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The Influence of Bridging the Knowing-Doing Gap through the Zone of Generativity on Pupils' Achievement, Retention and Anxiety towards Mathematics

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ABSTRACT

This study reports the influence of teaching mathematics in bridging the knowing-doing gap through the zone of generativity on pupils' achievement and retention score of Grade VI Mathematics as well as their anxiety towards Mathematics. It utilized a pretest-posttest quasi-experimental control group design to gather the data. This study was conducted at Claveria Central School in Claveria, Misamis Oriental among grade six pupils. The analysis of covariance was used to analyze the data collected because the participants were intact classes devoid of randomization. Results revealed that the pupils exposed to the method that bridge the gap of learning and doing through the zone of generativity have better achievement and retention score than those exposed to lecture method with groupings in the classroom. Those exposed through the zone of generativity with immediate application of the concept has lessen mathematics anxiety after the treatment. The researcher inferred that bridging the knowing-doing gap through the zone of generativity is an effective teaching method in improving pupils achievement and retention and in reducing mathematics anxiety of pupils.

Keywords: Connect, concept, immediate application

INTRODUCTION

Most Mathematics teachers have problems with their pupils due to their negative perception about mathematics. They do not enjoy the subject for they feel it is boring and has thought that mathematics has no importance in their life in the future. They think that it is a difficult subject, not useful to them and they do not believe that they can learn mathematics. Since pupils lack interest, this situation became a problem to mathematics educators because pupils get very low score in national assessment. One of the causes of lack of interest is may be due to lack of application of the knowledge in real life. Pupils are more focus on knowing the terms and process to make them ready for national assessment but no conceptual understanding.

Educators are tasked to prepare all pupils to compete globally in the world that relies heavily on using Mathematics with confidence. Learning standards can be raised only if there are changes that will have direct effect on pupils in the classroom. The driving force behind these changes is dissatisfaction with the declining mathematics achievement. Some of the position taken that resulted to poor mathematics achievement is the method of instruction of the teacher and the relevance of teaching methods and materials. Teachers need to consider approaches to teaching mathematics that can help reduce if not, eliminate, pupils mathematics anxiety and development of retention.

Ball (2012) said that the teachers need the power to close the gap of knowing – doing in education. She referred this as the Zone of Generativity. To know is not enough which is true in teaching mathematics. It is not enough that the pupils will know the concept, but also have to use what they know and become flexible in using the concept in future problems. Mathematics teachers need to close the knowing – doing gap in teaching mathematics. They can let the pupils learn mathematics not just for the sake of learning, but also to let them realize that it is very useful and can be applied in their daily life. Pupils will learn to love mathematics if it is experienced with joy and fun which may improve their mathematics performance and retention level.

As a response to the present needs of mathematics pupils for higher mathematics performance the researcher finds interest in making a study of Bridging the Knowing-Doing gap through the Zone Generativity to determine if it will affect pupils' mathematics achievement.

FRAMEWORK

Teaching involves ecology of classroom practice for learning that is engaging students to make immediate application of concept so that they will experience the worth of knowledge. Teachers at all levels struggle to make formal education a precursor to life – long learning.

The concept of this study is based in the idea of the Law of Learning by Doing by Bruner (1966) and Dewey (1902), which explains that in doing, learning takes place. It also used the Law of Exercise and the Law of Use by(Thorndike,1931). The Law of Use asserts that the more frequent a modified connection between a situation and respond is used, the stronger is the connection and there is more retention. It further use the Law of Frequency (Gregorio, 1960), which states that the more often responses are taking place, the next time the individual is in a situation recalling for the concept, it is easy because it is connected with event.

As the institution endlessly offer quality education,innovating instruction, practice and enhancing graduates performance serve up as an input for professional development (Pachejo *et al.*, 2013).

Teachers need to do review their mathematics interventions in order to equip with useful,evidence-supported information about the merit of a variety of educational practices (Cheung *et al.*, 2011).

Constructivism upholds a more open-minded learning experience based on individuals' experience (Edgar, 2012). This type of learning is not easily evaluated, nor is the result the same for every learner because constructivism sees every learner as different based on his experiences. Constructivism promotes construction of knowledge by the learners themselves. Educational constructivism has been categorized into personal, social and philosophical constructivism. Personal constructivism considers all knowledge to be personally constructed. Social constructivism believes that all knowledge is transactional and socially constructed. Philosophical constructivism states that there are no assumptions about the nature of knowledge. Learners need to immerse themselves in activities of learning for personal meaning to occur.

