Learners' Engagement and Achievement Through Localized Whole Brain Teaching Strategy

John Ritchie V. Reyes[1], and Victoria E. Tamban[2]

[1]Lumil National High School, Department of Education, Silang, Cavite Province, Philippines

[2]Laguna State Polytechnic University, Los Baños, Laguna, Philippines

Email: [1]itsolspulb@gmail.com and [2]victoria.tamban@lspu.edu.ph

***Abstract*—** The study aimed to determine the effectiveness of Whole Brain Teaching Strategy in improving the classroom engagement and achievement of learners in Mathematics 7. This used a quasi-experimental research design in which the groups answered pre-survey and post-survey, pre-test and post-test, and including formative tests in between. The comparison group was taught using conventional teaching method while the experimental group was taught using the WBT strategy. They had the same level of engagement and achievement before the study was conducted. There was significant improvement in comparisons' cognitive engagement while the experimental group improved in all dimensions of classroom engagement after the execution of the two teaching methods. They differed significantly in terms of cognitive classroom engagement with medium effect size. Meanwhile, the two groups showed significant improvements in achievement in Mathematics 7. However, there was no significant difference in their level of achievement as reflected in most of their formative tests and the post test. Moreover, both strategies produced significant relationship between engagement and achievement in which the behavioral engagement of the experimental group had moderate positive correlation to achievement. These imply that Whole Brain Teaching Strategy is more effective in enhancing classroom engagement but as just effective in increasing learners' achievement in Mathematics compared to conventional method.

***Keywords*—** achievement, engagement, mathematics, whole brain teaching strategy.

INTRODUCTION

Mathematics is a significant subject that has practical applications in everyday lives. Nevertheless, several countries perceived Mathematics as a difficult subject and hard to understand (Klinek, 2009). This requires more mental abilities of different concepts compared to other subjects (Noureen, Awan, and Fatima, 2017). Thus, many students often perform poorly in Math.

Teachers were identified as a factor that led to students' poor performance (Andaya, 2014). Hence, teachers are responsible to lead students to true learning (Noddings, 2007) including Mathematics. Teachers should deliver content through teaching strategies that can increase students' learning (Coyne, Kame'enui & Carnine, 2007, as cited in Olibie, 2013). Teaching strategies are organized and systematic ways of delivering lessons to attain specific aims. Appropriate teaching strategies are needed for effective instruction (Mojares, 2016).

Brain-based researches pointed a new concept that could help students to acquire higher levels of learning and greater academic achievement (Darling-Hammond, 2007, as cited in Richardson, 2011). Advocates of Brain Based Learning have concluded that it is effective in producing long term learning (Duman, 2006; Tufekci & Demirel, 2009).

Whole Brain Teaching (WBT) strategy is gaining popularity in America (Wolken, 2017), and this is anchored in Brain Based Learning. This strategy is focused in the students' learning (Biffle, 2013). This aims to maximize students' involvement by activating the whole brain in learning (Stearns, 2016) and is patterned cooperative learning principles (Alford, 2014).

Whole Brain Teaching provides activities that involve different parts of the brain. This uses techniques which incorporates gestures and sounds to stimulate the learner to think and to learn (Sontillano, 2018). This is composed of seven core teaching techniques known as the Big Seven which include Class-Yes, Five Classroom Rules, Teach – Okay, Switch, Scoreboard, Hands and Eyes, and Mirror. People who support WBT acknowledge that these classroom techniques help increase the students' academic performance, engagement and motivation (Biffle, 2013).

Mathematics is a complex subject; thus, Filipino Math teachers often resort in conventional method such as demonstration and lecture methods. This study aimed to know if there is a significant difference in the grade 7 learners' engagement and achievement in Mathematics who were taught in conventional method and those who were taught using the WBT.

This study aimed to determine the effect of Localized Whole Brain Teaching (WBT) strategy on learners' engagement and achievement in Mathematics 7 in a particular high school in Silang, Cavite.

The specific objectives are to determine the level of learners' engagement as reflected in the pre-survey and post-survey mean scores in terms of their affective or emotional engagement, behavioral engagement, and cognitive engagement and to determine the achievement level as reflected in the mean scores in terms of learners' pre-test, formative test, and post test.It also aimed to depicts significant difference between the mean scores of the comparison and the experimental groups as well as the significant relationships between classroom engagement and achievement of comparison group and experimental group.

MATERIALS AND METHODS

The research design used in this study is quasi-experimental research design, specifically, pretest-posttest design with a comparison group. A quasi-experiment is used to measure the casual effect of an alternative treatment or solution on identified subjects. The grade 7 learners were purposively selected as the respondents because the researcher was teaching in this grade level. There were five heterogeneous sections; however, only two of these were subjected for the study. Then, the fishbowl method was used to determine which sections would represent the comparison group and the experimental group. Additionally, to increase the probability that the comparison and the experimental groups were of equal performance prior to the conduct of the study, the participants of the experimental group were matched pair in the participants of the comparison group. The match pairing was based on the result of the pre-test results. The t-test of independent mean was also used to verify if the two groups are of equal prior knowledge.

