



Research Article

Effectiveness of Whole Brain Teaching on Academic Achievement and Self-Concept of Senior Secondary School Students in Mathematics: An Experimental Study

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Abstract

A significant change in the teaching strategies is required to improve the student's overall performance and the subjects' standards. Education research suggests that whole-brain teaching is a strategy that encourages students' motivation, involvement, attentiveness, and engagement in the classroom. The existing reviews also pointed out that more research studies have yet to be conducted in India among senior secondary students, particularly on Mathematics subjects concerning whole-brain teaching strategies. Therefore, the present study was planned to examine the effectiveness of whole-brain teaching on the academic achievement and self-concept of senior secondary school students in Mathematics. In 2022, a pre-test-post-test quasi-experimental single-group research design was adopted to complete this study. For conducting the present study, 25 students of the 11th class of Rajasthan Senior Secondary School Jalpali, Shrimadhampur Sikar (Rajasthan), India, were selected based on the low scores in the pre-test tests (achievement test & self-concept test in Mathematics). The experimental group was taught two units using a whole brain teaching strategy (key elements: attention getter, brain engager, direct instruction/ lesson chunks, mirror words, Motivation) as an intervention. After completing the intervention, post-tests were conducted. The data were analysed using a t-test, and the study results revealed that students' academic achievement and self-concept were higher in the post-test than in the pre-test. Therefore, the study's main findings were that WBT had a significant effect on the academic achievement and self-concept of senior secondary school students in mathematics. Therefore, it is suggested that teachers and policymakers support and implement whole-brain teaching into classroom practices. WBT should also be included in pre-service and in-service teacher education because it is an effective educational strategy that assists all students in meeting the subject standards as well as enhancing and succeeding them in a multicultural world. It can also be used as a high-energy, hyper-focused style in which teachers can employ games, challenges, keywords, and motivational strategies to keep students fully engaged in the learning. In the long run, this will be extremely useful to all levels of education.

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KEYWORDS: Whole Brain Teaching (WBT), Academic Achievement, Self-Concept, Mathematics.

1. INTRODUCTION

During COVID-19, the teaching and learning process were almost online-oriented. Without any doubt, the academic achievement, attentiveness, self-esteem, self-efficacy, and self-confidence of students is badly affected due to the online teaching-learning process because there was no more active involvement of learners and face-to-face interaction with teachers. And the situation becomes more serious in terms of challengeable subjects. Mathematics is a subject that matters in everyday life and requires a lot of concentration and practice. Thus, a significant change in the teaching strategies is required to improve students' overall performances and improvements in the mathematics' standards. Many teaching approaches can improve students' performance and confidence in Mathematics, like constructive approach, collaborative, integrative, reflective, inquiry-based learning, etc. But researches in the field of brain-based learning attracted the intentions of teachers to use the whole brain teaching strategies, in which students participate actively during classroom instructions.

Principles of Whole-Brain Teaching

In 1983, Brain based learning was introduced as the relationship between how the brain functions and the educational practices was established. However, after 15 years, Chris Biffle and his colleagues developed the Whole-Brain Teaching (WBT) method in 1999 (Kharsati & Prakasha, 2017). It is a strategy that encourages students' motivation, involvement, attentiveness and engagement in the classroom. The earliest versions of WBT were, Biffle simply asking students to repeat words back to him. After that it focuses on mimicry and motivates students by rewarding them to promote a high-energy, hyper-focused style in which teachers can employ games, challenges, key words, motivation and incentive methods to keep students fully engaged. If students repeat what they were taught, use gestures, and stimulate their body during learning, they can enhance their learning. Accordingly, it also focuses on both parts of the brain left and the right part. Students could retain their knowledge and information through involvement in the teaching-learning process. Thus, it is a teaching strategy in which teachers use motivational words, games, instructions, body movements, motivation, etc., to fully engage students in the teaching-learning process. This teaching approach can be applied to all age groups of students as it is a very flexible. Four words can easily understand whole brain teaching:

- **Engagement:** Student engagement is related with the students' level of attentiveness, inquisitiveness, hope, affection and motivation to get accomplishments in the learning and other activities related with institutions.
- **Involvement:** A strong emphasis is given on the student's active participation in the teaching learning process. Broadly, involvement is related throughout the student experiences, or narrow such as during exam preparation. At any one time, each student's level of involvement can differ.
- **Whole brain:** Being whole brain means being able to pause and respond, be proactive rather than reactive, and make better choices and judgments. When we do this, we

can stop a situation or thought in our immediate experience from triggering previous sub-conscious behaviour patterns we learned as children.