This study also made use of the "Theory of Performance" espoused by Elger (2011) which states that performance can develop and relate concepts to form a framework that can be used to explain results. This means that performing a process can start an understanding of the concepts appropriately applied to reality.

Allen (2012), in her study on the keys to successful group work, stated that teenagers need to talk about mathematics and need to justify their thinking. This can only be achieved if they were given an opportunity to have discourse through cooperative groupings.

Peer assissted learning and formative data-sharing with students produced moderate to large effects in low- achieving students(Hanover Research,2014). Techniques is considered as systematic and explicit when teacher demonstrated a specific strategy for tackling a problem, which students then used in independent work.

Lessons which are composed of a review session,a small group, problem – based exercises followed by individual learning activities has a positive effects in Math achievement on students (enVision MATH, 2012).

When early elementary math teachers ask students to explain their problem-solving strategies and then tailor instruction to address specific gaps in their understanding, students learn significantly more than those taught using a more traditional approach (Edmonds, 2013). This was the conclusion of a yearlong study of nearly 5,000 kindergarten and first-grade students conducted by researchers at Florida State University.

This model is also anchored on the theories of cooperative learning in which the pupils will be doing the actual implementation of the concept by group. Hence, the study will use the theory of the Zone of Proximal Development (Vygotsky, 1978). This theory asserts that the pupils learn more in a group of elders and friends in the learning process. There is learning potential in peer groups where pupils have incomplete idea but relatively equal expertise, each member possessing some knowledge and skills but requiring more knowledegable others to contribute in order to make progress. These allow the pupils to get involve and do active part in the group.

OBJECTIVES OF THE STUDY

The objectives of this study were: (1) to determine the pupils' pretest and posttest scores in the achievement test ,mathematics anxiety and retention test; (2) to compare pupils' Mathematics achievement and retention score as influenced by bridging the knowing-doing gap through the Zone of Generativity and Lecture Method with Groupings; and (3) to compare pupils' test anxiety score as influenced by the two methods of teaching.

METHODOLOGY

The study was undertaken using a quasi-experimental pretest-posttest control group design. This involved two randomly chosen intact section of pupils, one was randomly assigned as control group and the other as the experimental group. The experimental group was exposed to activities bridging the knowing-doing gap through the to zone of generativity while the control group exposed to lecture method with groupings.

This study used two instruments to gather the data. A 20-item teacher-made achievement test covering selected topics of the third and fourth grading period: rate, base, percentage, integers, area, circumference, perimeter and volume with a reliability coefficient of 0.68 was used to measure the pupils' achivement and retention level. A self-test for mathemtics anxiety was used to detemine the profile of the pupils' anxiety towards mathematics.

On the first day of week 1, pretest was given to the two groups. These tests were the 20-item teacher-made achievement test and self-test for mathemetics anxiety. On the second day of week 1 until the last day of week 8 was the whole duration of the experimental period.

On the ninth week, when all the topics included in the study have been discussed, posttest was given. These were the teacher-made achievement test and self-test for mathematics anxiety which were given to the two groups. On the tenth week, there were classes on the next topic to finish the remaining lessons in the fourth grading period but no longer included in the study. On the eleventh week, retention test was given to the two groups using the teacher-made achievement test.

The data gathered in the pretest-posttest achievement test, anxiety and retention were analyzed using ANCOVA.

RESULTS AND DISCUSSION

Table 1. Mean and Standard Deviation of the Pretest and Posttest Scores of the Achievement Test in Mathematics VI

	Experimental Group		Control Group	
	X	Y	X	Y
Mean	**4.07**	**16.28**	**4.75**	**11.96**
SD	**1.56**	**1.51**	**1.58**	**2. 12**