Student Engagement in Schools Questionnaires (SESQ)

The survey questionnaire was adapted from the study entitled "The Student Engagement in Schools Questionnaire (SESQ) and the Teacher Engagement Report Form-New (TERF-N): Examining the Preliminary Evidence" by Hart, Stewart, and Emerson (2011). This was composed of three parts namely affective or emotional, behavioral, and cognitive engagement. Parts I and II were composed of eight (8) statements each regarding the learners' affective or emotional and behavioral engagement. While Part III was composed of twelve statements (12) pertaining to the learners' cognitive engagement. The respondents rated themselves in these three dimensions of engagement. The following were some of the sample statements. The collected data were subjected to statistical analysis using the following statistical tools.

Mean was used to describe the level of learners' engagement. Mean, standard deviation and mean percentage score were used to describe the level of learners' achievement in terms of pre-test and posttest, Mean and MPS were used to describe the level of learners' achievement in terms of formative tests.

T-test for independent means was used to make inferences about the significant difference between the pre-survey mean scores, the significant difference between the pre-test mean scores, the significant difference between the post-survey mean scores, and the significant difference between the posttest mean scores of the experimental and comparison groups.

T-test for independent means was used to conclude regarding the significant improvement of the comparison and experimental groups in terms of classroom engagement and achievement in Mathematics 7.Cohen's d was used to determine the effect size of the of a certain treatment in a particular group.Pearson r was used to find if there would be a significant relationship and the level of correlation between the learners' classroom engagement and achievement in Mathematics 7 after the two groups were exposed to two different teaching strategies.

RESULTS AND DISCUSSION

Table 1 shows the mean scores and corresponding descriptions of learners' classroom engagement in Mathematics before the study was conducted based on the pre-survey results.

Table 1: *Mean Scores and Descriptions of Learners' Engagement in Pre-Survey*

Survey	Engagement	Mean	SD
Comparison	Affective	3.94	0.81
	Behavioral	3.81	0.78
	Cognitive	3.47	0.67
Experimental	Affective	4.00	0.76
	Behavioral	3.95	0.80
	Cognitive	3.80	0.74

Legend: 4.50 – 5.00 - Very High Engagement

3.50 – 4.49 - High Engagement
2.50 – 3.49 - Neutral Engagement
1.50 – 2.49 - Low Engagement
1.00 – 1.49 - Very Low Engagement

This shows that the comparison group got a mean score of 3.94 (SD = 0.81) in affective engagement and 3.81 (SD = 0.78) in behavioral engagement, which were both interpreted as high engagement; while its cognitive engagement was 3.47 (SD = 0.67) which was described as neutral engagement. On the other hand, the experiment group got a mean score of 4.00 (SD = 0.76) in affective engagement, 3.95 (SD = 0.80) in behavioral engagement, and 3.80 (SD = 0.74) in cognitive engagement which were all described as high engagement. It was also observable that the experimental group had more spread pre-survey scores compared to the comparison group in terms of behavioral, and cognitive engagements; while the latter group had a more variable pre-survey score when it came to affective engagement.

Table 2 shows the mean scores and the level of learners' classroom engagement in Mathematics 7 after the two treatments were executed based on the post-survey results.

Table 2: *Mean Scores and Descriptions of Learners' Engagement in Post-Survey*

Survey	**Engagement**	**Mean**	**SD**
Comparison	Affective	4.05	0.67
	Behavioral	3.99	0.64
	Cognitive	3.64	0.56
Experimental	Affective	4.26	0.61
	Behavioral	4.18	0.50
	Cognitive	4.05	0.55

Legend: 4.50 – 5.00 - Very High Engagement
3.50 – 4.49 - High Engagement
2.50 – 3.49 - Neutral Engagement
1.50 – 2.49 - Low Engagement
1.00 – 1.49 - Very Low Engagement

This reveals that the mean score of the comparison group in affective engagement is 4.05 (SD = 0.67), in behavioral engagement is 3.99 (SD = 0.64), and in cognitive engagement is 3.64 (SD = 0.56). These are all classified as high level of engagement. Meanwhile, the experimental group got the mean scores of 4.26 (SD = 0.61) in affective engagement, 4.18 (SD = 0.50) in behavioral engagement, and 4.05 (SD = 0.55) in cognitive engagement. This group has a high level of engagement in all dimensions of classroom engagement in Mathematics 7. Moreover, it is noticeable that the experimental group got a less variable post-survey scores than the comparison group in all dimensions of engagement. This implies that the consistency of the engagement of the learners taught using WBT becomes more intact compared to those who were taught using the traditional method.

This result was somehow parallel to the result obtained in the study of Muthukrishnan, et. al (2019). Despite that study did not get the mean score of each dimensions, they showed that there was a high frequency of observed positive engagement in the group that were exposed in WBT techniques. Thus, WBT strategy could generate higher frequency of students who become engaged in Mathematics class than the conventional method.

Table 3 shows the number of items, mean score, mean percentage score of the comparison group in fifteen (15) formative tests in the entire third grading period; and their corresponding descriptions and remarks based on the adaptation of Appendix B: Transmutation Table and on Descriptors, Grading Scale, and Remarks which are both stipulated in DepEd Order No. 8 s. 2015.

