Compare The Effect of Brain-Based Method and Traditional Method Regarding Students' Academic Achievement at Elementary Level

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Abstract

The study aimed to compare the effects of a brain-based teaching method versus a traditional method on elementary students' academic performance in General Science. Conducted using an experimental design with a pretest-posttest control group, the research involved all General Science students from Kotli AJ&K. The sample consisted of 60 students, randomly assigned to either an experimental group or a control group, each with 30 students. The study focused on the last four units of the General Science textbook, which were relevant for the third-term exams. The researcher created distinct lesson plans for both groups. A subject achievement test was administered as both a pretest and posttest. The control group received traditional instruction, while the experimental group was taught using a brain-based approach over eight weeks. The same pretest was given as a posttest to assess changes. Data analysis, conducted using SPSS version 23, employed paired sample t-tests to test the hypotheses. Results indicated that the brain-based method significantly outperformed the traditional method in enhancing students' academic achievement in General Science. The study concluded that students taught with the brain-based method achieved significantly better results compared to those taught with the traditional method.

Keywords: Brain-based method, Traditional method, Academic achievement, Elementary level.

Background of the Study

According to Pennington (2010) this learning is a complete balanced and complete learning approach that is based on current neuroscience research on how our brains naturally learn. The teaching learning process focused to obtained meaningful information by exploring ideas. Individual conceptual understanding plays a significant role in development of cognition among learners' and this learning is also considered as the combination of brain skills and individuals common-sense. Karen (2005) also defines brain-based learning as it includes using various learning methods on brain to encourage and enhance better learning strategies to improve learning of individuals. Brain-based learning is considered as effective teaching learning method that uses maximum brain's natural resources to strengthen spatial memory and enhance learners' knowledge and skills. This type of learning is basically considered as the application of important principles to enhance our thoughtful understanding that how our brain could work in an educational context.

The brain is social and possesses personal inner intelligence and enjoys interactive environments. Therefore, brain-based learning focused in planning instructional techniques and strategies in proportion to the learner and the environment so that brain areas of attention, emotion, and memory may be stimulated or activated (Schonert-Reichl 2017). Teaching learning by using the brain-based approach is not a quite easy and single task. This teaching learning process could only be completed by using and adopting different strategies that promote natural learning of learners to allow them to collect information in a natural way. Brain-based instructional strategies are effective because they are consistent with common sense and teach students how they can learn fearlessly (Erlauer, 2003).

Murniati, Susilo and Listyorini (2023) remarked that education is only possible when the brain is not forbidden from normal development and is structured by the proper shape and convenience of the brain all of this development is called brain-based learning. Similarly, some other researchers have defined a BBL method which is not measured as a simple program, as it is an inclusive teaching style based on the natural way our brains learn (Handayani and Purwati, 2022). Both of these researchers found that individuals can learn through certain teaching methods and learning processes that involve a natural boldness in the way they collect evidence around them.

Another researcher named Erlauer proposed the brain-based learning concept in his book which published in 2003 and stated that BBL could be considered as a friendly educational skill that can be achieved when it stimulates the collective intelligence of peers and mentors; they are easily surrounded by people recognize it. Likewise, the correct set of philosophical and neuroscientific foundations included in compatible brain teaching is known as BBL. BBL defined by Craig (2003) as brain based teaching and learning technique overcomes the influence of traditional education development, because unfortunately rote memorization and learning is a commonly practice in the classroom, as opposed to learning activities in the brain, and it is often used by teachers who are pleased to practice such traditional styles in education and also use in their teaching in their classrooms as this traditional approaches quite easy for them to use.

The common activities which a teacher perform in the institution during the ancients' period was the; verbally encouraged by the students, the learner was minimally involved in the preparation of classroom activities and the presentation of new concepts, whereas in learning teaching there was no connection between the learner's new concepts and higher concepts (Banner and Cannon 2017). By using concept-based learning as brain-based learning, it helps to restore learned learning as BBL is a hands-on education that improves the knowledge of the apprentice by working with the natural abilities of the brain and helps strengthen the learner's memory as well as skills (Davis, 2023).