X- Pretest Y- Posttest

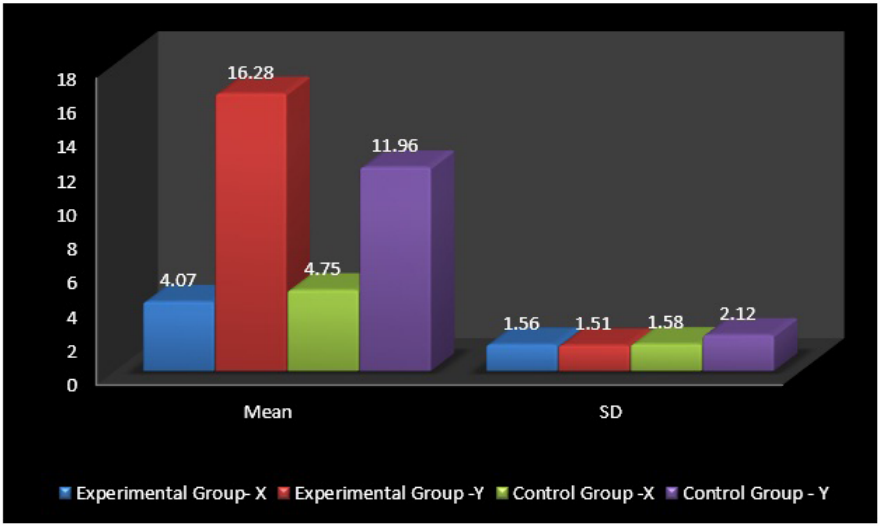

Figure 1. Graph Showing the Mean Score and Standard Deviation of the Experimental Group and Control Group, where X Means Pretest and Y Means Post Test

Table 1and Figure 1 show the mean and the standard deviation of pretest (X) and posttest (Y) scores on the Mathematics Achievement Test. In the pretest, the mean of the experimental group, which was taught by bridging the knowing-doing gap through zone of generativity using immediate application of the concept in real life situation is 4.07, while those in the control group which was using lecture method with groupings is 4.75. The results revealed that the pupils in the two groups had a limited knowledge of the concepts on selected topics on third grading period and fourth grading period since the test is consisted of 20 items. The control group is a little higher than the experimental group.

After the administration of the treatment, the experimental group had a mean of 16.28 and 11.96 for the control group. This indicates the experimental group got eighty one percent (81%) out of the 20-item achievement test, while control group got only sixty percent (60%). This implies that the teaching using zone of generativity had the a favorable effect on the achievement of the pupils in selected topics of third and fourth grading period. pretest and posttest. In the pretest, the experimental group had a standard deviation of 1.56 while the control As to variability of the achievement scores, the same table shows the standard

deviation of the group had 1.58. This indicates that the scores of control group have a wider spread than the experimental group. However, in the posttest, the variability of the scores in the experimental group becomes closer, while in the control group the scores become wider in spread. The experimental group had a standard deviation of 1.51 while the control group had 2.12. This result revealed that experimental group which is exposed to the zone of generativity have all increased their score which are closer to each other while in the control group some are high but some are low. It means that after the treatment, the scores of the experimental group were more homogeneous compared to the control group.

Table 2. Summary Table of One-Way ANCOVA Equal n's of Achievement Scores

Sources of Variations	Adjusted Sum of Squares	df Squares	Mean	F Computed Prob
Treatment Between	250.65	1	250.65	72.74 0.00
Error Within	182.64	53	3.45	
Total	433.29	54		

Table 2 shows the one-way Analysis of Covariance of pupils' achievement scores. The analysis yielded an F-ratio of 72.74 and a probability value is 0.000 lesser than the 0.05 level of significance. Thus, the null hypothesis is not accepted which means that there is significant difference in the pupils' performance. This implies that the experimental group of pupils exposed to the zone of generativity has significantly improved mathematics achievement compared to those exposed to lecture method with groupings. This means that the posttest mean of 16.28 of the experimental group is significantly higher than the posttest mean of 11.96 of the control group, which implies that bridging the knowing-doing gap through the zone of generativity is a better process of teaching than the lecture method with groupings in improving pupils mathematics achievement in classroom devoid of reality.

Table 3. Mean and Standard Deviation of Pupils' Math Anxiety

	Experimental Group		Control Group	
	X	Y	X	Y
Mean	4.25	1.13	4.16	1.59
SD	0.36	0.23	0.36	0.22

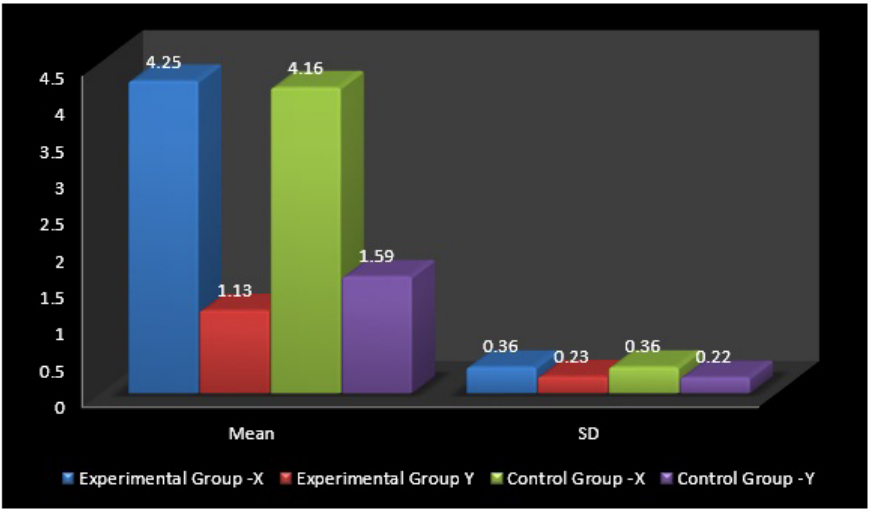

Figure 2. Graph Showing the Mean and Standard Deviation of Anxiety Score in the Experimental Group and Control Group, where X Stands for the Pretest and Y Stands for the Post Test