Table 3: *Mean Percentage Score of Comparison Group's Achievement in Formative Tests*

Lessons	**No. of Item**	**Mean Percentage Score**
Undefined Terms in Geometry	13	72.03
Subsets of a Line	5	70.91
Classifications of Angle According to Its Measure	20	67.73
Supplementary and Complementary Angles	10	72.42
Adjacent Angles and Linear Pair	10	69.70

Congruent Angles and Vertical Angles	5	63.64
Parallel and Perpendicular Lines	6	68.69
Angle Relationships Formed by Parallel Lines Cut by a Transversal	5	86.67
Segments and Angles Bisector, Perpendiculars and Parallels Lines	20	74.39
Polygons: (a) convexity; (b) angles; and c. sides	12	74.75
Relationship of exterior and interior angles of a convex polygon	4	71.97
Circles: radius, diameter, chord, and center of a circle	15	77.78
Circles: arc, central angle, and inscribed angle of a circle	10	75.45
Constructions of triangles, squares, rectangles, regular pentagons and regular hexagons	15	67.88
Solving Problems Involving Sides and Angles of a Polygon	10	70.91

Legend: 84% and above – Outstanding
76% – 83.99% - Very Satisfactory
68% – 75.99% - Satisfactory
60% – 67.99% - Fairly Satisfactory
60% and above – Passed
59.99% and below - Needs Improvement

The results also showed that the comparison group got its highest mean percentage score of 86.87 in Lesson 8 (Angle Relationships Formed by Parallel Lines Cut by a Transversal) which was described as outstanding. This lesson had a 5-item formative test in which this group has a mean score of 4.33. On the other hand, the comparison group had a mean score 3.18 in a 5-item formative test in Lesson 6 (Congruent Angles and Vertical Angles). This has a fairly satisfactory MPS of 63.67, which was the lowest mean percentage of the group for the whole quarter in terms of formative tests.

Furthermore, the result also showed that this group got one very satisfactory MPS of 77.78 in Lesson 12. It had ten satisfactory mean percentage scores in Lesson 1 (MPS = 72.23), in Lesson 2 (MPS = 70.91), in Lesson 4 (MPS = 72.42), in Lesson 5 (MPS = 69.70), in Lesson 7 (MPS = 68.69), in Lesson 9 (MPS = 74.39), in Lesson 10 (MPS = 74.75), Lesson 11 (MPS = 71.97), in Lesson 13 (MPS = 75.45), and in Lesson 15 (MPS = 70.91). It also got fairly satisfactory outcomes in Lesson 3 (MPS = 67.73) and in Lesson 14 (MPS = 67.88).

Table 5 shows the number of items, mean score, mean percentage score of the experimental group in fifteen (15) formative tests in the entire third grading period.

Table 4: *Mean Percentage Score of Experimental Group's Achievement in Formative Tests*

Lessons	**No. of Item**	**MPS**
Undefined Terms in Geometry	13	79.02
Subsets of a Line	5	79.39
Classifications of Angle According to Its Measure	20	78.33
Supplementary and Complementary Angles	10	78.18
Adjacent Angles and Linear Pair	10	76.97
Congruent Angles and Vertical Angles	5	71.52
Parallel and Perpendicular Lines	6	73.23
Angle Relationships Formed by Parallel Lines Cut by a Transversal	5	92.12
Segments and Angles Bisector, Perpendiculars and Parallels Lines	20	78.64
Polygons: (a) convexity; (b) angles; and c. sides	12	72.73
Relationship of exterior and interior angles of a convex polygon	4	90.15
Circles: radius, diameter, chord, and center of a circle	15	73.94
Circles: arc, central angle, and inscribed angle of a circle	10	82.73
Constructions of triangles, squares, rectangles, regular pentagons and regular hexagons	15	71.31
Solving Problems Involving Sides and Angles of a Polygon	10	67.58

Legend: 84% and above – Outstanding
76% – 83.99% - Very Satisfactory
68% – 75.99% - Satisfactory
60% – 67.99% - Fairly Satisfactory
60% and above – Passed
59.99% and below - Needs Improvement

This presents that the experimental group earned its highest MPS in Lesson 8 (Angle Relationships Formed by Parallel Lines Cut by a Transversal) which was an outstanding 92.12 based on the mean score of 4.61 in a 5-item formative test. Meanwhile, it got its lowest mean score in Lesson 15 (Solving Problems Involving Sides and Angles of a Polygon) which was a fairly satisfactory 67.58%. The said group made a mean score of 6.76 in a 10-item formative test.

This also revealed that the experimental group got another outstanding MPS in Lesson 11 which is 73.94. Moreover, it obtained a very satisfactory MPS in seven lessons namely Lesson 1 (MPS = 79.02), Lesson 2 (MPS = 79.39), Lesson 3 (MPS = 78.33), Lesson 4 (MPS = 78.18), Lesson 5 (MPS = 76.97), Lesson 9 (MPS = 78.64), and Lesson 13 (MPS = 82.73). While it got five satisfactory MPS Lesson 6 (MPS = 71.52), Lesson 7 (MPS = 73.23), Lesson 10 (MPS = 72.73), Lesson 12 (MPS = 73.94), and Lesson 14 (MPS = 71.31).

It was observable that most of the experimental group's seat works surpassed the level of achievements of the comparison' seat works. Thus, the learners who were taught using the WBT had a much more number of higher level of achievements than those who were taught using conventional method in terms of formative assessments.

Table 5 shows the mean scores, standard deviation, and mean percentage of the posttest of the two groups after the two different two teaching strategies were used to them.