Immordino-Yang, Darling-Hammond and Krone (2019) pointed out that our brain has a significant role of in human thinking, memory, emotions, and human development is the result of management of our thinking, emotions, and memory etc which may be considered as a success tool in various fields of our life. Education is fundamental to human society and is inseparable from progress in any field or region globally. As advancements are made, they contribute to the expansion of human knowledge and the processing of learning. Brain-based instruction is an educational approach built on trying to answer the question of what is most suitable for our brain and considered the learning that is consistent with the brain's owen style of learning in the mind (Jensen, 2008). It is the way of thinking about the all teaching learning process. It is not the solution to our every problem or issue we face, nor it is a technique or educational trend. If we see this in an instructor's viewpoint than it is not considered as a course or a method. Nonetheless, it is a system of values and the foundation of information and abilities upon which we may build more informed choices on the educational process. BBL is an approach to understanding the process of learning. It is a collection of guidelines and the basis for our knowledge and abilities that allow us to make more informed judgments regarding the process of learning (Jensen, 2008).

Brain-based learning approach links our learning to our brain in a such way that it works, claiming that improvements in brain performance and function which have a positively effect on learning. Therefore, learning often promotes development of brain. Neuroscience research examines the connections between human brain, its neural tissue, and intellectual reasoning behavior and learning. With discoveries in neuroscience and advanced technologies, brain-based learning has gradually become more clearly defined and promoted (Hansen & Monk, 2002).

Defining Brain-based Learning

According to Khadimally, (2016) instruction that considers the connections and information processing mechanisms of the brain is known as brain-based learning. It involves teaching concepts based on the anatomy and physiology of the brain. Learning take place as long as the brain is allowed to carry out its regular functions. It is the collection of exercises that are founded on brain research. It comprises of goals, resources, and techniques built on the idea of brain-based learning for use in different learning process.

Brain-Based Learning and Neuroscience

Simply stated, neuroscience is the branch of science which studied nervous system. Bear, Connors and Paradiso (2007) explain what the subject of neuroscience is in a more approachable way for laymen: "It is a natural fact that human nature is curious about what and how we see or hear, why some belongings hurt us or hurt others, how we move forward, how and why we reason, learn new things, remember something or forget an important thing sometime, the nature and reason of our anger and madness. These are most probably some mysteries which are initial to be discovered and might be the focused area of basic neuroscience research". According to this statement, neuroscience is interdisciplinary as well. To understand the nervous system, the findings from medicine, biology, psychology, chemistry, physics and mathematics must be examined.

Neuroscience as an individual scientific study is relatively young. The largest association of professional scientists in experimental biology named "The Society for Neuroscience" was founded in 1970 (Bear et al., 2007). There are, however, neuroscience sub disciplines, which have closer impact on brain-based learning. Judging by the citation from Cooke and Bear

(2010) neuroscience has a broad field of interest from which their research focused on the way of reasoning, learning, remembering and forgetting is of the greater importance for brain-based learning. The neuroscience sub discipline which embraces all these factors of human brain is called cognitive neuroscience. Every mental action, activity and process of receiving information and knowledge, thoughtful understanding through experience, and the senses is called Cognition and cognitive neuroscience studies it from the standpoint of biological processes.

Another neuroscience branch discipline which is incorporated to education through brain-based learning is social neuroscience. In this case, neuroscience examines how the biological processes affect social behavior (Siegel and Sapru, 2006). The study conducted by Louis Cozolino in 2013 focused on social neuroscience of education. The researcher remarked that brain-based learning applies discoveries from the field of cognitive neuroscience in the field of education. If we considered his point of view than we can say that the social neuroscience has not been considered by brain-based education.

Students' Academic Achievement

Generally, academic achievement can be categorized into two overarching definitions, with a broad and a narrow focus. Broadly, academic achievement encompasses the overall enhancement of students' abilities throughout their schooling years. Rahman, Zakariya & Naim Nor Ahmad (2020) suggests that academic achievement includes psychological and behavioral aspects in addition to cognitive and non-cognitive outcomes. According to Bloom (1956) academic accomplishment incorporates the procurement of information, improvement of values and perspectives, and authority of abilities or fitting ways of behaving.

