with verified instructional strategies and techniques for facilitating learning as well as a foundation for intelligent strategy selection (Peggy A. Ertmer and Timothy J. Newby, 2013).

However, thinking deeply with factual knowledge and concepts to communicate ideas and solve problems, transferring knowledge across distinct global contexts and situations, and seeing patterns and connections between concepts, ideas and situations are at the heart of concept-based teaching and learning. This creates a framework for learners to embrace three-dimensional instruction where one of the goals is increased conceptual understanding supported by factual knowledge and skills, and the transfer of understanding across global contexts to assimilate information (Erickson, 2008).

We have observed that the students of Gelacio C. Babao Sr. Memorial National High School were not motivated during their math classes and other students commit cutting classes. During the periodical tests, the subject mathematics has a lower mean score percentage as well. That is why this study will shed light on finding out reasons why students have low achievement in mathematics hence, appropriate actions are recommended to enhance teaching techniques and use of instructional materials.

II. METHODOLOGY

We used the Quasi-experimental method for the respondents from the control group which was exposed to traditional way of teaching and Concept-based Instruction for experimental group. We have made a pilot test in the Grade ten students and internal consistency for each scale was measured using Kuder-Richardson 20 (KR-20) and 21 (KR-21) which obtained 0.87202, which also means that it fell under the acceptable range but this grade 10 were not the respondents. In order to gather data we used modified questionnaire from the summative test of the Grade nine Learner's Material and competencies from the K-12 program. This is to determine the difference of the pre -test and post-test results with the use of concept-based instruction based on the following statement of the problems below.

1. What is the pre-test score distribution of the control and experimental groups for the following competencies:

1.1. illustrating the six trigonometric ratios;

1.2. finding the trigonometric ratios of special angles;

1.3. illustrating angles of elevation and angles of depression; and

1.4. using trigonometric ratios to solve real-life problems involving right triangle?

2. What is the post-test score distribution in the aforementioned competencies among the experimental group after exposure to concept-based instruction and among the control group after exposure to lecture-discussion method?

3. Is there a significant mean difference in the Mathematics performances of the two groups?

4. Is there a significant difference on the mean gain of the two groups?

The flow of the study was made through; Input, Process and Output. Input includes the pretest score distribution of the indicated competencies in Grade 9 Mathematics, Post test score distribution, significant mean difference of the pre-test and post-test and significant mean gain of the control group and experimental group. While the process includes gathering of data, tabulation, presentation, analysis, interpretation and implication in both control and experimental group. After the data was gathered, Output has been made in order to create a proposed lesson guide that could be helpful in teaching the students in Mathematics.

However, the study has been conducted in Gelacio C. Babao Sr. Memorial National High School, Valladolid, Carcar City, Cebu, Philippines. The 2 sections of Grade 9 was held as the respondents of the study, in which the sections are considered to be heterogeneous sections. We have utilized a modified questionnaires the summative test of the Grade 9 Learner's Material.

In the concept-based instruction, teachers should ask questions that uphold higher-level thinking. "Understanding requires knowledge, but goes beyond it" (Ron Ritchhart, 2015). However, that does not mean that a teacher should not be asking questions at the lower end of Bloom's Taxonomy of cognitive exactness. In fact, it is important that a teacher begins a

lesson with questions at the Recall and Understanding levels of Bloom's Taxonomy. However, in order to solve meaningful problems, students must be challenged with higher level questions that follow after the lower-level questions. Students will find difficulty applying their mathematical ideas or analyzing a mathematical situation if they are not asked higher-level questions in classroom activities and discussions.

This study utilized various statistical computations to analyze and interpret the data to be collected. Z-test was used to determine the pre-test and post-test score of the control and experimental group. While in getting the mean difference between the pre-test and the post-test scores for both groups of the Grade 9 – students of Gelacio C. Babao Sr. Memorial National High School after being exposed to concept-based instruction, the t-test of mean gain or correlated mean was used.

