Engaging Early Childhood Learners: Effectiveness of Whole Brain Teaching in Mathematics Classroom

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Abstract: The neuroscience research is gaining momentum and it explores the science of brain and performance of an individual. Whole Brain Teaching (WBT) is a blend of direct instruction and cooperative pedagogy that allow teachers to effectively deliver the lesson and to create an engaged and enjoyable learning experience for the children. This study aimed to investigate the effectiveness of whole brain teaching on learning Math and its impact on positive and negative learning behaviors of the children in Math classroom. The study adopted single group pre-test post-test experimental design and 30 six-years-old preschool children participated in the study. The data were collected using Math tests and observations. Math lessons on addition was considered to explore the effectiveness of WBT. Before the intervention, addition problems were taught using traditional teaching method and the children completed the pre-test. The five different WBT fun filled strategies were taught to the children prior to the intervention. This was followed by teaching addition using whole brain teaching which incorporates the WBT strategies. The paired t-test results revealed that the children scored high in WBT intervention (M=7.23, SD =1.40) compared to the traditional teaching (M=4.70, SD=2.21) and that there was a significant difference between the test scores before and after the treatment (t (29) = 5.517, p < 0.001). This concluded WBT enhances Math learning among early learners. Further, to study the impact of WBT on the engaged learning, 6 children learning behaviours were recorded and analysed. A tally sheet of positive and negative learning behaviours was used to record their behaviours. Three observations before and after the treatment were considered for the study. The results confirmed WBT increases the positive and decreases the negative learning behaviours. The study recommends the early childhood educators to teach Math using whole brain teaching for improved performance and engaged learning of the children.

Key words: Whole Brain Teaching, classroom engagement, early childhood learners, affective engagement, cognitive engagement, behavioural engagement

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I. INTRODUCTION

Neuroscience research is an emerging discipline which focuses on the effect of cognitive functions on the behavioural and affective domains of the individual. The findings related to brain based instructions revealed the intricacies of the brain functions which are attuned to the nature of the instruction and learning processes. This is essentially important for the teachers to decipher the instructions that could efficiently mediates the relationship between the learners' brain functions and their academic performance. Biffle (2013), referred WBT as "Power Teaching" which aims to improve the student engagement and their overall performance by integrating a set of fun filled strategies with direct instructions and delivered in a cooperative learning environment. WBT eliminates passive learning and improves active student engagement. Findings by Jensen (2005) identified that there was a substantial relationship between emotion and brain's learning process. Palasigue (2009) confirmed that emotion acts as a positive or negative catalytic action in information processing. This paper considers the student- centered learning in light of brain, behavior and performance. Early childhood learners experience challenges in understanding the abstract nature of Mathematics. Therefore, need for active participation, sustained attention and meaningful learning are essential for learning abstract concepts. This paper addresses the effectiveness of whole brain teaching in the math performance and comparing its impact on the engaged learning n a traditional and WBT classroom.

II. MATERIAL AND METHODS

Research on brain based learning and its implications in the field of education is expounding the need for active teaching to facilitate active learning. WBT is brain based instructions which create fun- filled active learning experiences and stimulate the brain to focus, process and retain information. Wolken (2017) stated that WBT is just not a multi-sensory teaching strategy but is a brain based learning strategy. Neuroscience teaches

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us about learning and that learning promotes learning, and how teachers can take advantage of the brain's neuroplasticity to ensure the memories they construct will be rich and lasting. When neurons that fire together, wire together make more connections form between neurons, there is greater potential for further learning. Each time the child participates in any endeavor, a certain number of neurons are activated. When the action is repeated, the same neurons respond again. The more times one repeats an action/practice, or recalls the information, the more dendrites sprout to connect new memories to old ones. Therefore, the stronger the connections between neurons become, and the more efficient the brain becomes at retrieving that memory or repeating that action. How your child learns best and build better brain rely on the stimulating increased interest and enthusiastic participation in academic activities.