- **Principles:** They are manuals for making teaching and learning more efficient, attractive, enjoyable, healthy, and meaningful.

The literature review related to WBT suggested that there are seven fundamental principles of Whole brain education or the Big Seven are a set of instructional methods (Biffle, 2013) [3]. These teaching strategies are the used in the WBT methodology, these are "attention getter, classroom rules, teach okay, the scoreboard, mirror, hands, and eyes, switch". Moreover, the researchers also have discovered some critical areas of the brain involved for each type of learning by using brain-imaging technologies. For instance:

- Visual/ spatial learners prefer picture, image, and spatial knowledge. The occipital and parietal lobes are responsible for spatial orientation.
- Sound and music are preferred by aural learners (auditory - musical). The temporal lobe of the brain has been developed. For music, the right temporal lobe is very crucial.
- In both speaking and writing, verbal learners prefer to use words. The temporal and frontal lobes are particularly important for sensory information (hearing, recognising language, and forming memories).
- Kinaesthetic (physical) learners love to use their bodies are well developed in these children. They are the found of sculpting, drawing, athletics, dance, and hands-on activities.
- Logical learners value systems and logic thinking. According to research, these children's parietal lobes, particularly on the left side of the brain are highly developed that stimulate the drive the logical thinking.
- Social people love to learn in groups or with other people. These children's anterior temporal lobe (ATL) has highly developed.
- Solitary students prefer to work and study on their own. They like to work independently, self-motivated. and focus on self-reflection.

Additionally, WBT was labelled "Power Teaching" by Biffle (2013) [3], as it replaces passive learning with active learning enhances active and student participation (Priyadarshini *et al.*, 2019) [15]. According to Biffle (2013) [3], WBT makes learning interesting and enjoyable. If kids are interested and attentive throughout lessons, they will get the most (Hannah, 2014) [11]. "In the classroom, the approach is viewed as a strong tool that allows students to learn in a more engaging and non-threatening atmosphere" (Wong *et al.*, 2018) [21]. Advocates of WBT teaching activities and techniques believed that these encourage learners' energy, motivation, engagement and focus in the teaching learning process. Therefore, this teaching style is becoming more and more popular and now it is used by several parents and teachers in many countries of the world.

CURRENT STATUS OF LITERATURE

The experimental research study conducted by Duman's (2010) ^[9] revealed that Brain-Based Learning (BBL) approach was more effective in improving student achievement. Although, it also noticed that no statistically significant differences existed amongst the achievement levels of the experimental group students with different learning styles. Similarly, Bawaneh, Zain and Saleh (2011) ^[2] study results revealed that Hermann Whole Brain Teaching Method (HWBT) was more effective than the conventional teaching method in encouraging students' understanding related to simple electric circuits. Although, there was existed no significant difference of the interaction between methods and gender on students' understanding of simple electric circuits. In addition, research conducted by Chavhan (2012) ^[4], an intervention programme was developed on brain-based learning strategies and pointed out that the brain-based learning intervention significantly improved students' academic achievements and self-esteem. The research conducted by Dewi (2013) ^[8] indicated that the web-based brain-based learning model positively affects the students' mathematical connection ability and conceptual understanding. A research study conducted by Mustiada (2014) ^[14] found that the experimental group's learning outcomes of students in science was higher than the control group using a conventional learning model. Further, a study conducted by Hosen (2015) ^[12] confirmed the whole brain teaching help the African elementary male students to reach the desired learning outcome. The study by Clark (2016) ^[6], concluded that whole brain teaching improves the engagement of students in classroom and it is a forecaster of positive academic self-concept. Additionally, Kharsati (2017) investigated the impact of whole brain teaching strategies among 30 students of seven class in Shillong to identify how whole brain teaching strategies can affect students' performance in science subject and found that it helps the students improve their test scores. A study conducted by Sontillano (2018) ^[18] showed a positive impact of whole brain teaching on the academic performance of grade 8 students in Algebra. An experimental study by Escultura and Ricafort (2019) ^[10] found that Whole Brain Teaching Strategy is effective rather than the Lecture-Laboratory Method to improve the students' performance in the class. A research study conducted by Devana (2020) ^[7] noticed a significant improvement in speaking by using Whole Brain Teaching method among the 10th grade students of SMK Negeri 2 OKU. By the study, conducted by Rukminingsih, Mujiyanto, Nurkamto, & Hartono (2021) ^[16] investigated "the impact of online instruction integrated with brain-based teaching to EFL students with different motivation level" and noticed that the achievement levels of the students with high motivation in the reading course were higher rather than those with low motivation. It supports to meaningful learning to integrate BBT with technology. The results of the study conducted by Balansag and Azuelo (2022) ^[1] revealed that the uses of Brain-based Blended approach help the students to get higher level of motivation in their order of preferences such as control of learning beliefs, self-efficacy extrinsic & intrinsic goal orientation, task value for learning, and test anxiety.