Table 5: *Mean Percentage of Learners' Achievement in Posttest*

Groups	Mean Score	SD	MPS	Mean Difference
Experimental	24.55	7.79	40.91	0.79
Comparison	23.76	7.81	39.60	

Legend: 84% and above – Outstanding
76% – 83.99% - Very Satisfactory
68% – 75.99% - Satisfactory
60% – 67.99% - Fairly Satisfactory
60% and above – Passed

This depicted that the experimental group had a mean score of 24.55 with equivalent MPS of 40.91 and a standard deviation of 7.79; while the control group got a 23.76 as the mean score, 7.81 as the standard deviation, and 39.60 as the MPS. The mean difference and MPS difference of the two groups are 0.79 and 1.31, respectively. Even after the execution of the two teaching methods, the two groups still failed to meet the 60 passing mean percentage score based on the prescribed standard aof the Department of Education.

Despite the mean scores of both groups became higher than their mean scores in the pre-test, they were not able to cross the passing rate as stated in DepEd Order No. 8 s. 2015. This may be compared to the performance of the Filipinos in different tests like the NAT and other international tests in which they got low or even failing scores in Mathematics. The result was also similar to the usual low MPS achievement of the common Filipino students in their diagnostic, quarterly, and achievement tests. There might be some underlying factors that might affect their performance like what Michae (2015) enumerated in his research. These are the learning environment, lack of self-practice, poor mathematical background, and not well-managed Mathematics department. In this case, it is also worth noting also that duration of the use of WBT. There might be a certain effect if the WBT techniques are being used for a longer period of time.

Table 6 shows the result of the test of significance difference between the mean scores of both groups based on their response on the pre-survey.

Table 6: *Results of t-Test of Independent Means of the Comparison and the Experimental Groups as Reflected by the Pre-Survey*

Engagement	Mean Scores		Mean Difference	t-value (df=64)
	Experimental	Comparison		
Affective	4.00	3.94	0.06	0.35
Behavioral	3.95	3.81	0.14	0.70
Cognitive	3.80	3.47	0.33	1.88

Significant at p-value < 0.05

This exhibits that in terms of affective engagement, the computed p-value was 0.73 which is higher than 0.05 [t(64)= 0.35; p > 0.05]; the null hypothesis is accepted and it was concluded that there was no significant difference. It could be deduced that affective engagement of the learners were of the same level prior to the study. Next, the computed p-value of behavioral engagement was 0.49 which was more than 0.05 [t(64)= 0.70; p > 0.05]; the null hypothesis was accepted, thus, there was no significant difference between the pre-survey mean scores of both groups in this dimensions. It could be inferred that their behavioral engagements are of the equal level. Third, the cognitive engagement had a computed p-value of 0,06 which was greater than 0.05 [t(64)= 1.88; p > 0.05]; the null hypothesis was accepted, then there was no significant difference in the mean scores of the two groups. This implied that the two groups were of equal level in terms of cognitive engagement. This showed that the two participating groups had the same level of over-all classroom engagement in Mathematics before the two treatments were executed.

Table 7 shows the result of the test of significance difference between the mean scores of both groups based on their response on the post-survey.

Table 7: *Results of t-Test of Independent Means of the Comparison and the Experimental Groups as Reflected by the Post-Survey*

Engagement	**Mean**		**Mean Difference**	**t-value (df=64)**
	Exp.	**Com.**		
Affective	4.26	4.05	0.20	1.29
Behavioral	4.18	3.98	0.20	1.36
Cognitive	4.05	3.64	0.41	3.03*

Significant at p-value < 0.05

This depicts that the computed p-value in affective engagement is 0.20 which was greater than 0.05 [t(64)= 1.29; p > 0.05]; the null hypothesis was accepted, then there was no significant difference between the mean scores of the two groups. This means that the level of affective engagement of the two groups were the same. Also, the Cohen's d of 0.32 shows that the WBT has a low effect in size. This implied that WBT strategy lowly affects the affective engagement in Mathematics 7.

The behavioral engagement's p-value is 0.18 which was higher than 0.05 [t(64)= 1.36; p > 0.05]; the null hypothesis was accepted, therefore there was no significant difference between the two mean scores. This indicated that the learners have equal level of engagement in terms of behavioral dimension. In addition, this dimensions attained a Cohen's d of 0.34. This indicated that behavioral engagement was lowly affected by the WBT strategy.

The p-value of cognitive dimension is <0.00 which was lower compared to 0.05; the null hypothesis was rejected, thus there was significant difference between the means scores. This indicated that they have different level of cognitive engagement after the study. Since The experimental group has a higher mean score of 4.05, this means that they were more engaged cognitively. Furthermore, the computed Cohen's d is 0.74 which was classified as medium effect in size. This explained that WBT strategy moderately affects the cognitive engagement of the learners in Mathematics 7.

The result posited that WBT increases the engagement of the students (Armijo, 2009). It also affirmed the claim of Muthukrishnan, et. al, 2019 that those students who were taught using the Whole Brain Teaching Strategy showed an improved engagement in terms cognitive domains compared to the comparison group. However, it contradicts that the experimental group differ significantly from the comparison group when it comes to affective and behavioral aspects of classroom engagement. In spite of this, the two studies generalize that WBT strategy is able to engage the learners much more than the conventional method when the over-all engagement in Mathematics is talked about.

