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Context Orientated Teaching in Grade 9 Mathematics

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Abstract: The main purpose of this study is to determine the effectiveness of Context Orientated Teaching in Mathematics concerning grade 9 students' performance levels. This study used Solomon's four-group design to assess whether there is an interaction between the treatment and its performance from the pre-test to its performance in the post-test. It shows that both pretested groups established a significant mean gain from pre-test to post-test, such between mean gains showed no significant mean difference. On the other end, performance levels among the four groups showed significant outcomes, which were dominated by the experimental non-pretested group. In other words, Context Orientated Teaching in Mathematics is better than the traditional instructional approach. Context Orientated Teaching showed enough evidence not only of students' interest in mathematics but also a feeling of being part of real-life situations. The best experience of contextualization in learning mathematics is nonetheless the partition of mathematical context as well as mathematical conceptual context. Therefore, Context Orientated Teaching in Mathematics gives necessary skills for the students to be equipped with the strategy on how to start an appropriate solution to real-life problems in a natural way, which keep them within the proximity of both practical and theoretical as far as learning mathematics is a concern.

Keywords: Context Orientated Teaching in Mathematics, Theory of Didactics, Math Performance

1. Introduction

Since time immemorial, it has been documented by historians and men of sciences that man is created with his innate capacity to discern things around him, perceiving that the world will help him in any ways. When man starts to think logically, he feels the weight of the world because of the continuous existence of the problems before him. Thus, he must solve the problem ahead of time before another problem sets in. As a matter of fact, straddling, glancing, and even talking about real problems do not merely help in solving them. It requires a thorough move of any man in letting the problems be opened to any possibilities. By engaging so, this becomes his weapon to keep abreast of the true course of life's test making him appreciates the beauty of real living. The notion behind the dilemma stresses the concept of open real-life situation. Nikos and Stavros [17] asserted that COT model helps students to foresee the improvement of learning development inside the classroom. It means that the teacher can easily identify those students who will be encountered difficulties.

To add up, a study review by John Dossey of Illinois State University during the 14th ICMI Study as cited in the Journal for Research in Mathematics Education [23] reveals the cause and effect of why students receive relatively high grades in their mathematical schoolwork and yet fails to apply their mathematical knowledge and skills in contextual settings they encounter in other studies and in their daily lives. Furthermore, it emphasizes why educators cannot just simply impart mathematical concepts through drill and practice and that drills possibly kill students' interest in learning mathematics particularly 9th grade mathematics. One must think and consider that the situation is different, but the problem is just the same. Henceforth, open problem must be considered at the first instance of the process of learning Mathematics. In other words, giving open problem during the first instance of the learning process towards learners entail creativity, exposure to flexibility, and develop critical thinking in solving problems. The excerpt of these notions will constitute to a practical solution in any other way – the generator of understanding the content of Mathematics such as Context Orientated Teaching. For this reason, as a generator of knowledge, it will give light to students' critical thinking, and problem-solving skills, and boost their interest to provide logical proof in Mathematics and integrating to the real-life situation. In line with this, the little piece of change will optimistically contribute to the mission-vision of DepEd Mathematics Education.

Indeed, it is the core goal of the researcher to find out and test the effectiveness of a Context Orientated Teaching model to Grade 9 students. Furthermore, this study aims to cater the development of the teaching guide and other necessary learning materials that can be of great help to the students, teachers, researchers, and other entities. This study also psychologically targets the students, parents, teachers, school heads, education supervisors, and schools division superintendents in adapting new teaching strategy and unlearning the obsolete ones to be able to maximize the students' academic performance.

2. Literature Review

This study is anchored on the claims of Nikos and Stavros [17] that in mathematics teaching using COT model – learning process is designed for the students to undergo the five Activity Types. Its goals is achieve through didactical theory and pre-formal proof. Along the process, the teacher finds himself comfortable as he/she will be in a position to locate exactly the learning set-up towards the students in which the learners will have a better strategy on how to start solving open problem. Below is figure 1 that shows the schematic diagram of the theoretical-conceptual –framework of this study.