PROBLEM OF THE STUDY

The review of literature revealed that brain-based teaching has a significant positive impact on students' academic performance, self-concept, self-esteem, conceptual understanding, speaking skills, and reading ability across different age groups and educational levels, from kindergarten to higher education. Despite these encouraging findings, this area of research remains relatively underexplored across various subjects and educational stages. The literature also suggests that Whole Brain Teaching (WBT) enhances students' motivation, engagement, learning awareness, and reflective thinking. However, research on WBT in India is still limited and has primarily focused on academic achievement in science subjects. Furthermore, very few studies have examined its effectiveness among senior secondary students, particularly in Mathematics. This gap in the literature motivated the researchers to undertake the present experimental study to explore the effectiveness of Whole Brain Teaching in improving learning outcomes among senior secondary Mathematics students. Therefore, based on theoretical framework, the study aimed to examine, "effectiveness of whole brain teaching on academic achievement and self-concept of senior secondary school students in Mathematics, that was conducted to a modest endeavour to reveal the significance of WBT on students' achievements and self-concepts. And this aim was achieved through the following objectives.

2. OBJECTIVES OF THE STUDY

There are following objectives of the study:

- To study the effect of Whole Brain Teaching (WBT) on the academic achievements of senior secondary school students in Mathematics in Mathematics.
- To find out the effect of WBT on the self-concepts of senior secondary school students in Mathematics.

3. HYPOTHESES OF THE STUDY

To achieve the objectives of the presented study, following null hypotheses were formulated as following:

- There is no significant effect of WBT on the academic achievement scores of pre-tests and post-tests of senior secondary school students in Mathematics.
- There is no significant effect of WBT on the self-concept scores of pre-tests and post-tests of senior secondary school students in Mathematics.

DELIMITATIONS OF THE STUDY

- The 11th class students selected from the Rajasthan Board of Secondary Education, Rajasthan state, India.
- The experiment was done only for two units: - Permutation and Combination, Straight Lines.
- The current research was limited to classroom-based learning.

RESEARCH FOCUS

The study is experimental and aimed to examine the effectiveness of whole brain teaching on academic achievement and self-concept of senior secondary school students in mathematics. All variables measured with valid and reliable

scales. The study has adopted a quantitative approach toward obtaining and analysing data.

4. RESEARCH METHODOLOGY

General Background

In this study, the independent variable is the Whole Brain Teaching, used as a teaching strategy and academic achievement & self-concept of 11th grade students in Mathematics as the dependent variables. According to the nature and objectives of the study, experimental method was found most appropriate. Where the researchers had designed and conducted a pre-test of 11th class students for selecting their experimental group. A pre-test-post-test quasi experimental single group research design was adopted to complete the present study.

Sample

25 students of 11th class of Rajasthan Senior Secondary School, Jalpali, Shrimadhapur, Sikar (Rajasthan), India had taken for the study.

