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Interaction effect of Brain Hemispheric Dominance and Self-Concept on Academic Achievement in Mathematics

Parvinder Singh
P. G. Department of Mathematics, S.G.G.S. Khalsa College, Mahilpur. (Hoshiarpur), Punjab. (India)

Abstract: *Brain hemispheric dominance and self-concept are student level variables and are of great significance concerning their scholastic achievement. Analysis with interaction effects of the Brain hemispheric dominance and Self-concept with academic achievement in mathematics was ended in this study and discover that there is no significant relationship between academic achievement in mathematics and combined effect of brain hemispheric dominance and self concept.*

Key Words: *Brain Hemispheric Dominance, Academic Achievement, Self-concept*

I. Introduction

Mathematics is as old as humanity itself. Since antiquity, it has been fundamental to advances in science, engineering and philosophy. Mathematics involves simple counting, measurements and calculations and systematic study of numbers, shapes of different objects and motion of physical objects, through the application of abstraction, imagination and logic. The study of development of mathematics is long and impressive one. In early period, it advances in Egypt and revolutionary development in ancient Greece. In east remarkable developments in mathematic takes place particularly in China, India and Islamic empire which established across Persia, the Middle East, Central Asia, and North Africa.

1.2 Nature of Mathematics:

Mathematics is the science of logical reasoning where results are developed through the process of reasoning. By far most significant development in mathematics was giving it firm logical foundations. This took place in ancient Greece in the centuries proceeding Euclid. Logical foundations give mathematics more than just certainly the tool to investigate the unknown. As a science of abstract objects, mathematics relies on logic rather than an observation as its standard of truth. It employs observation simulation and even experimentation as means of discovering the truth. The special role of mathematics in education is a consequence of its universal applicability.

1.3 Achievement in Mathematics:

It is said that learning is not limited to mere acquisition of knowledge; it includes various other aspects such as attitude, interests, values etc. Rao (1964) said that academic achievement includes life goals, aspirations, study habits, emotional factors, personnel and social adjustment etc. Harrock (1969) defined academic achievement as "The state or level of person's skill, the range and depth of his knowledge and his proficiency in a designed area of learning and behavior."

Academic achievement in the present socio-economic and cultural context is of paramount importance. Dictionary of Behavioral Sciences (Wolfman, 1973) defined academic achievement as the level of proficiency attained in some specific area concerning scholastic domain such as reading, mathematics, science and social studies or some other subject.

1.4 Brain Hemisphericity:

Brain hemisphericity or the cerebral dominance of an individual is described as the retaining and processing of information with different modes in his own style of learning and thinking. Researchers have shown that the human left cerebral hemisphere is to be specialized for primarily in verbal, analytical, abstract, temporal and digital operations (Bogen 1969, Gazzaniga 1970, Ornstien 1972). The same investigation revealed that the right cerebral hemisphere is to be specialized for primarily non-verbal, holistic, concrete, creative, analogical and aesthetic functions. For identifying the hemispheric dominance, the ways in which levels at which the information is being processed by the individuals are to be studied.

1.5 Brain Hemispheric Dominance:

Brain hemispheric dominance is the use of the different sides of the brain in learning and listening patterns that is to mean, the consistence of using one side of the brain over the other. Herrmann (1995) "Brain dominance was expressed in terms of how we prefer to learn, understand and express something." The term brain is used to describe the thinking modes of the brain. Although a function may depend more on one hemisphere than the other (e.g., language, motor control), the notion that one hemisphere is dominant and the other is non dominant is possibly too simplistic for describing most tasks (Gabbard, 1997). Certain individuals possess qualities that make them double dominant. Their preferred mode of thinking allows them to use both hemispheres equally. Individuals that display a double dominance are able to use both sides of the brain to logically process thoughts and create intrinsic values and decisions. This stage is called whole brain dominance or integrated dominance.

1.6 Characteristics of the Left Brain Dominance:

Intellectual, remembers names, verbal response to instructions and explanations, experiments systematically and with control, makes objective judgements, planned and structured, prefers established certain information, analytic reader, reliance on language in thinking and remembering, prefers talking and writing, prefers multiple choice tests, control feelings, not good at interpreting body language, rarely uses metaphors and favours logical problems solving.

1.7 Characteristics of the Right Brain Dominance:

Intuitive, remember faces, responds to demonstrated, illustrated or symbolic instructions, experiment randomly and less restraint, make subjective judgements, fluid and spontaneous, prefers elusive, uncertain information, synthesizing reader, reliance on imaging in thinking and remembering, prefers drawing and manipulating objects, prefers open-ended questions, more free with feelings, good at interpreting body language, frequently uses metaphors, and favours intuitive problem solving.