Table 8 shows the result of the test of significance difference between the comparison group's mean scores between the pre-survey and post survey.

Table 8: Results of t-Test of Correlated Means of the Comparison Group's as Reflected by the Pre-Survey and Post-Survey

Engagement	**Mean Scores**		**Mean Difference**	**t-value (df=32)**
	Pre-Survey	**Post-Survey**		
Affective	3.94	4.05	0.11	0.35

Behavioral	3.81	3.98	0.17	1.60
Cognitive	3.47	3.64	0.17	1.91*

***Significant at p-value < 0.05*

This reveal that the affective engagement has a p-value of 0.36 [t(32) = 0.35; p > 0.05]. The p-value is greater than 0.05; so, the null hypothesis was accepted. This tells that the comparison group did not improve in terms of affective engagement. While the behavioral engagement has 0.05 [t(32) = 1.60; p > 0.05]. The p value was equal to 0.05; then the null hypothesis was accepted which led to the conclusion that this group did not improve in engagement behaviorally. Cognitive engagement got the p-values of 0.03 [t(32) = 0.91; p <0.05]. The p-value is lower than 0.05; the null hypotheses are rejected, then there are significant improvements in two latter domains of the classroom engagement. This means that the comparison group had improved in cognitive classroom engagement in Mathematics 7 after the study was conducted.

Table 9 shows the result of the test of significance difference between the experimental group's mean scores between the pre-survey and post survey.

***Table 9**: Results of t-Test of Correlated Means of the Experimental Group's as Reflected by the Pre-Survey and Post-Survey*

Engagement	Mean Scores		Mean Difference	t-value df=32
	Pre-Survey	Post-Survey		
Affective	4.00	4.26	0.26	2.16*
Behavioral	3.95	4.18	0.23	2.14*
Cognitive	3.80	4.05	0.25	2.67*

**Significant at p-value < 0.05*

This shows that the affective engagement has a p-value of 0.02 [t(32)= 2.16; p < 0.05], the behavioral engagement has 0.02 [t(32)= 2.14; p > 0.02], the cognitive engagement has 0.01 [t(32)= 2.67; p > 0.05]. Each p-value was less than 0.05; all the null hypotheses were rejected, thus, there were significant improvements in each domain of the classroom engagement. This means that using WBT strategy could significantly improve all dimensions of classroom engagement in Mathematics 7.

Table 10 shows the of the result test of significance of mean scores of the comparison and experimental groups as reflected in 15 formative tests in the entire third grading period.

***Table 10:** Results of t-Test of Independent Means of the Comparison and the Experimental Groups as Reflected by the Formative Tests*

Lesson	**t-value (df=64)**	**Effect Size (Cohen's d)**
Undefined Terms in Geometry	0.87	0.20
Subsets of a Line	1.09	0.27
Classifications of Angle According to Its Measure	1.75	0.43
Supplementary and Complementary Angles	0.85	0.21
Adjacent Angles and Linear Pair	1.52	0.37
Congruent Angles and Vertical Angles	1.48	0.36
Parallel and Perpendicular Lines	0.70	0.17
Angle Relationships Formed by Parallel Lines Cut by a Transversal	0.98	0.24
Segments and Angles Bisector, Perpendiculars and Parallels Lines	1.11	0.27
Polygons: (a) convexity; (b) angles; and c. sides	0.34	0.08
Relationship of exterior and interior angles of a convex polygon	3.07	0.75
Circles: radius, diameter, chord, and center of a circle	0.84	0.21

Circles: arc, central angle, and inscribed angle of a circle	1.18	0.29
Constructions of triangles, squares, rectangles, regular pentagons and regular hexagons	1.04	0.26
Solving Problems Involving Sides and Angles of a Polygon	0.43	0.11

***Significant at p-value < 0.05*

Almost the computed all p-values are lower than 0.05 which lead to reject the null hypothesis; therefore, the almost all the mean scores of the two participating groups did not differ significantly. This means that they had the equal level of achievement in fourteen formative assessments throughout the entire quarter. However, it was noticeable that in Lesson 11 (Relationship of exterior and interior angles of a convex polygon), the two groups differed significantly with a computed p-value of <0.00 [t(64)= 3.07; p < 0.05]. The experimental group got a mean score of 3.61 (based on Table 7.4) which is greater than the mean score of the control group of 2.88 (based on Table 7.3). The Cohen's d also shows that WBT strategy has a medium effect in size in Lesson 11 (d = 0.75). This reveals that in this particular lesson, the learners who were taught using WBT strategy performed better than the learners who were taught sing using the conventional method. It was also observable with the Cohen's d of 0.08 indicated that WBT Strategy has the smallest effect in size is in in Lesson 10 (Polygons: (a) convexity; (b) angles; and (c) sides). The two groups also did not differ significantly as revealed by the p-value of 0.74 [t(64)= 0.34; p > 0.05]. Therefore, the two groups were of the same level in terms of achievement in the 12-item formative assessment number 10.

Table 11 shows the result of the test of significance of mean scores of the comparison and experimental groups in the posttest.