Instrument and Procedures

The study variables measured through valid and reliable scales namely; Achievement test and self-concept test in Mathematics. Researchers constructed and standardized these tests using two units (Permutation and Combination & Straight Lines) of 11th class NCERT book of Mathematics. First, as the pre-test of an achievement test & self-concept test in Mathematics administrated on the 38 students of 11th standard (senior secondary) and both tests, 25 students were found low achievers. With the help of experts and teachers, 20 lesson modules (each for 45-60 minutes) of same two units prepared by inculcating the following key elements of the Whole Brain Teaching Techniques (Attention getter, Brain engager, Direct instruction/ lesson chunks, Mirror words, Motivation). These lesson modules used as an intervention and experiment group taught through the same. After intervention post-tests were conducted by using the same tests as mentioned above.

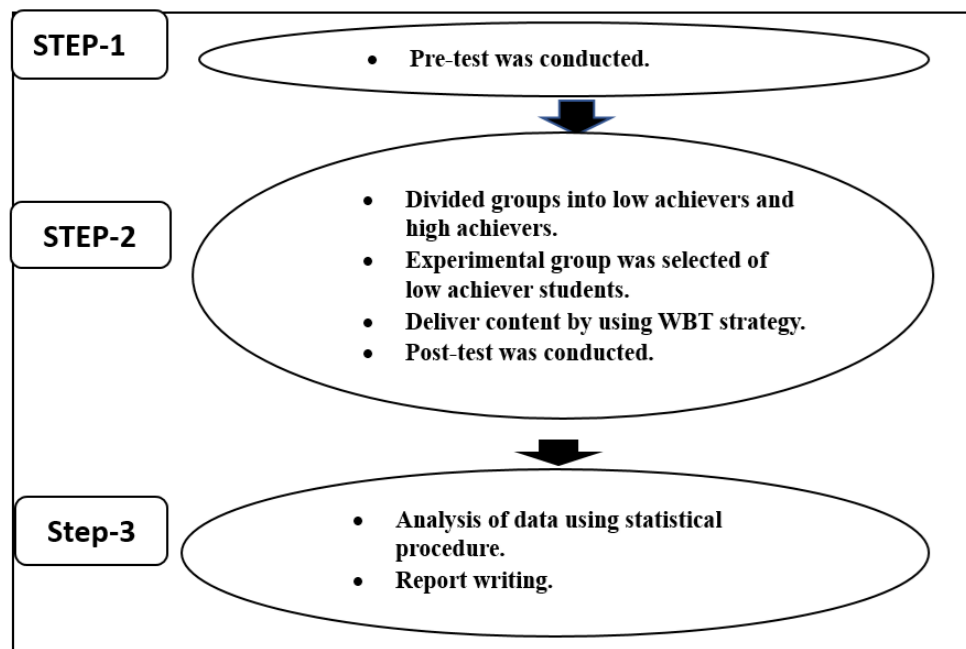


Fig 1: Diagrammatic Representation of the Research Design

DATA ANALYSIS

After that, as per the nature of the hypotheses, these were analysis through inferential statistics.

5. RESEARCH RESULTS

Data analysis had done by t-test. Considering male and female distribution, out of the total sample of 25 students, 15 (60%) were males and 10 (40%) were females. The analysis and interpretation with regards to effectiveness of whole brain teaching on academic achievement and self-concept of senior secondary school students in mathematics, are given below:

Analysis of the Effect of Whole Brain Teaching on the Academic Achievement of Senior Secondary School Students in Mathematics

Table 1: Effects of WBT on the Academic Achievement of Senior Secondary School Students in Mathematics

Group	N	Mean	S.D.	S.P.	t-test Value	Level of Significance
Pre-test Group	25	13.68	5.31	4.87	10.81	0.001
Post-test Group	25	28.56	4.38			

Interpretation

Table 1 highlights the effects of whole brain teaching on the academic achievement (pre-test and post-test group) of

secondary school students in Mathematics that calculated by the t-test and the value of “t” is 10.81 which is highly significant at 0.001 level of significance. It implies that the null hypothesis, “there is no significant effect of WBT on the academic achievement scores of pre-tests and post-tests of senior secondary school students in Mathematics.”, is rejected. A positive effect exists on the post-test result in students' academic achievement compared to pre-test. The mean values of the students after using whole brain teaching modules were noticed higher than the pre-test. Thus, there has a significant effect of WBT on the academic achievement of senior secondary school students in Mathematics. The same results also confirm findings of other studies (Duman's, 2010; Chavan, 2012; VanHosen, 2015; Sontillano, 2018) [9, 19, 18], which indicate significant effects of WBT on students' academic achievement.