The mean and standard deviation of the pupils' scores in mathematics anxiety are shown in the table 3. The pretest mean scores of both groups is between 3.5 to 4.49, which means both groups shows almost the same mean scores before the treatment, which are both interpreted as with great amount of anxiousness at the start of the study. While in the posttest, the experimental group got 1.13 and the control group got 1.59. The posttest mean score of both group had decreased but the experimental group got a bigger decrease of the mean score by 3.12. After the treatment, it it can be inferred that the experimental group resulted to a greater reduction of the mathematics anxiety score. Thus, experimental group's mean is

better the range of 1.00 – 1.49, this means that the pupils have no more feelings of anxiousness after the treatment. While the control group's mean is between 1.5 – 2.49, meaning the pupils feel less anxious after the treatment. This indicates that promoting immediate application of the concept by groups had contributed to the reduction of pupils mathematical anxiety. To determine there if there is significant effects of bridging the knowing-doing gap of the zone of generativity on pupil's mathematical anxiety, the ANCOVA is used.

The pretest standard deviation of the experimental group and control group are comparable. This suggests that pupils in the experiment group and the control group have the same feelings or level of anxiety towards mathematics before the treatment. However, in the posttest, the difference in the standard deviation is only 0.01 indicating that the pupils are homogeneous in their feelings towards mathematics.

Table 4. Summary Table of One-Way ANCOVA Equal n's of Pupils' Math Anxiety

Sources of Variations	Adjusted Sum of Squares	df Squares	Mean	F Computed	Prob
Trearment Between	2.8816	1	2.8816	57. 13	0.00
Error Within	2.6731	53	0.0504		
Total	5.5547	54			

Table 4 shows the summary of the analysis of covariance of pretest and posttest means of the experimental and control groups mathematics anxiety. The analysis yielded a computed F-ratio is 57.13 with a probability value is 0.000 lesser than the 0.05 level of significance. This result led to the rejection of null hypothesis. This implies that the experimental group of pupils exposed to the zone of generativity has significantly reduced mathematics anxiety than those exposed in lecture method with groupings. This means that the posttest mean of 1.13 of the experimental group is significantly lower than the posttest mean of 1.59 of the control group, which means that exposing pupils immediately to the reality of life in zone of generativity is a better method of teaching than the lecture method with groupings. This implies that immediate application of the concept has better power to reduce pupils' mathematics anxiety. This is due to the fact that when pupils had the opportunity to express their ideas which will

be incorporated into learning activities and experience and they may have more positive attitude towards learning.

Table 5. Mean and Standard Deviation of the Post Test and Retention Test in Mathematics VI

	Experimental Group		Control Group	
	Post Test	Retention Test	Post Test	Retention
Mean	16.28	13.43	11.96	7.68
SD	1.56	2.62	2.12	3.71

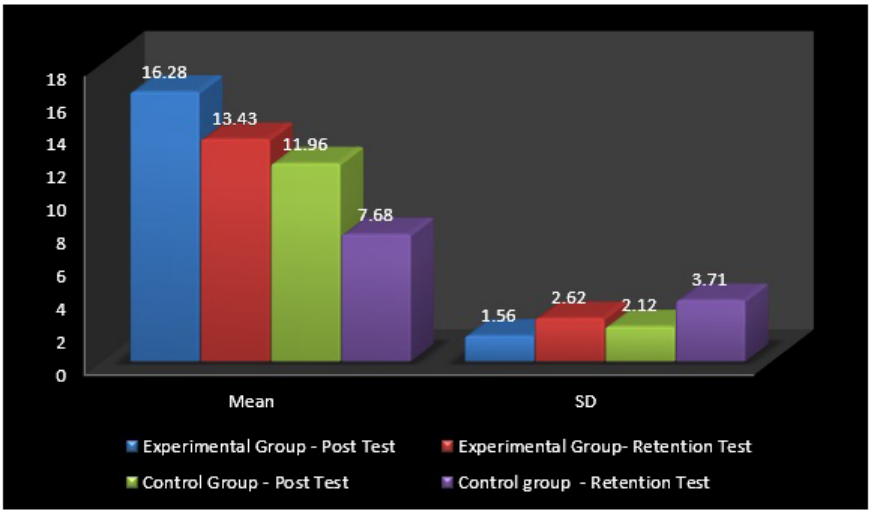

Figure 3. Graph Showing the Mean Score and Standard Deviation of the Post Test and Retention Test of the Experimental Group and Control Group