Table 11: *Results of t-Test of Independent Means of the Comparison and the Experimental Groups as Reflected by the Posttest*

Groups	**Mean difference**	**t-value (df = 32)**	**p-value ($\alpha = 0.05$)**	**Effect Size (Cohen's d)**
Experimental	0.79	0.41	0.68	0.10
Comparison				

***Significant at p-value < 0.05*

This presents that the experimental group got a slightly higher mean score which was 24.55 compared to the other group which was 23.76. Moreover, the spread of their scores are almost the same. The experimental group got a slightly more consistent scores for having an SD = 7.81 than the comparison group that had an SD = 7.81. The computed p-value was 0.68 that surpassed 0.05 [t (64)= 0.41; p > 0.05] in which the null hypothesis was accepted. The result shows that there was no significant difference in posttest mean scores of the two groups. Furthermore, the computed Cohen's d is 0.10 which showed that there was only a small effect in size. This reveals that the comparison and experimental group still have the same level of achievement even after being exposed two different teaching strategy. This also showed that the Whole Brain Teaching Strategy was as effective as the conventional teaching method.

The result agrees to the Sontillano's (2018) conclusion that the two methods of teaching are of equal level of effect in increasing the learners' achievement in Mathematics. It also affirms the claim of Aligam (2016) that Grades 8 and 9 participating experimental and comparison groups did not differ significantly in Science posttest mean scores after the two treatments were executed to them. This was because they were in adjusting period. However, this opposes the other outcome of the same research that Grades 7 and 10 performed better in Science because they were playful and mature, respectively.

Table 12 shows the result of the test of significant difference of the comparison group's mean scores between the pre-test and posttest.

Table 12: *Results of t-Test of Correlated Means of the Comparison Group as Reflected by the Pre-test and Posttest*

Groups	**Mean difference**	**t-value (df = 32)**
Pre-test	6.55	6.20*
Posttest		

**Significant at p-value < 0.05*

The result shows that the posttest mean score of the comparison group was 23.76 which was more than its pre-test mean score which was 17.21 with a mean difference of 6.55. However, this posttest (SD = 7.81) was more spread than the pre-test (SD = 3.94). The p-value was <0.00 [t(32)= 6.22; p < 0.05] which was lower compared to 0.05 level. The null hypothesis was rejected; therefore, there was significant difference in the mean scores of the comparison group between the two aforementioned tests. This that there was a significant improvement in the academic achievement of the said group after being taught using the conventional teaching method.

The result is somehow similar to the result from the study of Sotillano (2018) in which the comparison group was able to improve significantly in terms of their achievement in Mathematics 8. The two study only show that conventional method of teaching such as lecture and demonstrations methods can still increase the achievement of this generations' mathematical achievement.

Table 13 shows the result of the test of significant difference of the experimental group's mean scores between the pre-test and posttest.

Table 13: *Results of t-Test of Correlated Means of the Experimental Group as Reflected by the Pre-test and Posttest*

Groups	**Mean difference**	**t-value (df = 32)**
Pre-test	7.34	5.56*
Posttest		

Significant at p-value < 0.05

The experimental group had a posttest mean score of 24.55 which was higher than its pre-test mean score of 17.21 and these differ by 7.34. Its standard deviation in pretest 3.94 that is lower than the 7.79 posttest's SD. This mean that the posttest scores were more variable. The computed p-value is 0.00 that surpassed the 0.00 [t(32)= -5.56; p < 0.05]. The null hypothesis was rejected; thus, there was significant difference between the pre-test's and posttest's mean scores. This suggests that this group improved significantly in terms of academic achievement after being taught using the Whole Brain Teaching Strategy.

The result confirms the claim of Armijo (2009), Biffle (2013), Sontillano (2018), and Muthukrishnan et. al (2019) that WBT can improve the achievement of the learners. This further proves that using the Brain Based Learning, in which the WBT was derived, can improve student's academic performance (Noureen, Awan, & Fatima, 2013) and mathematical skills (Risley, 2009). Thus, Whole Brain Teaching is an effective teaching method to bring significant increase in the learners' academic performance especially in Mathematics.

Table 14 shows the result of the test of relationship between classroom engagement and achievement of the comparison group.

Table 14: *Results of Test of Relationship of the Comparison Group between Classroom Engagement and Achievement*

Engagement	**r**
Affective	0.47*
Behavioral	0.36*
Cognitive	0.36*

**Significant at p-value < 0.05*

Legend: 0.90 – 1.00 – Very High Positive Correlation

0.70 – 0.89 – High Positive Correlation

0.50 – 0.69 – Moderate Positive Correlation

0.30 – 0.49 – Low Positive Correlation

0.00 – 0.29 – Very Low Positive Correlation

This shows that the affective engagement had a p-value of 0.01 and an r-value of 0.47. Both behavioral and cognitive engagements got a p-value of 0.04 and r-value of 0.36.

This reveals that all dimensions of classroom engagement have significant relationship with the comparison group's academic achievement in Mathematics 7 with low positive correlation when being taught using the conventional teaching method. Despite of low correlation, the result still agrees to Wongwanich and Wiratchai (2013) that classroom engagement is indeed has a significant relationship on the learners' achievement.

Table 15 shows the result of the test of relationship between classroom engagement and achievement of the experimental group.