Analysis of the Effect of Whole Brain Teaching on the Self-Concept of Senior Secondary School Students in Mathematics

Table 2: Effects of Whole Brain Teaching on the Self-concept of Senior Secondary School Students in Mathematics

Group	N	Mean	S.D.	S.P.	t-test Value	Level of Significance
Pre-test Group	25	40.76	10.46	10.10	10.63	0.001
Post-test Group	25	71.72	9.72			

Interpretation

Table 2 depicts the effects of whole brain teaching on the self-concept (pre-test and post-test group) of senior secondary school students in Mathematics, calculated by the t-test. The value of “t” is 10.63, which is highly significant at 0.001. It infers that null hypothesis that was “there is no significant effect of WBT on the self-concept scores of pre-tests and post-tests of senior secondary school students in Mathematics”, is rejected and there exists significant difference in the result of post-test in the self-concept of students as compared to pre-test. The mean values of the students after using whole brain teaching module were noticed higher than the pre-test. Thus, there is a significant impact of WBT on the self-concept of senior secondary school students in Mathematics. In a similar study, (Clark (2016) [6] also concluded that “whole brain teaching is a predictor of positive academic self-concept”.

6. CONCLUSIONS AND IMPLICATIONS

This study analysed the academic achievement and self-concept of students in Mathematics using the Whole Brain Teaching methodology. The study's main findings were that there had a significant effect of WBT on the academic achievement and self-concept of senior secondary school students in Mathematics. The main intention of WBT is to keep students attentive and engaged during classroom. It is also clearly observed that there was an improvement in social competency while using the WBT technique in the classroom. WBT is a type of multisensory instruction and a learning approach based on the brain (Wolken, 2017) [20]. It is founded on cooperative learning principles (Preslee & Prakasha, 2017) [13]. Moreover, As WBT strategy mainly focuses on the student's involvement,

engagement, and attention in the classroom during the teaching-learning process, this teacher should try to find out many other ways to attract student's attention that can make the WBT strategy more enjoyable and attractive.

The researches confirmed that the elements of the Whole Brain Teaching are designed to increase student's attention, motivation and control their failures in academic performance and improve their perception of their self-concept in the subject. Thus, it is suggested that the teachers should also have the whole knowledge of the WBT strategies so they can implement them properly in the classroom. They should always try to understand the learners' needs and keep in mind that learning through real world ideas is more beneficial than rote learning. This strategy is beneficial for adolescents to engaging them throughout the learning process. If students are shy in nature and introvert type person then teachers also can use WBT strategy as it is a co-operative learning that enhance the students' social interaction. They should always motivate the learner in a good way so that learner can again have power to give answers and also can ask their queries. Teachers also have to use more and more techniques to acquire students' attention and involvement in the classroom activities. To achieve a common goal, students work together in groups to repeat what they have been learned, allowing teachers to see where students are falling behind. The mirror word strategy also improves students' ability to operate in society. Overall, it all turns into the students' positive attitudes in Mathematics learning.

RECOMMENDATIONS

The findings of this study revealed several educational implications for students, curriculum planners, teachers, teacher educators and policy makers that they should support and implement the whole brain teaching into classroom practices. As well as, WBT as an effective educational strategy to assist all students in meeting the subject standards as well as enhancing and succeeding in a multicultural world, therefore it should include in pre-service & in-service teacher education as a teaching strategy. WBT is important in mathematics because it positively affects students' achievement and self-concept. Thus, it becomes important to provide training courses and workshops for teachers/faculty members in teaching mathematics on how to use WBT in their lectures. Moreover, WBT can also be used as a high-energy, hyper-focused style in which teachers can employ games, challenges, keywords, and motivational strategies to keep students fully engaged on the learning. It allows the teachers to effectively respond to these varied children by increasing cross-cultural understanding and academic accomplishments. In the long run, this will be extremely useful to all level of education.

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