Table 5 and Figure 3 show the mean and the standard deviation of pupils' posttest and retention test scores. In the posttest, the mean score of the experimental group, which was taught by bridging the knowing-doing gap through zone of generativity using immediate application of the concept in real life situation is 16.28, while those in the control group which was using lecture method with groupings is 11.96. The results revealed that the pupils in the experimental group

got higher mean score than the control group. This indicates the experimental group got eighty one percent (81%) out of the 20-item achievement test, while the control group only sixty percent (60%). This implies that the teaching using zone of generativity had a favorable effect in the achievement of the pupils in selected topics of the third and fourth grading period.

After two weeks, the retention mean score of the experimental group is 13.43 while the control group got only 7.68 mean score. The pupils' retention score in the experimental group is higher than the control group by 5.75. The table revealed that the pupils exposure to zone of generativity got the higher retention mean score than the control group.

As to variability of the scores in the posttest and retention test, the same table shows the standard dviation. The experimental group had a standard deviation of 1.51 while the control group had 2. 12. This indicates that the score of the control group have wider spread than the experimental group. However, in the retention test, the variability of the scores in both group became wider in spread. The experimental group had a standard deviation of 2.62 while the control group had 3.71. This result revealed that the control group have a wider spread than the experimental group. It means that, after two weeks, the retention score of the experimental group were more homogeneous compared to the control group.

After the administration of the treatment, the experimental group had a mean of 16.28 and 11.96 for the control group. This indicates the experimental group got eighty one percent (81%) out of the 20-item achievement test, while control group got only sixty percent (60%). This implies that the teaching using zone of generativity had the a favorable effect on the achievement of the pupils in selected topics of third and fourth grading period.

As to variability of the achievement scores, the same table shows the standard deviation of the pretest and posttest. In the pretest, the experimental group had a standard deviation of 1.56 while the control group had 1.58. This indicates that the scores of control group have a wider spread than the experimental group. However, in the posttest, the variability of the scores in the experimental group becomes closer, while in the control group the scores become wider in spread. The experimental group had a standard deviation of 1.51 while the control group had 2.12. This result revealed that experimental group which is exposed to the zone of generativity have all increased their score which are closer to each other while in the control group some are high but some are low.

Table 6. Summary Table of one-way ANCOVA Equal n's of Post Test Scores and Retention Scores

Sources of Variations	Adjusted Sum of Squares	df Squares	Mean	FComputed	Prob
Treatment Between	184.38	1	84.38	8.59	0.005
Error Within	520.83	53	9.83		
Total	605.21	54			

Table 6 shows the one-way Analysis of Covariance of pupils' posttest scores and retention scores. The analysis yielded an F-ratio of 8.59 and a probability value is 0.005 lesser than the 0.05 level of significance. Thus, the null hypothesis is not accepted which means that there is significant difference in the pupils' performance. This implies that the experimental group of pupils exposed to the zone of generativity has significantly improved retention level compared to those exposed to lecture method with groupings. This means that the retention test mean of 13.43 is significantly higher than the retention test mean of 7.68 of the control group, which implies that bridging the knowing-doing gap through the zone of generativity is a better process of teaching than the lecture method with groupings in enhancing pupils' retention on the lessons learned in Mathematics VI. This finding imply that mathematics can be best learned or remembered if there are activities associated in every topic if possible.

CONCLUSIONS

Based on the findings of the study, it can be inferred that pupils have increased their mathematics achievement, a decrease in the mathematics anxiety and an improvement in their level of retention of the lessons learned. These indicate that the teaching method had contributed to the reduction of the pupils mathematical anxiety of the experimental group. Thus, bridging the knowing-doing gap through zone of generativity as a teaching method in Mathematics VI has exhibited a positive influence on pupils' achievement, has reduced pupils mathematics anxiety and has enhanced pupils retention on the lessons discussed.

RECOMMENDATIONS

1. Sustain the use of bridging the knowing-doing gap using zone of generativity as a teaching method.

2. Teachers may use immediate real life application of concepts and process through the zone of generativity.

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