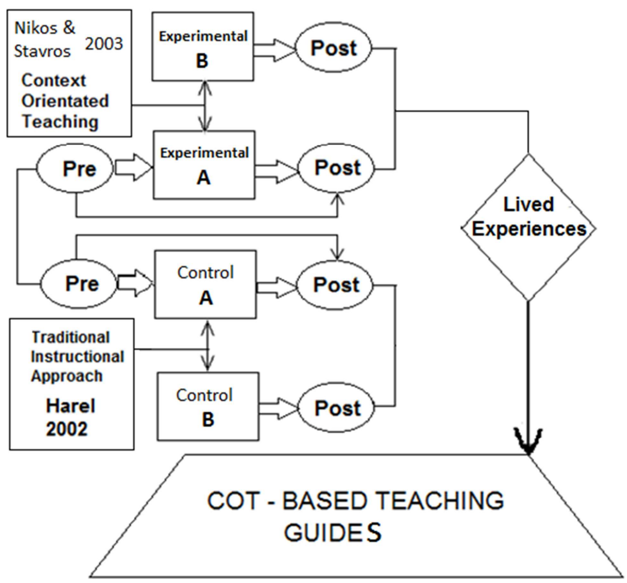

Figure 1. *The Schematic Diagram of the Theoretical Conceptual Framework of the Study.*

Context Orientated Teaching in grade 9 Mathematics is an avenue that describe in the theory of didactics. According to Chevallard [7] and Brousseau [6], they describe didactics as a scientifically and artfully way of teaching. It derives from the Greek word *didaktikos*, which means "skillful at teaching". It also called in *Latin* as docile, disciple, and doctor. In other words, learning acquired by the learners because someone attempts to do so. This means that in mathematics teaching authentic learning happens in the hands of someone who is expert in the delivery and systematic in learning process.

Learning development have two parts. These are the parts of the side of the teacher and the side of the learners. COT in Mathematics as describe by Nikos and Stavros [17] that learning development should have two skeleton of teaching unit – first, it regards about the proof of mathematical conjecture, while the other one shall have to do with the solution of the open real life problem [23]. Proof is the last step of COT's learning process. On the other hand, Context Orientated Proof which is basically in line with Blum's [5] pre-formal proofs considered significance in mathematical learning. There are several reasons why proof is part of the learning context, simply because to have proofs and to be able to prove plays a vital roles in attaining ultimate goals of mathematics eduaction. These two elements is somehow unsepararable to each other [11]. This means that, the best element in real life situation is when learners established proof towards mathematics education.

There are many aspects of real life situation appears to be the most challenging task and that is proving. According to Nikos and Stavros [17], COT in Mathematics education varies directly the principle of epistemology and philosophy in mathematical undertakings. This principle of understanding mathematics relates toward decontextualizations and recontextualizations. This implies that mathematics can't be departed from proof. It means that the most meaningful in learning mathematics must be ended up to the esblishment of proof. It is then suggested in COT model the interconnected steps of the five Activity Types.

Specifically, learning development in COT model comprises of two task and these are the task context and situation context. As what has been cited in Journal for Research in Mathematics Education [23], Nikos and Stavros [17] posited that learning development is divided into two parts – the task context which undertakes by the students and situation context where the students are directed to undergo. This means that, this situational context has regarded towards open problem occurrences, while task context is task given to the learners as they will bound to comply.

Similarly, teaching mathematics is not an easy task it requires didications and excellent in theories of learning. Winslow [21] opined that the didactical terminology brings closely to epistemologically ideas. It implies that mathematics teaching had developed theoretically through didactics. Meaning that teaching mathematics should artfully and systematically imparted to the learners. Therefore, it is obvious that whatever the child has been acquired of will show how much is being transmitted by the teacher. This follows that the child will represent the idea of "live". For Chevallard [7] asserts that "live" is the main position of didactics of mathematics education.

On the other hand, everyday teaching has a common denominator among teaching-learning most especially in mathematics teaching. This means that traditional way of teaching is what we usually do. Traditional teaching as describe by Nikos & Stavros [17] learning development is all manipulated by the teacher and has concentration on students' knowledge rather than making students to think critically. Because of its convenience, it tends to attract teachers and eventually will use this method but unknowingly lessen their skills in mathematics teaching.

In fact, some teachers having used the traditional teaching methods may be also deemed restricted to some degree. Despite of the fact that Friere [14] was strongly opposed to the concept of education whereby knowledge is deposited into the minds of the students by the teachers, conventional teaching is nowadays a common denominator. This kind of monopoly in teaching-learning mathematics usually do "talk and chalk" rather than encouraging them to interact, ask questions, explicit dialogue, or engage them thoroughly. Most of the classes involves rote learning, where students depend on memorization even if they do not understand the mathematical concept. In fact, long lectures and dictations entails less interaction among learners and lead towards behavioral and academic problems. In other words, they have a little opportunity to discover and develop themselves as well as the problems to identify learners' learning difficulties.

Likewise, traditional teaching is concerned with the teacher being the regulator of knowledge. There is only one side of the story wherein all decisions are always bearable in favor of the teacher. These criticisms include: 1.) the winner takes it all while the rest of the students must fail; 2.) it causes negative perceptions among students such as low esteem personality, cheating, selfishness, and even violence [15]. Meaning, this will put mathematics more complicated to learn and eventually becomes unrealistic learning.