There are seven core WBT techniques which aim to facilitate cooperative classroom practices and it allow teachers to implement the techniques to suit the nature of the learner and the content. The first technique, class-Yes requires children to mimic the teacher's voice, tone, rhythm and it creates readiness to learn. This technique gains attention of the students and activates the prefrontal cortex of the brain which is involved in the executive functions. The second technique the organizer is a set of five classroom rules which have to be rehearsed every day before the start of the class. Rules are essential for effective classroom management and Biffle (2013) confirmed that this techniques stimulates limbic system, broca's area, Wernicke's area, motor and visual cortex. The third technique is the focuser or hand and eyes. Tipton (2016) highlighted that this technique allow children to pay extra attention when the teacher says "hands and eyes" and the students need to mimic the teacher's words and movements. This techniques eliminates distractions and allows instant focus to the lesson. The fourth technique is teach-okay, the most powerful of the WBT is used during the informative part of the lesson when the teacher uses direct instructions to teach the lesson. This technique is a whole brain activator which activates visual cortex, motor cortex, Wernicke's area, Broca's area and hippocampus to form long term memories. Cannon (2014) confirmed that teach- okay improves student engagement. The fifth technique is called as mirror or the class unifier activates the visual and motor cortex of the brain (Biffle, 2013). It can be used anytime during the lesson, in which the students will pay attention to the teacher's gestures and speech and mimic by mirroring gestures and repeated words. Earlier research confirmed that association of words and gestures improves memory (Jones. 2014). The sixth technique is switch or the involver is usually combined with teach-okay technique. It involves reciprocal teaching in which the students will be allowed to teach and to listen to their peers. When the teacher shout switch, the students will switch their roles either as a teacher or a listener. Biffle (2013) confirmed this improves the speaking and listening skills. The last technique is called as scoreboard or the motivator which triggers the limbic system's emotions and the amygdala which register pleasure and pain. The students are rewarded with smiley face for their desirable behavior and frowning faces for the undesirable behavior, the points in the scoreboard will motivate the students for better performance.

According to Preslee et al., (2017), WBT is based on the Vygotsky's theory of social constructivism and Wenger's community of practice. During early childhood, millions of human brain cells make synaptic connections based on the environment, experiences and actions. Winter (2001) urged the researchers to focus on early education because of the rapid development of the synapses during the early years. Jensen (2008) recognizes engagement, coherence, emotional states, input quality, repetition, timing and error correction as the critical process involved in learning process. According to Fredericks et al., (2004) learning engagement included interconnected dimensions: behavioural, cognitive and affective engagement.

Engagement is a multicomponent concept that can be separated as distinct dimensions, however they remain intersected in profound manner. Children engagement is a multidimensional construct that can be measured using three dimensions: affective, behavioural and cognitive engagement. These dimensions are interrelated. Affective engagement is related to the extent of positive and negative learning experiences in the classroom and with teachers and peers. The behavioural engagement of the children in the classroom focused on the participation of the children in academic, co-curricular and social activities. Cognitive engagement refers to the engagement in learning (Fredricks, Blumenfeld, &Paris, 2004).

Literature review revealed that very few researches were conducted in WBT in preschool children learning. The current research aimed to investigate the effectiveness of the WBT in Mathematics classroom and its impact on the classroom engagement ofsix- years old children.

The research questions for the study are
1) Is there a statistically significant difference between traditional and whole brain teaching on the Mathematics performance of the six years old children?
2) How does the Whole Brain Teaching (WBT) improve the classroom engagement in Mathematics classroom?