III. RESULTS AND DISCUSSIONS

This study found out the effects of the Concept-based Instruction in Mathematics among the Grade nine students of Gelacio C. Babao Sr. Memorial National High School during the school year 2019 – 2020 with the following tables below.

Table 1 below shows the Summary of the pre-test score distribution of the experimental and control group per competency. It was described in the table that the combined figures of the two groups belonged to below average level.

TABLE 1: SUMMARY OF PRE-TEST SCORE DISTRIBUTION FOR THE EXPERIMENTAL AND CONTROL GROUPS PER COMPETENCY

Learning Competencies	No. of Items	Group	h.m.	a.m.	S.D.	Z-test	Critical z-values	Description
Illustrating the six trigonometric ratios	10	Experimental	7.5	4.11	6.04	3.85	1.96	Below Average
	10	Controlled	7.5	3.31	6.56	3.02	1.96	Below Average
Finding the trigonometric ratios of special angles	10	Experimental	7.5	3.74	6.10	4.23	1.96	Below Average
	10	Controlled	7.5	3.37	6.54	4.55	1.96	Below Average
Illustrating angles of elevation and angles of depression.	5	Experimental	3.75	1.11	6.23	2.91	1.96	Below Average
	5	Controlled	3.75	1.04	7.36	2.66	1.96	Below Average
Using trigonometric ratios to solve real life-problems involving right triangles.	5	Experimental	3.75	0.74	6.56	3.15	1.96	Below Average
	5	Controlled	3.75	0.65	6.76	3.31	1.96	Below Average
Total	30	Experimental	22.5	9.7	7.59	11.57	1.96	Below Average
	30	Controlled	22.5	8.37	7.66	13.31	1.96	Below Average

It primarily focuses in the pre-test score distribution of the students in the following Grade nine competencies namely: illustrating the six trigonometric ratios, finding the trigonometric ratios of special angles, illustrating angles of elevation and angles of depression, using trigonometric ratios to solve real life-problems involving right triangles. The post-test shows results after using the Concept-based instruction. The significant mean difference between the pre-test and post-test results and the learning guide to be proposed based on the findings.

However, table 2 below displays the level of competence of the respondents from both groups based from the post-test score distribution in the pre-determined competencies. The post-test results suggest that the respondents in the experimental group performed better than the respondents in the controlled group after they were exposed to Concept-based instruction and the lecture –discussion method, respectively.

In the study of Major et al (2000) as cited in Ali (2010) in those classrooms in which problem based learning methods are used for instructional processes, the students take much more responsibility for their own learning. They have become independent and lifelong learners, and can continue to learn in their whole life.

TABLE 2: LEVEL OF COMPETENCE OF THE RESPONDENTS FROM BOTH GROUPS BASED FROM THE POST-TEST SCORE DISTIBUTION IN THE PRE-DETERMINED COMPETENCIES

Learning Competencies	No. of Items	Group	h.m.	a.m.	S.D.	Z-test	Critical z-values	Description
Illustrating the six trigonometric ratios	10	Experimental	7.5	8.7	4.2	1.96	1.96	Above Average
	10	Controlled	7.5	3.77	5.25	5.12	1.96	Below Average
Finding the trigonometric ratios of special angles	10	Experimental	7.5	7.79	3.9	0.51	1.96	Average
	10	Controlled	7.5	5.79	8.72	1.41	1.96	Average
Illustrating angles of elevation and angles of depression.	5	Experimental	3.75	4.57	2.7	2.08	1.96	Above Average
	5	Controlled	3.75	2.69	8.5	0.90	1.96	Average
Using trigonometric ratios to solve real life-problems involving right triangles.	5	Experimental	3.75	4.26	3.2	1.09	1.96	Above Average
	5	Controlled	3.75	1.33	7.2	2.42	1.96	Below Average
Total	30	Experimental	22.5	25.32	4.28	4.52	1.96	Above Average
	30	Controlled	22.5	13.58	9.44	6.81	1.96	Below Average

Table 3 expresses the pre-post mean gain of the experimental and controlled groups. This means that the hypothesis of no significant mean gain in the pre-test and post-test scores of the students were rejected. This also shows that their scores had increased when they were exposed to the Concept-based Instruction and lecture discussion method.

