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Interaction effect of brain hemispheric dominance and study habits on academic achievement in mathematics

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Abstract

Brain hemispheric dominance and study habits are student level variables and are of great significance concerning their scholastic achievement. Analysis with interaction effect of the Brain hemispheric dominance and study habits with academic achievement in mathematics was ended up in this study and discovers that there is a significant interactional relationship between academic achievement in mathematics and combined effect of brain hemispheric dominance and study habits of a student.

Keywords: Brain Hemispheric Dominance, Academic Achievement, Study Habits

1. 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) ^[15] said that academic achievement includes life goals, aspirations, study habits, emotional factors, personnel and social adjustment etc. Harrock (1969) ^[6] 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) ^[17] 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,

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Gazzaniga 1970, Ornstien 1972)^[18, 5, 13]. 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)^[10] "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)^[4]. 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 Study habits and Academic Achievement

Many students fail in their examinations not because they lack of knowledge or ability, but because they do not have adequate study habits and study skills (Menzal, 1982)^[19]. Good students are not born but are made by constant and deliberate practice of good study habits for which there is no substitute. Thus in order to improve student's academic achievement in different aspects of education it is essential to improve their good study habits. According to (Kizlik 2001)^[20] development of good study habits in children depends upon the combined efforts of parents and teachers.

Study habits as a research variable has been studied by many of the researchers (e.g. Kochar 2000, Jain 1965)^[21, 22]. Most of the pupils of today lack depth of thought and breadth of vision due to bad study habits. Effective study habits are learned at home and school. Parenting means teaching our children, these skills and making them habits. Study skills are so important to improving grades and achievement in academics. There are some poor study habits such as poor attendance, poor note taking, poor time management, last minute work, procrastination, failure to read directions, over confidence, lack of concentration during learning, etc, a student has to overcome these systematically to increase in his academic achievement.

"The triangular relationship between parents, teachers and child makes the child on the receiving end and two factors come into play, education and family" (Jawaharlal Nehru.)

1.10 Review of literature

Singh (2010)^[23] examine the nature, type and characteristics of study habits in high school children in relation to various organic variables like gender, age, class or grade level and scholastic achievement. Study revealed that girls have better study habits than boys, which is matched with similar lower ratings given by their class teacher. It is also seen that study habits improve with age and class or grade levels in children. Study further revealed that there is no significant difference between students in relation to gender, grade/class of study or age of students.

Ergene(2011)^[3] in his study investigate the relationship among study habits, test anxiety, environment motivation and academic success in a Turkish high school for class 10th students by using study habits inventory and showed that study habits and anxiety were positively associated with academic achievement.

Singh (2011)^[24] conducted a study consisting of 100 higher secondary students selected randomly, revealed that there is significant difference between study habits of boys and girls. Study also revealed that there is a positive significant correlation between study habits and academic achievement of boys and girls.

Hassanbeigi (2011)^[8] investigate the relationship between various study skills and academic achievement of university students. Study indicated that there is significant positive correlation between study skills and academic performance of the students.

Kaur & Shikha (2012)^[11] 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.

Kumar (2013)^[14] made an attempt to find out the effect of home environment, school environment and study habits on academic achievement of scheduled caste students. Study reveals that there was no significant relationship between study habits and academic achievement. Home environment had significant effect on academic achievement but school environment does not play a significant role in academic achievement.

[Kaur & Lal (2013)^[25] 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)^[7] 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)^[9] 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.

1.11 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 Study Habits.
3. To study the interactional effect of Brain hemispheric dominance and study habits with academic achievement in mathematics.

1.12 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 levels of 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 study habits of the students.

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

1.13 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)^[26].
2. Study-Habit Inventory (Mukhopadhaya and Sansanwal, 2005)^[27].

1.14 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 Nawanshahr districts of Punjab. From each of these districts namely Hoshiarpur, Jalandhar and Nawanshahr 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. Table 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.

Table1.3: ANOVA analysis of the academic achievement of the students categorized on basis of their study habit scores

Category	N	Mean	SD	F Test
High study habits	1	68.00	.	1.975
Above Average study habits	1	83.00	.	p = 0.281
Moderate study habits	23	82.43	14.352	
Below Average study habits	108	75.16	16.120	Significant
Poor study habits	219	53.03	14.669	
Very Poor study habits	248	51.35	13.536	
Total	600	74.33	14.534	

Hypothesis H3

Table 1.3 shows that the students having high study habits have 68.00 mean score on academic achievement in mathematics, with above average study habits mean score is 83.00, with moderate study habits mean score is 82.43 with standard deviation of 14.352, with below average study habits mean score is 75.16 with standard deviation of 16.120, with poor study habits mean score is 53.03 with standard deviation of 14.669 and with very poor study habits mean score is 51.35 with standard deviation of 13.536. F value is **1.975** and **p value is 0.281** which is significant thus the null hypothesis assumed H3 is rejected as there is significant relationship was reported among the different study habits of the students with their academic achievement scores in mathematics.

Table1.4: ANOVA analyses with interaction effect of the brain hemispheric dominance and study habits on the academic achievement in mathematics

Source	Type III Sum of Squares	df	MeanSquare	F	Pvalue
Corrected Model	7198.059 ^a	12	599.838	2.952	0.001
Intercept	138287.749	1	138287.74	680.500	0.000
Dominance	96.480	2	48.20	0.237	0.789
Study Habits	360.745	5	72.149	0.355	0.879
Dominance* Study Habits	3683.327	5	736.665	3.625	0.003
Error	118271.033	582	203.215		
Total	3412613.000	595			
Corrected Total	125469.092	594			

Hypothesis H4

Table 1.4 shows that the null hypothesis assumed H4 is rejected as there is significant interactional effect ($p = 0.003 < 0.05$) of the brain hemispheric dominance and study habits 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 study habits has strong association 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 between different categories of the study habits of the students with their academic achievement scores in mathematics.
- There is significant relationship between academic achievement in mathematics and combined effect of brain hemispheric dominance and study habits of a student.

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