1.8 Need to Use the Whole Brain:

The current educational system is designed to prepare students for jobs. Hence, they are trained to follow instructions and then perform. They are rarely taught to think on their own, because that would hamper their ability to follow instructions and do the job. If you are also a product of the current educational system, chances are high that the left hemisphere of your brain has received much more training and exercise than the more intuitive and creative right one. However, in today's rapidly changing world, development of only left hemisphere functioning is no longer enough. The future jobs and society will require more proportion of creative and intuitive thinking and the ability to execute. So, it is imperative to learn how to develop and integrate both sides of the brain and use it as whole.

1.9 Self-concept:

Not to be confused with self awareness, self consciousness, self Image or self perceptions. Self-concept (also called self-construction, self identity or self perspective) is a multidimensional construct that refers to an individual's perception of 'Self' in relation to any number of characteristics such as academics and non academics. Self-concept is an internal model which comprises self assessment. To gain a better understanding of our self-concept it is important that we examine our personality. An analysis of our thoughts and feelings about ourselves and the world around us can assist us in this process.

According to the 'Dictionary of Education' by Taneja (1989) "self concept refers to the picture or image a person has of himself.

"Self-concept is the product of reflectivity; it is the concept of the individual of himself as a physical, social and moral and existing being. The self-concept is sum total of the individual's thought and feelings about him or herself as an object "John (2000).

1.10 Self-concept and Academic Achievement:

Self-concept is frequently positively correlated with academic performance, but it appears to be a consequence rather than a cause of high achievement (Baumeister et. al., 2003). This suggests that increasing students' academic skills is a more effective means to boost their self-concept than vice versa.

Most of the researches showed relentless support towards the belief that there is a significant relationship between academic self-concept and academic achievement in secondary and post-secondary school students (Cokley & Patel, 2007; Gordon, 1997; Yara, 2010). Recent study by Yara (2010) on student's self-concept and mathematics achievement in some secondary schools in South-Western Nigeria revealed that students with good self-concept perform well in mathematics. Cokley (2000) found that the grade point average was the best predictor of academic self-concept for students attending predominantly white colleges and universities.

1.11 Review of literature:

Kaur & Shikha (2012) made an attempt to find out the correlation between personality and hemispheric preferences among science and arts stream students of secondary school of Jalandhar city in Punjab. Study revealed that there exist a significant relationship between hemisphericity and some personality traits namely general ability, creativity, self-control and social warmth, individualism and sensitivity.

Archna (2012) in her study revealed that there is a significant and positive relationship between the select variables namely self-concept and academic achievement of students in different categories of schools following different systems of education at higher secondary levels.

Asako (2012) investigated the relationship between eighth grade student's mathematics related self-concept and their achievement in the Trends in International Mathematics and Science Study (TIMSS). The finding demonstrated that the student's mathematics self-concept was positively associated with their achievement both in United States and Japan.

Karimzade and Mohseni (2013) investigate the relationship between self-concept and academic achievement among 300 female students in Tehran. The study revealed that in both groups academic self-concept could predict academic achievement ($p < .000$).

Gurdeep kaur & Brij Lal (2013) investigate the relationship of style of learning and thinking (SOLAT) in the right cerebral dominance with achievement in mathematics, creativity and right or left handedness among school children. Study reveals that high achievers school children differ from low achiever school children on style of learning and thinking scale measure in their right cerebral dominance. It may be due to the reason that achievement in mathematics depends upon right cerebral dominance of school children in processing different modes of information and mathematical operations.

Humera (2015) in his study hemispheric dominance and mathematics achievement of 10th standard students of Aurangabad city. Research finding reveals that majority of the students have right hemispheric dominant style of learning and thinking. No significant difference was found between mathematics achievement of students with respect to different hemispheric dominant style of learning and thinking. No significant difference was found between mathematics achievement of girls and boys.

Ferrer (2015) disclosed that there were no significant correlation between the learner's brain dominance and their performance in mathematics. By calculating coefficient of correlation using Pearson product moment correlation to determine the relationship of learner's performance in mathematics and the percent dominance of being left-brained or right brained.

1.12 Objectives of the study:

The present study was undertaken by keeping in view the following objectives:

1. To find out the level of Brain Hemispheric Dominance of senior secondary stage students.
2. To study the relationship between academic achievement in Mathematics with Brain Hemispheric Dominance and Self-Concept.
3. To study the interactional effect of Brain hemispheric dominance and self concept with academic achievement in mathematics.

1.13 Hypotheses of the study:

On the basis of above mentioned objectives the following null hypotheses have been framed.

H1: There is no significant difference between level of (left, right or whole) brain hemispheric dominance of the students.

H2: There is no significant relationship between academic achievement in mathematics and brain hemispheric dominance.

H3: There is no significant relationship between academic achievement in mathematics and self-concept of the students.

H4: There is no significant interactional effect of brain hemispheric dominance and self-concept of a student on academic achievement in mathematics.

1.14 Tool used:

The following Research tools were used to collect data for the present study

1. Brain Hemispheric Dominance test. (style of learning and thinking), (D.Venkataraman, 1994).
2. Self-Concept Scale (R.K. Saraswat, 1992).