The conventional way of teaching mathematics presents the corresponding proof and the appropriate solutions without knowing whether the learners are ready or not. According to Harel [10], teachers who uses traditional instructional approach in dealings with mathematical proof like the presentation of examples and how to go about it. This implies that there is no students-initiated proof towards proving mathematical concepts and theorems [16]. Meaning, mathematical statements and reasons are already given by the teachers.

Whereas COT as a model for teaching mathematics is purely initiated by the learners in giving proof. According to Klaoudatos [13] this must be considered that, modelling must constitute one of the essential components of teaching mathematics in secondary education. This implies that students will realize that mathematics is beneficial and useful because it solves not only an ordinary problem but also an unending real-life problem.

Real-life problems or open problems are what mathematics teaching objectively targeted. It is everyone's goal towards better understanding of the real context of mathematics education nowadays. This is clearly supported by Chevellard [7] that the main issues and concerns of that affect mathematics education nowadays is the proof to establish fact that every child have their own of proving mathematical concept. This implies that no one is the monopoly of knowledge. It has to be understood that every learner is unique and therefore they must be considered at all times. Meaning, everyone has the right to access through engagement, explicit dialogue, and be respected of whatever response he/she is going to establish.

In this light, Context Orientated Teaching in Mathematics (COT-Mathematics) gave the student an ideal position on how to attack real life situations that challenges them in mathematical learning. This will lead the students to make a good move to start a point of direction. In other words, Context Orientated Teaching in Mathematics is a teaching model that offers solution in the process of five Activity Types. These five Activity Types are introduced by "didactical" procedure and follows the idea of "pre-formal proving".

3. Research Methodology

The significance of this model is where the effectiveness of the results thru the process of its learning Activity Types. Nikos and Stavros [17] pointed out the five Activity Types. The first Activity Type is Context Orientated Question (COQ) – contextual problem will be posted using technology which comes from a context familiar to the students. Most likely from mathematics locally known among students. The second Activity Type is Context Orientated Heuristics (COH) – learning at this stage gives clues and enforces other activity types to open difficulties and other vagueness of the learning process. The third Activity Type is Context Orientated Concepts (COC) - At this level of learning process the new mathematical concept is formulated. The fourth Activity Type is Context Orientated Conjectures (COCJ) - this Activity comes very closely to the concept of Pre-formal Proving and essentially argued from COH to establish conjectures. With the help of COH and COQ this will lead to some thoughts and arguments that make a certain statement that drawn out from COQ and COC. So, we have conjectures derives from COQ or COC, whatever may be the case, raised at earlier stages. The last Activity Type is Context Orientated Proofs (COP) - The findings of Activity Type 4 that lead to a COCJ belong to the area of "pre-formal proving". In this level, ideas and arguments that has been drawn out from COCJ, will be translated to mathematical theorems and statements. It is important for those ideas and arguments that lead to the development of COCJ, to be translatable to a (formal) proof. Just to provide a (formal) proof independent from what has been taking place up to now, should be avoided if possible.

This study was conducted to find out the effectiveness of Context Orientated Teaching (COT) to develop open-ended problem-solving skills towards 9^{th} grade learners. This quasi-experimental pre/post-test study had used the Solomon four-group design. This design was used in order to establish significant difference among four groups. Each group had composed of thirty students and were selected randomly into groups of two control and two experimental.

The subjects in each group were from 4 sections of 9th grade level. The control groups had two sections and one of them had undergone pre-test while the other two sections were for the experimental groups and one of them had undergone pre-test. The four groups were undergone post-test. Below is table 1 that shows the experimental design of this study.

3.1. Population and Sample

The subjects and respondents of this study were the 168 9th grade students. The researcher, thru drawing randomly technique, had selected group (A) with 30 students to serve as pre/post-tested experimental group, a group with 30 students to serve as pre/post-tested control group A, while experimental group (B) and control group (B) with both 30 students to serve as post-tested groups. The experimental groups had been taught using Context Orientated Teaching whereas, control groups used traditional teaching approach. Out of 168 9th grade students, only 120 had been the sample of this study.

3.2. Research Instruments

A teacher-made summative test in 9th grade mathematics was utilized as a main instrument of this study. This is a 54-item test that includes variations, the theorems of similarity and its problems including proportion, and the definition of the six trigonometric ratios, exact values of trigonometric ratios involving special angles, diagrams and solutions to real-life problems, the laws of sines and cosines in solving problems involving oblique triangles. The questions were constructed according to Blooms Taxonomy as revised by Anderson and Krathwohl [4]. Before this instrument was tested to the respondents, there was a pilot-testing to grade 10 to ensure its validity and reliability and follows an analysis of the results. To further validate this instrument and its assurance of reliability, the researcher has asked for assistance from the two experts of mathematics educators.