Defining Academic Achievement

Academic achievement encompasses both broad and narrow definitions. Broadly, it refers to the overall improvement of students' abilities and outcomes during their academic journey. Astin (1985) highlights that academic achievement includes not only psychological and intellectual outcomes, but also mental and social styles. Bloom (1956) adds that it includes obtaining information, creating values and mentalities, and dominating abilities and ways of behaving. In contrast, narrow definitions of academic achievement focus specifically on students' measured performance in examinations at various educational stages. Li and Wang, (2022) equate academic achievement with academic performance that includes all aspects of students' knowledge, competence, and literacy development. Empirical studies often adopt this narrower definition, particularly in assessing primary and secondary school students, where academic achievement is commonly defined by researchers such as Li and Wang (2022), and Li and Chai, (2018) based on students' performance in school assessments like final examinations.

Statement of the Problem

In elementary General Science education, there is a notable absence of laboratory work. Currently, students primarily engage in practical tasks through note-taking or verbal responses to their teacher. The prevailing teaching method relies heavily on textbooks, fostering a rote memorization approach where students reproduce content verbatim without hands-on experience. This traditional method contributes to poor academic performance in General Science. In contrast, brain-based teaching methods advocate for a shift from rote learning to a more meaningful understanding through concept-based instruction, which could address the core issues of low academic achievement in the subject.

Significance of the Study

This study is intended to provide valuable insights for General Science teachers at the elementary level by identifying more effective teaching methods for their students. It aims to guide educators in selecting and implementing instructional strategies that can enhance student engagement and learning outcomes. By highlighting the benefits of a brain-based teaching approach over traditional rote learning, this research can assist teachers in planning and organizing their lessons more effectively. Additionally, the findings may suggest integrating practical work into the General Science curriculum, potentially leading to improved teaching practices and better academic performance among students.

Objective of the study

The objective of this study was as follows:

1. To compare the effect of brain-based method and traditional method regarding students' academic achievement.

Research Hypothesis

The research hypothesis of this study was as follows:

H_o1: There is no significant difference between the mean score of students' academic achievement taught through brain-based method and traditional method

Delimitation of the Study

The study was specifically focused on 8th-grade General Science students from District Kotli, AJ&K, and was conducted with a sample of 60 students from Government Boys High School Panag Sharif in the same district. The scope of the study was confined to four chapters from the General Science textbook: i) Reflection and Refraction of Light, ii) Electricity and Magnetism, iii) Technology in Everyday Life, and iv) Our Solar System.

Research Methodology

The research methodology details the strategy for collecting and analyzing data, along with the experimental components of the study.

Research Design

The study utilized an experimental approach with a true experimental design featuring a pretest-posttest control group setup. This design includes random assignment, which guarantees that each participant has an equal probability of being selected for any group.

Population and Sample

The study's population consisted of all 8th-grade General Science students from District Kotli, Azad Jammu and Kashmir. A purposive sampling method was employed to select Government Boys High School Panag Sharif, as it was the only school in the district with the required number of students. The researcher chose sixty students from this school as the sample for the study.

Instrument
The researcher developed a tool named the Subject Achievement Test, which was administered as both a pretest and a post-test to both the experimental and control groups.

Construction of Subject Achievement Test Items
A researcher-created Subject Achievement Test was used for both the pretest and post-test. The test featured concept-based items rather than text-based ones and consisted entirely of multiple-choice questions. It included 10 MCQs from Chapter 9, 12 MCQs from Chapter 10, 13 MCQs from Chapter 11, and 15 MCQs from Chapter 12, totaling 50 marks.

Validity of Instrument
To refine the test items developed by the researcher, the following procedures were implemented:
1. Alignment with Specifications: Ensured that the test items were proportionally aligned with the respective tables of specification for each chapter.
2. Expert Review: Collected feedback from educational experts to enhance the quality and relevance of the test items.

Lesson Plans for Both Groups (Control and Experimental)
Lesson plans for the control group were created using the traditional teaching method, while lesson plans for the experimental group were designed using the brain-based teaching method.

Data Collection
An experimental research design was employed for this study. The researcher first established two main groups and then randomly divided these groups into control and experimental subgroups. A pretest was administered to all students, and the results were collected. Following an eight-week treatment period, the same test—with rearranged items—was administered to both the control and experimental groups, and the results were subsequently gathered.

Data Analyses
The collected data was analyzed using the Statistical Package for the Social Sciences (SPSS) version 23. To test the research hypotheses, the researcher employed the paired sample t-test. This statistical test was used to compare the scores of the pretest and posttest.