III. RESEARCH METHODOLOGY

The present research adopted mixed- method approach. Data were collected using experimental study and through observations. The study considered convenience sampling technique and 30 six- years old pre-school children from a private kindergarten participated in the research. Single group pre-test post-test design experimental study was used to measure the effectiveness of WBT. The effect of WBT on the Mathematics performance of the children were measured by the change in the pre-test and post-test scores. The children were taught using traditional teaching method and completed the pre-test which was an addition worksheet with 10 addition problems. This was followed by teaching the seven WBT fun filled strategies to the children prior to treatment. Whole brain teaching was incorporated in teaching the addition lessons for four weeks. The post-test was conducted after four weeks of the treatment. Further, to explore the effect of the WBT on the engaged learning, the researcher used observation and tally sheet to collect the data. Based on the literature review, checklists for the engaged learning in the affective, behavioural and cognitive engagement was prepared. The negative learning behaviours checklist was adapted from Palasigue (2009). To analyse the effectiveness of WBT on the classroom engagement, 6 children were considered for the observations. Three observations before and after the intervention were video recorded. The learning behaviours were analysed and scored in the classroom engagement checklist. The frequency of the positive and negative behaviours were analysed to investigate the effectiveness of WBT on classroom engagement.

IV. Results

To answer the first research question, paired T test was conducted and the results is shown in Table 1. The results indicated that there was a statistically significant difference between the traditional (M= 4.70, SD= 2.21) and whole brain teaching (M=7.23, SD=1.40), t (29) =5.517, p<.001, CI.95-3.47, -1.59 among the six years old children (n=30) in their mathematics test scores. According to Cohen (2007), the effect size (d = 1.923) suggested high practical significance and strong effect of the WBT on Mathematics performance.

Table no 1: Results of t-test and descriptive statistics for the Traditional and Whole Brain Teaching.

Variable	TT Mean (SD) n=30	WBT Mean (SD) n=30	95% CI for Mean Difference	t	df	*p*
Mathematics Test score	4.70 (2.21)	7.23 (1,40)	-3.47, -1.59	5.517*	29	.000

* p < .001

To answer the second research question the data was collected using observations and checklists. The Table 2 shows the results of the impact of WBT on the learning behaviors of the children. The results confirmed that the whole brain teaching increased the frequency of the positive learning behaviors and decreased the negative learning behaviours of the children.

Table no2: Effectiveness of Whole Brain Teachingon classroom engagement

Classroom engagement	Learning behaviours	Frequency of the observed behaviours		
		TT[a]	WBT[b]	D[c]
Affective engagement	Excitement in learning	5	16	11
	Complaining	6	0	-6
	Responsiveness	2	31	8
Behavioural engagement	Idle Posture	16	7	-9
	Distracted Movements	23	11	-12
	Following directions without involvement	10	4	-6
	Gaining peer/teacher attention inappropriately	57	25	-32
Cognitive engagement	Consistent focus	3	6	3
	Providing correct responses	11	20	9
	Working independently	44	54	10

[a]*TT* is Traditional Teaching; [b]*WBT* is Whole Brain Teaching: [c]*D is* the difference between *TT* and *WB*

The results have confirmed that the children have displayed improved affective, behavioural and cognitive engagement in learning in WBT implemented classroom compared to the traditional classroom. The children showed improved classroom engagementin all the positive learning behaviours: expressing excitement in learning, responsiveness to the questions/assigned task, consistent focus and ability to stay on task, providing correct responses and ability to work independently. Further, children showed decrease in the negative learning