The summative test got reliability coefficient of 0.71 upon computation thru the Kuder – Richardson method 20. This implies that the instrument is highly reliable. By using the formula, its quotient of total number of items and its difference of total number of items and one (1) will be multiplied to the difference of one (1) and the quotient of the sum of the product of population of students who got the correct answers and its population of students who got wrong answer and the square of its standard deviation.

The test questions are congruent to the table of specifications that has been measured accordingly with Bloom's Taxonomy as described by Anderson and Krathwohl [4]. The 54-item test was designed in order to be answered within 60 minutes.

The second instrument that was used by the researcher was a teacher-made questions for the Focus Group Discussion intended for journaling. The unstructured form of interview was implemented among group of 5 students to stress out their feelings, feedbacks, and their experiences during the conduct of Context Orientated Teaching.

The third instrument that was used by the researcher was the COT lesson plans together with the activity sheets that were utilized during teaching – learning process. This was a guide of the researcher in the process of learning towards the experimental groups. Traditional lesson plans were also made as guiding instrument in the process of learning towards the control groups. Each plan has contained the main parts, but COT lesson plan differs from traditional plan in terms of processes and steps of the lessons. COT process is problem-based in open character while the steps followed the 5 Activity Types.

3.3. Data Analysis

The statistical parametric measures intended for data analysis, findings, and interpretations had been logically employed. To determine the pre-test and post-test mathematics performance of the students in terms of their achievement in grade 9 mathematics, such then the z-test. For the improvement of the performance, the t-test of mean gain had been used to find out the improvement of students' performance in teaching grade 9 mathematics. While its significant for mean difference, the t-test of mean difference of the pre/post-test mathematics performance between the pre-test and post-test of experimental A and control A. Likewise, to determine the mean difference among the four groups in their post-test mathematics performance, the F-test using one-way ANOVA had been applied. On the other hand, the lived experiences of students during the conduct of Context Orientated Teaching, thematic analysis were used and utilized Focus Group Discussion (FGD) as qualitative interpretations of the attribute data.

4. Results

Table 1. *The pre-test performance level of the students in experimental group (A) and control group (A).*

Competencies No.	Groups	K	H.M.	A.M.	SD	Computed Z Value	DESC.
	Experimental A	10	5	2.5	1.23	11.12	BA
	Control A			2.1	1.18	17.25	BA
	Experimental A	8	4	2.57	1.12	7.04	BA
	Control A			2.43	1.04	15.69	BA
	Experimental A	14	7	0.7	0.82	42	BA
	Control A			0.4	0.67	51.47	BA
	Experimental A	5	2.5	1.67	0.87	5.25	BA
	Control A			1.83	1.32	5.03	BA

Competencies No.	Groups	K	H.M.	A.M.	SD	Computed Z Value	DESC.
	Experimental A	1	0.5	0.5	0.5	0	A*
	Control A			0.27	0.45	0.704	A*
	Experimental A	2	1	0.27	0.51	7.85	BA
	Control A			0.57	0.63	3.66	BA
	Experimental A	1	0.5	0.27	0.44	2.89	BA
	Control A			0.3	0.47	0.49	A*
	Experimental A	5	2.5	0.87	0.85	10.6	BA
	Control A			0.93	0.98	8.59	BA
	Experimental A	3	1.5	0.4	0.49	12.3	BA
	Control A			0.47	0.63	7.69	BA
	Experimental A	5	2.5	1.04	0.81	9.65	BA
	Control A			0.83	0.95	9.03	BA
TOTALITY	Experimental A	54	27	10.8	2.56	34.66	BA
	Control A			10.13	2.86	45.47	BA

*Significant when t > 1.96 @ 0.05 level of significance (2-tailed); N = 30 not significant when t < 1.96 @ 0.05 level (2-tailed).

Table 2. *The significant difference in the pre-test of students' performance level of mathematics learning between the experimental group (A), and control group (A).*

Competencies No.	Groups	Mean	SD	Computed t-value	Remarks
1.	Experimental A	2.5	1.23	1.285	Accept Ho
	Control A	2.1	1.18		
2.	Experimental A	2.57	1.12	0.502	Accept Ho
	Control A	2.43	1.04		
3.	Experimental A	0.7	0.82	1.552	Accept Ho
	Control A	0.4	0.67		
4.	Experimental A	1.67	0.87	0.554	Accept Ho
	Control A	1.83	1.32		
5.	Experimental A	0.5	0.5	1.873	Accept Ho
	Control A	0.27	0.45		
6.	Experimental A	0.27	0.51	2.027	Accept Ho
	Control A	0.57	0.63		
7.	Experimental A	0.27	0.44	0.255	Accept Ho
	Control A	0.3	0.47		
8.	Experimental A	0.87	0.85	0.253	Accept Ho
	Control A	0.93	0.98		
9.	Experimental A	0.4	0.49	0.480	Accept Ho
	Control A	0.47	0.63		
10.	Experimental A	1.04	0.81	0.921	Accept Ho
	Control A	0.83	0.95		
Totality	Experimental A	10.8	2.56	0.956	Accept Ho
	Control A	10.13	2.86		

Significant when t > 2.042 @ 0.05 level (2-tailed), not significant when t < 2.042 @ 0.05 level (2-tailed), N = 30 for both Experimental and Control group.