Table 15: *Results of Test of Relationship of the Experimental Group between Classroom Engagement and Achievement*

Engagement	r
Affective	0.35*
Behavioral	0.55*
Cognitive	0.49*

**Significant at p-value < 0.05*

Legend: 0.90 – 1.00 – Very High Positive Correlation

0.70 – 0.89 – High Positive Correlation

0.50 – 0.69 – Moderate Positive Correlation

0.30 – 0.49 – Low Positive Correlation

0.00 – 0.29 – Very Low Positive Correlation

This indicates that the p-value of engagement, behavioral, cognitive, and over-all engagements were 0.44, 0.00, 0.00, and 0.00, respectively. This means that each dimension of the classroom engagement has significant relationship with the achievement of learners who were using the WBT strategy.

The affective and cognitive engagements have a computed r-values of 0.35 and 0.49, respectively. Both of these were interpreted as low positive correlation. On the other hand, the behavioral engagement got a 0.55 r-value and the over-all engagement got 0.53 which were both classified as moderate positive correlation. This implied that learners' affective and cognitive engagement have low positive correlation in academic achievement while the behavioral and over-all classroom engagement and academic achievement in Mathematics 7 have moderate positive correlative when being taught of the WBT strategy.

The result affirms the statement of Ganuc (2014) that the three dimensions of engagement have significant relationship on the students' academic performance. Aside from, it also posits the claim of Lee (2014) that affective and behavioral engagement were correlated significantly to performance though it was in reading. Thus, it was concluded that using Whole Brain Teaching Strategy can produce a significant relationship between classroom engagement and learners' achievement with positive correlation.

CONCLUSION AND RECOMMENDATION

Based on the findings of the study, the researcher had arrived to the following conclusions and recommendations:

It was revealed that before the study was conducted, the two groups had same level of classroom engagement and achievement. After the implementation of the two treatments, there was significant increase in comparisons' cognitive engagement while the experimental group improve in all kinds of classroom engagement. They also differed significantly in terms of cognitive engagement. On the other hand, there were significant improvements from the pre-test mean scores to the posttest mean scores of both the experimental and the comparison group. Although, their posttest mean scores did not differ significantly. It implied that the achievement of the learners exposed in the WBT strategy was equal to achievement of those who were taught using the conventional teaching strategy. Therefore, Whole Brain Teaching Strategy is as effective as the conventional teaching strategy in Mathematics 7.

It was shown using the two methods, classroom engagement had significant relationship in learners' academic achievement. However, using WBT strategy could generate moderate positive correlations in behavioral engagement. Additionally, as mentioned above, the group exposed in this method improved significantly in all dimensions' engagement. Therefore, WBT strategy can stimulate more classroom engagement in Mathematics 7 compared to conventional teaching strategy

Based on the findings and conclusions of the study, the researcher recommends the following: Teachers may use WBT strategy as an alternative teaching method in engaging the learners in Mathematics class which may also result to increase in achievement. WBT may be used at most thrice a week for too much use may lead to boredom; teachers are encouraged to incorporate other teaching methods like utilizing varied forms of technology to increase and facilitate learning; teachers who will use WBT Strategy might encounter no-participating learners because of personal and intellectual differences. Teachers may research further studies and strategies that may be incorporated to WBT Strategy to address the character, cultural, emotional, and intellectual diversities of the learners; and school administrators may provide seminars, /webinars, workshops, and learning action cell focus on the importance and innovation in pedagogy like the Whole Brain Teaching Strategy.

ACKNOWLEDGEMENTS

The authors would like to humbly thank the President of Laguna State Polytechnic University, Dr. Mario R. Briones , the Vice President of R & D, Dr. Corazon San Agustin, the Director of R &D, Dr. Editha S. Perey and Associate Dean Consorcia S. Tan of College of Teacher Education for their support for the product of this research study.

REFERENCES

[1] Alford, D. (2014). What is whole brain teaching in the classroom. Walsh University article. Retrieved from http:/www.walsh.edu/whole-brain-teaching.

[2] Andaya,Olive Joy F. (2014). Factors That Affect Mathematics Achievements of Students of Philippine

[3] Bawaneh, A. K. A., Md Zain, A. N & Saleh, S. (2011). The Effect of Herrmann Whole Brain Teaching Method on Students' Understanding of Simple Electric Circuits. European Journal of Physics Education, 2(2).

[4] Biffle, C. (2013). Whole Brain Teaching for Challenging Kids (and the rest of your class, too!). Yucaipa, CA: Whole Brain Teaching LLC.

[5] Boer, A., Steyn, T., &Toit, P.H. (2001). A whole brain approach to teaching and learning in higher education. South African Journal of Higher Education, 15(3), 185-93.

[6] Calderon, M. T. F. (2014). A Critique of K-12 Philippine Education System

[7] Coyne, M. D., Kame'enui, E. J., &Carnine, D. W. (2007), Effective teaching strategies that accommodatediverse learners. India: Prentice Hall

[8] Duman, B. (2006). The effect of brain-based instruction to improve on students‟ academic achievement in social studies instruction. Retrieved from http://www.ineer.org/Events/ICEE2006/papers/3380.pdf.

[9] Duman, B. (2010). The effects of brain-based learning on the academic achievement of students with different learning styles. Retrieved from http://files.eric.ed.gov/fulltext/EJ919873.pdf

[10] Fernandez, A. F. (2013). Standards-Based Assessment: DepEd's Perspective. NETRC, DepEd. Retrieved July 7, 2018 from http://ceap.org.ph/upload/download/20136/31131995_1.pdf

[11] Hakim, L., Cahya, E., Nurlaelah, E., & Lestari, Z. (2015). The Application EQ and SQ in Learning Mathematics with Brain-Based Learning Approach to Improve Students' Mathematical Connection and Self-Efficacy in Senior High School. PEOPLE: International Journal of Social Sciences, 1(1), 542-557.