TABLE 3: SUMMARY TABLE FOR PRE-POST MEAN GAIN OF THE EXPIREMENTAL AND CONTROL GROUPS

Groups	Mean		Mean Gain	Computed t-value	Critical t-value	Decision	Interpretation
	Pre-test	Post-test					
Experimental	9.7	25.32	15.62	4.72	2.02	Reject Ho	Significant
Controlled	8.37	13.58	5.21	4.31	2.00	Reject Ho	Significant

Table 4 demonstrates the Significant Difference of the Mean Gain between the Experimental and the Control Groups. Thus, the hypothesis of no significant difference was rejected. There is a significant mean difference in the mean gain of the experimental and controlled groups.

Concept-based instruction gives more opportunity for the students to learn and situations that could be related to their real life problems. Just like the activity on how they could come up with the solution on getting faster in getting into their house. They have realized that the hypotenuse is the shortcut way compared to the sum of the two legs which means they could go home faster when they use the hypotenuse rather than the legs. Another is the height of the basketball ring, how long it would take them to go near the post of the ring. As we go a long with the discussions some students have related some situations that they already encountered. They have recognized that unconsciously, they were already using the concept of the trigonometric functions.

In the study of Nesmith (2008), the predictable way of teaching Mathematics such as memorization of facts, ability to execute rules and follow plug in formulas limit and affect the students in learning the subject area and only those can easily absorb things excel in this traditional way of teaching. The activities in the manual demand effort, time and memorization of formulas and these limits the students to engage and do other enjoyable activities related to the topics.

TABLE 4: SIGNIFICANT DIFFERENCE OF THE MEAN GAIN BETWEEN THE EXPERIMENTAL AND THE CONTROL GROUPS

Groups	Mean Gain	Computed t-value	Critical t-value	Decision	Interpretation
Experimental	15.62	18.45	1.99	Reject Ho	Significant
Controlled	5.21				

Based on the obtained data, there was a significant mean gain or improvement between the pre-test and post-test result in the control group. The students had improved their thinking ability in the post-test. There was also significant mean gain between the pretest and posttest results in the experimental group in Mathematics from **below average to above average level.** Lastly, there was a significant difference between the mean gain of the student's performance in Mathematics in the control group and experimental group. Moreover, the experimental group had higher mean gain than the student's performance in the control group.

IV. CONCLUSION AND RECOMMENDATIONS

A. Conclusion

Based on the results and findings, integrating Concept-based Instruction in teaching can improve the performance of the students. Most of the students would be motivated with the use of Concept-based instruction in teaching since teachers would be able to incorporate the lesson with the real life situations and some problems that would help the students to solve. In line with this, the study showed that students in the experimental group are better achiever than the respondents form the control group who undergone Concept-based instruction. In other words, the use of Concept-based Instruction is more effective than the lecture-discussion method.

B. Recommendations

1. Math Teachers may integrate Concept-based instruction on their lesson since it also promotes analytical thinking skills especially on Junior High School students.

2. Curriculum Guide developers may incorporate the ideas of the Concept-based instruction in Mathematics as objectives.

3. Master teachers may encourage math teachers to participate in the Learning Action Cell (LAC) session that involves Concept – based instruction.

4. Parents are encouraged to be involved in the process of learning the concept-based instruction and to support their students to apply the learnings of concept-based instruction in real-life situations.

5. Students should be consistently exposed to open-ended problems where they can think of many possible solutions in a way that they practice analytical thinking skills.

6. Assessment should address the learner's development of critical thinking and problem-solving skills as to applying the concept-based learning.

7. School administrators may be able to get involved in the use of Concept-based instruction in teaching Mathematics as they would be able to establish basically the needs of the teachers in incorporating this type of approach in their teachers.

8. Sample learning guides about concept-based instruction should be utilized as the basis of the teacher's lesson preparation to enhance critical and analytical thinking skills of the students.

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