Table 3. *The post-test performance level of grade 9 students in mathematics for experimental A and control group A.*

Competency No.	Groups	K	H.M.	A.M.	SD	Z Value	DESC.
1.	Experimental A	10	5	3.93	2.05	2.859	BA
	Control A			4.80	1.99	0.55	A
2.	Experimental A	8	4	2.47	1.59	5.271	BA
	Control A			2.77	1.65	4.083	BA
3.	Experimental A	14	7	1.37	1.94	15.895	BA
	Control A			2.27	1.96	13.218	BA
4.	Experimental A	5	2.5	2.20	1.0	1.643	A
	Control A			2.10	1.37	1.599	A
5.	Experimental A	1	0.5	0.17	0.38	4.757	BA
	Control A			0.40	0.50	1.095	A
6.	Experimental A	2	1	0.60	0.68	3.27	BA
	Control A			0.43	0.57	5.477	BA
7.	Experimental A	1	0.5	0.33	0.48	1.94	A
	Control A			0.33	0.48	1.94	A
8.	Experimental A	5	2.5	1.13	1.32	5.642	BA
	Control A			0.60	0.67	15.532	BA
9.	Experimental A	3	1.5	0.90	0.76	4.324	BA
	Control A			1.07	0.69	3.413	BA

Competency No.	Groups	K	H.M.	A.M.	SD	Z Value	DESC.
10.	Experimental A	5	2.5	1.100	0.71	10.8	BA
	Control A			1.33	1.06	6.046	BA
TOTALITY	Experimental A	54	27	14.20	6.48	10.819	BA
	Control A			16.10	6.74	8.858	BA

Significant when t > 1.96 @ 0.05 level significance (2-tailed), not significant when t < 1.96 @ 0.05 level (2-tailed), N = 30 for both Experimental and Control group.

Table 4. *The post-test performance level of grade 9 students in mathematics for experimental B and control group B.*

Competency No.	Groups	K	H.M.	A.M.	SD	Z-Value	DESC.
1.	Experimental A	10	5	4.47	2.1	1.38	A
	Control A			2.73	1.72	7.23	BA
2.	Experimental A	8	4	3.07	1.7	2.99	BA
	Control A			2.47	1.53	5.48	BA
3.	Experimental A	14	7	2.77	3.78	6.13	BA
	Control A			1.37	2.11	14.7	BA
4.	Experimental A	5	2.5	2.53	1.41	0.12	AA
	Control A			2.27	1.11	1.14	A
5.	Experimental A	1	0.5	0.3	0.47	1.94	A
	Control A			0.33	0.48	1.94	A
6.	Experimental A	2	1	0.63	0.76	2.67	BA
	Control A			0.37	0.56	6.16	BA
7.	Experimental A	1	0.5	0.53	0.51	0.32	AA
	Control A			0.27	0.45	2.8	BA
8.	Experimental A	5	2.5	1.73	1.53	2.76	BA
	Control A			1.03	0.96	8.39	BA
9.	Experimental A	3	1.5	1.13	0.82	2.47	BA
	Control A			0.57	0.68	7.49	BA
10.	Experimental A	5	2.5	1.5	0.97	5.65	BA
	Control A			1.03	0.93	8.66	BA
TOTALITY	Experimental A	54	27	18.67	10.42	4.38	BA
	Control A			12.43	6.04	13.2	BA

Significant when z > 1.96 @ 0.05 level of significance (2-tailed), not significant when z < 1.96 @ 0.05 level (2-tailed), N = 30 for both Experimental and Control group.