1.15 Sample:

In the present study researcher had selected a sample of 600 students of class XI and XII from the Government and Non-Government senior secondary Schools of Hoshiarpur, Jalandhar and Nawanshahar districts. From each of these districts namely Hoshiarpur, Jalandhar and Nawanshahar 200 students were selected for sample out of which 100 are boys and 100 are girls.

1.16 Results and Discussion:

In this section by using statistical techniques verify the various hypotheses of the study as under

Table: 1.1 Distribution of the male and female students in terms of their level of brain dominance

Sex	Right Dominance	Left Dominance	Whole Dominance	Total
Boys	216(49.3%)	58(61.7%)	26(38.2%)	300
Girls	222(50.7%)	36(38.3%)	42(61.8%)	300
Total	438(73.0%)	94(15.7%)	68(11.3%)	**G.T.=600**

Chi Square = 8.996, *df* = 2, p = 0.011 < 0.05

Hypothesis H1:

Table 1.1 reveals that among all 600 students surveyed 438(73.0%) was found to be right brain dominant students and among them 222(50.7%) was the girls and 216(49.3%) were the boys respectively. The 94(15.7%) of the total students were found to be left brain dominant students and among them 58(61.7%) was the boys and 36(38.3%) of the students were girls. The proportions of whole brain dominant students were 68(11.3%) of the total students and among them 42(61.8%) were the girl students while 26(38.2%) are the boys. Therefore it is observed that majority of the girls are whole brain dominant while on being right brain dominance approximately both the sexes are in equal proportion. Hence by using Chi square hypothesis H1 is rejected.

Table: 1.2 Correlation analyses of the academic achievement in mathematics and the brain hemispheric dominance

		Right Dominance	Left Dominance	Whole Dominance
Academic achievement in mathematics	Karl-Pearson Co-efficient of correlation	-.069	.069	.026
	P value	.093	.091	.531
	N	**600**	**600**	**600**

Hypothesis H2:

Table 1.2 gives the correlation analysis of the brain hemispheric dominance of the students with their academic achievement in mathematics. The analysis of the table 1.2 shows that the null hypothesis H2 was accepted as there is no significant relationship was established among the brain hemispheric dominance of the students and their academic achievement in mathematics. It is analyzed that the correlation co-efficient between the academic achievement in mathematics and the right brain dominance was r = -0.069 which is negative and not significant at .05 and .01 level of significance. Correlation co-efficient between the academic achievement in mathematics and left brain dominance was r = 0.069 which is positive and not significant and lastly the correlation co-efficient of the whole brain dominance of the students and their academic achievement in mathematics was r = 0.026 which is also positive and not significant at any level of significance.

Table: 1.3 ANOVA analysis of the academic achievement of the students categorized on basis of their self-concept scores

Category	N	Mean	SD	F Test
Average self-concept	27	69.22	14.050	1.970
Above Average self-concept	477	74.45	14.351	p = 0.249
High self-concept	96	75.29	15.137	**Significant**
Total	**600**	**74.35**	**14.487**	

Hypothesis H3:

Table 1.3 shows that mean academic achievement score in mathematics with average self-concept is 69.22with standard deviation of 14.050, with above average self-concept the mean score is 74.45 with standard deviation of 14.351, with high self-concept score is 75.29 with standard deviation of 15.137, the null hypothesis assumed H3 is rejected as F value is 1.970 and p value is 0.249 which is significant at .01 level of significance and shows that there is significant relationship among the different categories of the self-concept of the students with their academic achievement scores in mathematics.

Table: 1.4 ANOVA analyses with interaction effect of the brain hemispheric dominance and self-concept on the academic achievement in mathematics

Source	Type III Sum of Squares	df	Mean Square	F	P value
Corrected Model	2992.138[a]	8	374.017	1.801	0.074
Intercept	147928.972	1	147928.972	712.443	0.000
Dominance	196.583	2	98.292	0.473	0.623
Self-Concept	892.200	2	446.100	2.148	0.118
Dominance* Self-Concept	948.033	4	237.008	1.141	0.336
Error	122505.328	590	207.636		
Total	3436329.000	599			
Corrected Total	125497.466	598			

Hypothesis H4:

Table 1.4 shows that the null hypothesis H4 has been accepted as there is no significant interactional effect ($p = 0.336 > 0.05$) of the brain hemispheric dominance and self-concept was revealed for the academic achievement in mathematics scores of the students. Thus it is concluded that combined effect of the brain hemispheric dominance and self-concept of a student has nothing associated with academic achievement in mathematics.

1.17 Conclusions: From the above study it was concluded that

- Majority of the boys are left brain hemispheric dominant.
- Majority of the girls are of whole brain hemispheric dominant.
- Being right brain hemispheric dominance approximately both the sex are in equal proportion.
- There is no significant relationship between academic achievement in mathematics and brain hemispheric dominance.

- There is significant relationship among the different categories of the self-concept of the students with their academic achievement scores in mathematics.
- There is no significant relationship between academic achievement in mathematics and combined effect of brain hemispheric dominance and self concept.

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