Academic Achievement of Experimental Group

Table 1

Experimental group pretest post-test mean score

	Group	N	Mean	Std. Deviation	Correlation (Sig)	Sig (2-tailed)
Pair 1	Pretest	30	15.37	6.446	.245 (.192)	.000
	Post test	30	34.67	5.122		

Table 1 shows that the academic achievement of students was assessed by comparing the pretest and post-test scores. The mean pretest score was 15.37, while the post-test mean score was 34.67. The standard deviation for the pretest was 6.446, and for the post-test, it was 5.122, indicating that the pretest scores were more dispersed than the post-test scores. The results demonstrate an improvement in student performance following the treatment. The correlation between pretest and post-test scores in the experimental group was .245 with a significance of .192, suggesting a positive but not statistically significant correlation in academic achievement. The calculated mean score difference was 19.3 and 0.00 was significance level which is less than the alpha value of 0.05, indicated a significant difference in academic achievement before and after the intervention in the experimental group.

Academic Achievement of Control Group

Table 2

Control group pretest post-test mean score

	Group	N	Mean	Std. Deviation	Correlation (Sig)	Sig (2-tailed)
Pair 1	Pretest	30	15.33	6.424	.823 (.000)	.000
	Post test	30	20.00	5.977		

Table 2 reveals that the control group comprised 30 students. Academic achievement was evaluated by comparing the pretest and post-test scores. The mean pretest score was 15.33, while the mean post-test score was 20.00. The standard deviation for the pretest was 6.424, and for the post-test, it was 5.977, indicating that the pretest scores were more dispersed compared to the post-test scores. These results suggest an improvement in student performance following the treatment. The correlation between pretest and post-test scores in the control group was .823 with a significance of .000, showing a strong positive correlation and indicated increased academic achievement. The difference in mean scores from the pretest to the post-test was 4.67. The significance level was 0.00, which is below the alpha value of 0.05, indicated a statistically significant difference in academic achievement for students in the control group before and after the intervention.

Comparison of Academic Achievement in Experimental and Control Group

Table 3

Comparison of Pretest Post-test Mean Score of Control Group Academic Achievement

Control Group	N	Mean	Std. Deviation
Pretest score	30	15.33	6.424
Post-test score	30	20.00	5.977

Table 3 reveals that the pretest mean scores were 15.33 for the control group and 20.00 for the experimental group, resulting in an average difference of 4.67. Additionally, the standard deviations were 6.424 for the control group and 5.977 for the experimental group, indicating that the pretest scores were more spread out compared to the post-test scores. The mean values suggested that student performance in the post-test was slightly higher than in the pre-test.

Table 4

Comparison of Post-test Mean Score between Experimental and Control Group Academic Achievement

	Groups	N	Mean	Std. Deviation
Post-test score	Experimental	30	34.67	5.122
	Control	30	20.00	5.977

Table 4 illustrates that the post-test mean scores were 34.67 for the experimental group and 20.00 for the control group, resulting in an average difference of 14.67. Additionally, the standard deviation was 5.122 for the experimental group and 5.977 for the control group, indicating that the scores in the experimental group were more dispersed than those in the control group. The calculated mean values demonstrated that the experimental group performed better as compare to the control group.

Significant Mean Difference of Brain Based Method and Traditional Method on Students Academic Achievement (Hypothesis H_o1)

H_o1: There is no significant difference between the mean score of students' academic achievement taught through brain-based method and traditional method.

Table 5

Significant difference between brain-based method and traditional method on students' academic achievement

	Group	N	Mean	Std. Dev.	t	df	p value Sig (2-tailed)
Mean score	Control	30	15.35	6.380	-9.975	58	.000
	Experimental	30	27.33	9.227			

Table 5 presents the results of the mean score for the control group was 15.35, while the experimental group had a mean score of 27.33. This indicates a substantial difference of 11.98

points between the experimental and control groups, with the experimental group achieving significantly higher scores. The mean scores reflect notable improvement in the experimental group. Additionally, the standard deviation for the control group was 6.380, whereas for the experimental group was 9.227. This suggests that the scores in the experimental group were more dispersed than those in the control group.