Table 5. *The mean gain between the pre-test and post-test in grade 9 mathematics performance of the students in the experimental group (A).*

Competency No.	Test	Mean	SD	Mg	SDg	T-Value	Remarks
1.	Pre test	2.5	1.23	1.43	2.50	3.13	Reject Ho
	Post test	3.93	2.05				
2.	Pre	2.57	1.12	-0.1	1.67	-0.33	Accept Ho
	Post	2.47	1.59				
3.	Pre	0.7	0.82	0.67	2.17	1.69	Accept Ho
	Post	1.37	1.94				
4.	Pre	1.67	0.87	0.53	1.25	2.32	Reject Ho
	Post	2.2	1				
5.	Pre	0.5	0.5	-0.33	0.61	-2.98	Accept Ho
	Post	0.17	0.38				
6.	Pre	0.27	0.51	0.33	0.80	2.25	Reject Ho
	Post	0.6	0.67				
7.	Pre	0.27	0.44	0.06	0.64	0.60	Accept Ho
	Post	0.33	0.48				
8.	Pre	0.87	0.85	0.26	1.36	1.09	Accept Ho
	Post	1.13	1.33				
9.	Pre	0.4	0.49	0.5	0.94	2.92	Reject Ho
	Post	0.9	0.76				
10.	Pre	1.07	0.81	0.03	1.00	0.16	Accept Ho
	Post	1.1	0.71				
TOTALITY	Pre	10.8	2.56	3.4	6.49	2.87	Reject Ho
	Post	14.2	6.48				

*Significant when t > 2.042 @ 0.05 level of significance (2-tailed), not significant when t < 2.042 @ 0.05 level (2-tailed), N = 30.

Table 6. *The mean gain between the pre-test and post-test in grade 9 mathematics performance of the students in the control group (B).*

Competency No.	Test	Mean	SD	Mg	SDg	T-Value	Remarks
1.	Pre test	2.10	1.18	2.70	2.07	7.14	Reject Ho
	Post test	4.80	1.99				
2.	Pre	2.43	1.04	0.34	2.14	0.85	Accept Ho
	Post	2.77	1.65				
3.	Pre	0.40	0.67	1.87	2.11	4.84	Reject Ho
	Post	2.27	1.96				
4.	Pre	1.83	1.32	0.27	1.6	0.92	Accept Ho
	Post	2.10	1.37				
5.	Pre	0.27	0.45	0.13	0.57	1.28	Accept Ho
	Post	0.40	0.5				
6.	Pre	0.57	0.63	-0.14	0.73	-1	Accept Ho
	Post	0.43	0.57				
7.	Pre	0.30	0.47	0.03	0.61	0.3	Accept Ho
	Post	0.33	0.48				
8.	Pre	0.93	0.98	-0.33	1.028	-1.78	Accept Ho
	Post	0.60	0.67				
9.	Pre	0.47	0.63	0.60	1.07	3.071	Reject Ho
	Post	1.07	0.69				
10.	Pre	0.83	0.95	0.50	1.25	2.19	Reject Ho
	Post	1.33	1.06				
TOTALITY	Pre	10.13	2.91	5.97	6.941	4.7087	Reject Ho
	Post	16.10	6.74				

Significant when t > 2.042 @ 0.05 level (2-tailed), not significant when t < 2.042 @ 0.05 level (2-tailed), N = 30.

Table 7. *Significant mean gain difference between the pre-tested experimental and pre-tested control groups' performance.*

Competencies No.	Group	Mean Gain	Mean Difference	t- test	Remarks
1	Experimental A	1.43	-1.27	-1.969	Accept Ho
	Control A	2.70			
2	Experimental A	-0.1	-0.44	-0.851	Accept Ho
	Control A	0.34			
3	Experimental A	0.67	-1.2	-3.194	Accept Ho
	Control A	1.87			
4	Experimental A	0.53	0.26	0.675	Accept Ho
	Control A	0.27			
5	Experimental A	-0.33	-0.46	-2.728	Accept Ho
	Control A	0.13			
6	Experimental A	0.333	0.473	2.249	Reject Ho
	Control A	-0.14			
7	Experimental A	0.06	0.03	0.189	Accept Ho
	Control A	0.03			
8	Experimental A	0.26	0.59	1.833	Accept Ho
	Control A	-0.33			
9	Experimental A	0.5	-0.1	-0.356	Accept Ho
	Control A	0.60			
10	Experimental A	0.03	-0.47	-1.882	Accept Ho
	Control A	0.50			
TOTALITY	Experimental A	3.4	-2.57	-1.637	Accept Ho
	Control A	5.97			

Significant when t > 2.042 @ 0.05 level (2-tailed), not significant when t < 2.042 @ 0.05 level (2-tailed), N = 60.