behaviours such as complaining or whining, idle movements (staring into space/ Fidgeting/stretching/ head or hand on desk), distracted movements (Getting out of seat frequently, talking when required to be listening, unintentional movements), following directions without involvement and trying ways to gain peer/teacher attention inappropriately. The Fig.1 displays the comparison of the learning behaviours in the traditional and WBT classroom.
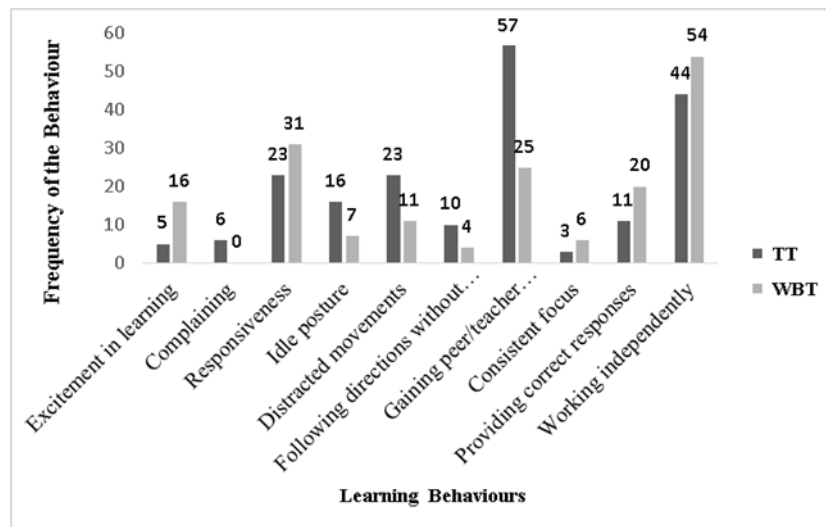

Fig 1. Effectiveness of WBT on engaged learning (TT- Traditional Teaching; WBT - Whole Brain Teaching

V. DISCUSSION

Whole brain teaching is a multisensory teaching strategy and it involves multiple areas of the brain and results in better attention and engagement in the learning process. The present study investigated on teaching math using whole brain teaching technique in an early childhood classroom. The findings showed improved involvement, attention and performance of the children. The research findings confirmed that active involvement reduces the disengaged behaviours in the classroom. The t-result results confirmed there is significant improvements in the performance of the children in learning math. Further, the study concluded that WBT intervention has shown improved classroom engagement of the children. The children displayed improved affective, behavioural and cognitive engagement. The findings werein congruence with findings byPalasigue (2009) who found that there was 50% decrease in the negative learning behaviours among the fifth grader students.Biffle (2013) claimed that disruptive behavior in the classroom is because students' brain demands activity and the classroom fails to provide it. Vanhosen et. al., (2015) concluded that emotions and stress impact the brain's ability to process information and Macias (2013) identified students disruptive behavior decreased 72% in a week in WBT classroom.Clark (2016) confirmed that WBT improves student engagement. In similar line, Laxman and Chin (2010) stated that physical motions during instruction improves blood circulation and brain functions. The physical activities and use of gestures in whole brain teaching allowed children to observe their peers and showed improved cooperation. This aided teachers to have better classroom management. The Cohen's effect size for the current study confirmed the strong effect of WBT on mathematics performance. Similar results were revealed by Fayogi, et. al (2017) in the study of teaching self- introduction using WBT. Further, the children displayed positive engagement in the three domains. The current study findings are similar to the findings by Scott, Hirn & Alter (2014) which confirmed that there was a positive correlation between teaching and engagement and a significant negative correlation between teaching and disruptive behaviors. The current research confirmed that teaching Math by incorporating WBT techniques showed increase in children's enthusiasm and active learning.

VI. CONCLUSION

The findings of the study confirmed the effect of whole brain teaching in the performance and engaged learning of the early learners in the Mathematics classroom. The effectiveness of WBT showed tremendous results on learning behaviours in terms of affective, cognitive and behavioural engagement. In short, the overall findings revealed that connecting neuroscience teaching strategies have promising implication for mathematical achievement for young children. In addition, this research has demonstrated that engaging students in the learning process increases their attention and focus; promote learning interests and increase positive involvements in Mathematics class. However, there are several limitations to the current study that provide directions for future research. The sample size is too small and limited to the 6-years-old children. As such

replication of the current findings with additional sample is necessary. It is crucial to determine if the impact of the WBT is similar for the mathematical achievement across all levels. With the growing demands in the STEM education and the need for active and engaged learning, WBT allows teachers to create and deliver the lessons to achieve the intended learning outcomes.

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