The t value was -9.975, and the significance level (p-value) was 0.00, which is below the alpha threshold. This indicated a significant difference in academic achievement between students taught using the brain-based method and those taught using traditional methods. Therefore, the null hypothesis (H_o1) stating that there is no significant difference between the mean scores of brain-based and traditional methods on students' academic achievement was rejected. Consequently, the alternative hypothesis (H6), which posits a significant difference between the mean scores of brain-based and traditional methods on students' academic achievement, was accepted.

Findings of the Study

Following findings were made from the analyses of the data.

Before the intervention, both groups were tested to assess students' academic achievement. The pretest scores for the experimental group averaged 15.37, slightly higher than the control group's average of 15.33. The standard deviation for the experimental group was 6.446, compared to 6.424 for the control group, indicating that the experimental group's scores were slightly more dispersed.

The significance level of the difference was 0.984, which is greater than the p-value of 0.05, and the t-value was 0.020, showing statistical insignificance. These results suggest there was no significant difference in mean scores between the two groups before the intervention. Therefore, based on the pretest results, it was concluded that the academic achievement scores were similar in both groups prior to the intervention.

Findings about Objective 1: The Effect of Brain Based method and Traditional method on Students' Academic Achievement

It was indicated in table no. 5 that the calculated mean score of control and experimental groups were 15.35 and 27.33 respectively. This calculation revealed a difference of 11.98 in mean score of the experimental group which was significantly high than control group mean score. The mean results indicated that there was improvement in students of experimental group. Furthermore, the t-value is -9.975 and the p-value was 0.00 which was less than 0.05 indicated a significance difference in academic achievement of students' who taught through brain-based method in experimental group than control group. For this reason, it was found that brain-based method gave the significant results in improving academic achievement of students in general science subject at elementary level than the traditional method.

Discussion

The current study demonstrated a significant improvement in students' academic achievement when taught using the brain-based learning (BBL) method, confirming its effectiveness in enhancing academic performance. Brain-based learning not only optimizes cognitive functioning but also boosts academic scores (Klinek, 2009; McGuckin & Ladhani, 2010). Previous research supports these findings, showing that BBL improves brain function and student achievement (Shabatat & Al-Tarawneh, 2016).

The results of this study align with previous research indicating that brain-based learning is more effective than traditional methods in teaching general science and improving academic achievement (Duman, 2010). Uzezi and Jonah (2017) also highlighted the superior effectiveness of brain-based learning for student success. This study's findings are consistent with those of Wortock (2002) and Ceylan & Saka (2022), who observed similar improvements in academic performance with brain-based learning. Furthermore, Yağbasan & Altun (2023) found that brain-based learning enhanced achievement in social science subjects.

Overall, the study reinforces previous research (Duman, 2010; Gozuyesil & Dikici, 2014) indicating that brain-based learning is more effective than traditional teaching methods. These findings are corroborated by Davis (2004), Akyurek, and Afacan (2013), who applied brain-based methods in various subjects, including science and technology, and observed improved student outcomes.

Conclusions

Based on the findings of the study, the following conclusions have been drawn:

1. Improved Academic Achievement: The application of the brain-based method in the experimental group significantly enhanced students' academic achievement in general science. This method facilitates a deeper understanding and processing of information by leveraging the brain's full capabilities, leading to more meaningful learning experiences.
2. Active Learning vs. Rote Memorization: Unlike the traditional method, which often promotes rote memorization and results in passive learning, the brain-based method actively engages students. This approach encourages questioning, class discussions, collaborative work in pairs and small groups, and individualized tasks tailored to each student's needs.
3. Enhanced Engagement and Understanding: In the brain-based learning environment, students explore real-life problems, engage in various learning activities, and build new knowledge on existing understanding. This active involvement and contextual learning lead to significantly better academic performance compared to students taught using traditional methods.

Recommendations

1. The teachers may divide students in small groups on the basis of their critical thinking skill and academic achievement level within the classrooms for their better learning.
2. Students are encouraged to express their emotions, ideas, responses, and different points of view freely and without any hesitation.
3. There is a need to change the "General Science" textbook according to brain-based strategy instead of traditional one. So, general science curriculum may be reviewed and revised as per the findings of this study and prepare textbooks that promotes critical thinking of students through brain-based learning.
4. This study was experimental in nature. So, descriptive study may be conducted to check the effect or effectiveness of this method on students critical thinking and academic achievement.

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