Table 8. *The significant difference in the post-test of grade 9 mathematics Level of performance of students among the four groups.*

SUMMARY					Tukey Q Test
Groups	Count	Sum	Mean	Variance	
Experimental A	30	426.00	14.20	42.03	1.36
Control A	30	483.00	16.10	45.47	
Experimental B	30	560.00	18.67	108.64	**4.48
Control B	30	373.00	12.43	36.53	

SUMMARY					Tukey Q Test
Groups	**Count**	**Sum**	**Mean**	**Variance**	
ANOVA					
Source of Variation	Sum of Squares (SS)	df	Mean Square (MS)	Computed F	
Between Groups	641.77	3	213.92	3.68	
Within Groups	6,747.53	116	58.17		
FINAL RESULT					
Computed F-ratio	Critical F-value	P-value	Decision	Interpretation	Interpretation
*3.68	2.70	7.4607E-14	Reject Ho	Significant	Significant

Significant when $t > 2.70$ @ 0.05 level (2-tailed), not significant when $t < 2.70$ @ 0.05 level (2-tailed), N = 120.
**Significant when $t > 3.4$ @ 0.05 level (2-tailed), not significant when $t < 3.4$ @ 0.05 level (2-tailed), n = 30.

Table 9. *Students' lived experiences during the conduct of Context Orientated Teaching.*

FOCUS GROUP DISCUSSION			
Guide Questions	**Number of Students**	**Groups**	**Themes**
What are some of positive aspects of learning inside the classroom? What did you feel during the conduct COT? What experiences do you have during the conduct of COT?	86	Experimental A Experimental B	*Ensuring positive thinking and comfort in learning* *Developing independent learners* *Creating logical thinkers and real-life problem solvers*

5. Discussion

Table 1 presents the performance level of pre-tested groups. These were all far behind from the hypothetical mean. It shows that their actual means were significant as below the hypothetical wherein the computed z-values were all greater than the tabled value of 1.96 at 0.05 level. Thus, students' entry of knowledge fell significantly under below average.

Table 2 shows no significant difference among the pre-tested groups were the computed t-values were less than of the tabled value at 0.05 level. This implies that both groups were comparable and has no implication of disadvantages. This relates to the findings of Clarke et al. [8] about cognitive load theory that, instruction needs to be designed in a manner that facilitates the acquisition of knowledge in long-term memory while reducing unnecessary demands on working memory. It implies that, students' acquisition of knowledge has been designed accordingly, and it was scientifically designed of which the selection among each group was done unbiasedly.

Table 3 shows the post-test performance of pre-tested groups and were significantly below average at 0.05 level. This conveys to the findings of such study that, solving mathematical problem does not help students to remember mathematics concepts very well as they didn't do any problem solving in the classroom [19]. It is true that sometimes it makes students to be just recipients of the knowledge hence banking system of teaching rather than problem solving because they are not used to it.

The data in table 4 presents the post-test performance of non-pretested groups. It is evident that the computed z-values of both groups were shown statistically significant under below average. This relates to the findings of Dapueto and Parenti [9] that, there are cases of a complex and discontinuous transition from intuitive of everyday concepts related to "common sense" (the line as a pen stroke, a piece of chord, etc.) to concepts related to a mathematical practice but not rigorously defined and to formal concepts (the line as an equation or systems of equations, or defined vectorially, or defined implicitly by a system of axioms, etc.). This means that, though experimental B had experienced an open problem and real-life situation, their skills from it does not follow in learning mathematics rigorously by some of the learners.

Another finding is supported by Smith [22] and posits, students' cultural backgrounds differ and can affect students' influences to study mathematics [19]. In the same way, factors such as cultural celebrations like fiesta especially involving a group of many students can lessen the focus among the learners in learning mathematics. But the knowledge that the groups obtained is not necessarily significant as far as standard measure is concern. But experiencing mathematics realistically to solve, think, operate, work and motivated is more than standard measurement. In other words, COT model really help students to be logical thinkers and real-life problem solvers.

The data in table 5 presents the mean gain between the pre-test and post-test of experimental group and found it significant. It shows that, the mean gain had corresponding increased and showed significantly that there was an improvement of class performance during post-test as compared to their pre-test. It follows that the hypothesis of no mean gain was rejected @ 0.05 level of significance. It implies that, the students had significantly improved their learning. This validates the claim of Nikos and Stavros [17] and further validated the theory of learning called didactic. This context is described as a problem to solve, but the usual "didactical" meaning of problem solving can run down the complexity of the interests of the various "solvers" involved in a real modelling activity [5]. It means that as far as the validation of COT notion is concern, the most meaningful things happen was the creation of new generation of critical thinkers and problem solvers.

The data in table 6 presents the mean gain between the pre-test and post-test of control group. The findings is significant. It shows that the pre-tested control group got enough mean gain to establish statistically significant difference between the pre-test and the post-test. This implies that there was an enough improvement of class performance during post-test as compared from their pre-test. This relates to the findings of Gagnon and Maccini [18] that direct instruction has more reaching effect on students' achievement especially in algebraic concepts and skills for those students having a difficulty in learning mathematics. Not all lessons in algebra maybe taught and learned effectively through cooperative learning. Absorption of knowledge towards conventional way of learning process may enhance performance since learners are used as they encountered it on their daily studies. It means that, it is easy for the students to learn because most of their classes had used and practiced such kind of instruction.