[12] Hart, S. R., Stewart, K., Jimerson, S. R. (2011). The Student Engagement in Schools Questionnaire (SESQ) and the Teacher Engagement Report Form-New (TERF-N): Examining the Preliminary Evidence

[13] Herrmann-Nehdi, A. (2002). Training with The Brain in Mind: The Application of brain dominance technology to teaching and learning. Session Number 509.

[14] Herrmann-Nehdi, A. (2009). The Best of Both Worlds-Making Blended Learning Really Work by Engaging the Whole Brain®. Lake Laurie, NC: Herrmann International.

[15] Ganuc, S. (2014). The Relationship Between Student Engagement and Their Academic Achievement, YuzuncuYil University

[16] Ghazvini, S. D. (2011). Relationships between Academic Self-concept and Academic Performance in High School Students. Procedia- Social and Behavioral Sciences, 15, 1034-1039. https://doi.org/10.1016/j.sbspro.2011.03.235

[17] Inocian, R. B. (2015). Integrated Arts-based Teaching (IAT) Model for Brain-based Learning. Journal of Curriculum and Teaching, 4(2). https://doi.org/10.5430/jct.v4n2p130

[18] C., Neacsu, I., Safta, C.G., &Sudita, M. (2011), The study of the realtion between the teaching methods and the learning styles-The impact upon teh students‟ academic conduct. Procedia:Social and behavioural sciences, 256-260

[19] Jensen, E. (2005). Brain-based learning. Pearson Education, Inc., Indian Branch, 482 F.I.E. Patparganj, Delhi. 15.

[20] Jensen, E. (2009). Teaching with poverty in mind: What being poor does to kids‟ brains and what schools can do about it. Alexandria, VA: Association for Supervision and Curriculum Development.

[21] Klinek, S. R. (2009). Brain-based learning: Knowledge, beliefs, and practices of college of education faculty in the Pennsylvania state system of higher education. (doctoral Dissertation), Indiana University of Pennsylvania.

[22] Lee, J.S. (2014). The relationship between student engagement and academic performance: Is it a myth or reality? The Journal of Educational Research, 107(3), 177–185. https://doi.org/10.1080/00220671.2013.807491

[23] Lockhart, E. (2016). English as a Foreign Language through Whole Brain Teaching in Primary School (Doctoral dissertation, RoviraiVirgili University).

[24] McGuckin, D., &Ladhani, M. (2010). The Brains behind Brain-Based Research: The Tale of Two Postsecondary Online Learners. College Quarterly, 13(3), 6-7.

[25] Michael, I. (2015). Factors Leading to Poor Performance in Mathematics Subject in Kibaha Secondary Schools, University of Tazania

[26] Mojares, Juvy G. (2016). Teaching Strategies in English: The Case of Batangas State University - Malvar, Philippines

[27] Muthukrishnan , P., Phang, A., Rui, Y. & Ling, L. B. (2019). Early Childhood Learners: Effectiveness of Whole Brain Teaching in Mathematics Classroom Engaging

[28] Noddings, N. (2007). Philosophy of education. Cambridge, MA: Westview Press.

[29] Noureen, G., Awan, R. N., & Fatima, H. (2013). Effect of Brain-based Learning on Academic Achievement of VII Graders in Mathematics

[30] Olibie, E. (2013). Emergent Global Curriculum Trends: Implications for Teachers as Facilitators of Curriculum Change

[31] Rehman, Malik, M. A., Hussain, S., Iqbal, Z., & Rauf, M. (2012). Effectiveness of Brain- Based Learning Theory on Secondary Level Students of Urban Areas. Journal of Managerial Sciences, 6(1), 113-122.

[32] Risley, R. (2009). Book Review: How the Brain Learns Mathematics, David A. Sousa. International Electronic Journal of Elementary Education, 1(2), 97-100.

[33] Richardson, J. J. (2011). Increasing Left and Right Brain Communication to Improve Learning for Tenth Grade Students in a Public School (Doctoral Dissertation). Retrieved from ProQuest Dissertations Publishing (UMI No. 3468506)

[34] Sontillano, R. (2018). Impact of Whole Brain Teaching Based Instruction On Academic Performance of Grade 8 Students in Algebra: Compendium of WBT-Based Lesson Plans

[35] Skinner, E.A., Kindermann, T.A. &Furrer, C.J. (2009). A Motivational Perspective on Engagement and Disaffection: Conceptualization and Assessment of Children's Behavioral and Emotional Participation in Academic Activities in the Classroom. Educational and Psychological Measurement, 69(3), 493-525.

[36] Sterns, C. H. W. (2016). Effect of whole brain teaching on student self-concept. Walden University Scholar Works.

[37] Tufekci, S., &Demirel, M. (2009). "The effect of brain based learning on achievement, retention, attitude and learning process." Elsevier publication. Procedia Social and Behavioral Sciences. 1782-1791.

[38] Winters, C. A. (2001). Brain based teaching: Fad or promising teaching method. U.S. Department of Education. Retrieved from http://files.eric.ed.gov/fulltext/ED455218.pdf.