The data in table 7 presents the difference of means that gains from each pre-tested group. It shows that there was no significant mean gain difference between these pre-tested groups at 0.05 level. So, both groups had improved their learning whether exposed to context orientated teaching or not. This relates to the findings of Adams [1-3] that, with real-life context, students have the potential to develop students' critical mathematical thinking (CMT) in which COT is using and has instituted enough evidence to support that mathematics classroom is a complex environment [12, 20].

Table 8 presents the significant difference among the four groups in their performance level of learning mathematics. It also represents whether Context Orientated Teaching is effective compared to the traditional way of teaching. It shows that, there was significant difference of students' performance in the four groups at 0.05 level. Hence, the hypothesis, "there is significant difference in the post-test of students' performance level of mathematics learning among the four groups" was accepted. This was due to the fact that at least the computed F-value (ANOVA) was greater than the tabled value (Critical value) though p-value of 7.4607E-14 was less than the value of 0.05 (level of significance). Thus, there were at least two groups that differ to each other as far as their performance level is concern. It was suggested that, there were at least two groups that differ to each other as far as their performance level is concern.

In the summary of means among the four groups, non-pretested experimental group obtained the highest mean and variance while pretested experimental and control group got a means and variances that were close to each other. Whereas non-pretested control B got the lowest mean and got the highest variance next to non-pretested experimental group. These groups were all in the position of below average, but it does not necessarily mean that all of them (Students) belong to below average. This was due to the result of its variances. This is also supported by its coefficient of variation. It implies that some of the students in each group were above average most especially in non-pretested experimental group. It means that the greater the variance the greater in its variability. The pre-test given to pre-tested experimental group does not give enough advantage to gain something out from non-pretested experimental group. On the other hand, despite a pre-test given to pre-tested control group, it does not affect at all towards non-pretested control group.

Tukeys Honestly Significant Difference (HSD) Post Hoc results showed that, there was a significant difference between non-pretested groups since the computed Tukeys Q test value was greater than the tabled value at 0.05 level. Experimental group perform better than control group since, the mean of non-pretested experimental group is higher than the non-pretested control group. Thus, comparison among the four groups were validly selected. Nevertheless, this validates the claim of Nikos and Stavros [17]. It means that COT is effective, and their claim establishes evident that the model of teaching – Context Orientated Teaching provides the students a tool to help them organize their thoughts and gives the teacher a better position to locate in which stage and difficulties each student had encountered [17].

On the other end, table 9 shows the lived experiences of the students as they were exposed to Context Orientated Teaching during the conduct of the experiment, the Focus Group Discussions (FGD) were used. There were 86 students that came from the two sections of experimental groups – pretested and non-pretested. A group of 5 students in every batch to stress out their feelings, feedback, and their experiences during the conduct of Context Orientated Teaching. The following themes were recorded: 1. Ensuring positive thinking and comfort in learning, 2. Developing independent learners, and 3. Creating logical thinkers and real-life problem solvers.

It shows a converse statement of other studies that the students receive relatively high grades in their schoolwork and yet fails to apply their knowledge and skills in contextual settings they have encountered in other discipline and in their daily lives [23].

It is in this light that Context Orientated Teaching in Mathematics offers a variety of learning styles. These different kinds of learning styles can be accommodated in different context of learning in mathematics. The contextualized learning process is somehow a natural process that the best taste of learning will be made possible.

6. Conclusion

Context Orientated Teaching showed enough evidence not only to students' interest towards mathematics but also a feeling of being part of the real-life situations. The best experience of contextualization in learning Mathematics is real-life context to open problem context and eventually in the context of mathematical concepts. Therefore, COT gives necessary skills for the students to be equipped with a strategy on how to start an appropriate solution towards real-life problems in a natural way. It also gives the teacher a tool a realistic one to have learning process better understanding the concepts. This mathematical contextualized approach is another avenue of learning environment in keeping the students within the proximity of practical and theoretical as far as learning mathematics is concern.

7. Recommendations

It is in this light that after the thorough findings and conclusions, these are the following recommendations:

Teaching and non-teaching personnel who are concern with learning outcomes and experiences of students are encouraged to put into consideration that in learning Mathematics, it is always best for the learners to adapt a learning process thru the five steps of learning mathematics the way COT delivered.

Higher authorities in the bureau of education may find someone who is able to teach using this model of teaching.

Further studies may be conducted most likely to non-night high school respondents using Context Orientated Teaching strategy in learning mathematics.

Seminars and in-service training may be recommended in order to give ample time in the familiarity of this approach – Context Orientated Teaching and make use of technology and abreast the trends of new computer generation.

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