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### RESEARCH ARTICLE

#### IMPACT OF LEARNING AND THINKING STYLES ON ACADEMIC ACHIEVEMENT AMONG SECONDARY SCHOOL STUDENTS OF MYSURU DISTRICT

Bettaswamy H.B.<sup>1</sup> and Praveena K.B.<sup>2</sup>

1. Assistant Professor, BGS B.Ed College, Kuvempunagar, Mysuru, Karnataka, India.
2. Professor, DOS in Education, University of Mysore, Mysuru, Karnataka, India.

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#### Abstract

Learning and Thinking styles are the ways students take in process and remember information. The present study was undertaken to know the effect of learning and thinking styles on academic achievement of secondary school students. Academic achievement was treated as dependent variable whereas; learning and thinking styles are independent variables. Both the hemisphere of brain and their functions consider knowing the holistic performances of the students. Locality, Gender and Type of school were treated as background variables. A sample of 240 secondary school students was selected through multi-stage random sampling technique. Style of Learning and Thinking (SOLAT) test developed by Venkataraman (2011) was used to measure learning and thinking style of students in terms of their hemisphericity functions of the brain. The obtained data were analyzed using Three Way ANOVA with  $2 \times 2 \times 2$  factorial design. Levine's Test of Homogeneity of Variance was also applied to test the assumption of homogeneity of variance for ANOVA. Main effects of learning and thinking style, locality and gender on academic achievement of secondary school students were found to be significant. Significant interaction effect of learning & thinking style and locality; learning & thinking style and gender was reported on academic achievement of secondary school students. The findings of the present study have an implication for teachers that they should find out the domain part of their students' brains first and then use the appropriate classroom techniques, methods and tools according to them only then better and greater learning can be accomplished. Results of the study revealed that Active Learning Styles were effective in enhancing the Thinking Styles and Academic Achievement among the secondary school students. The study also showed a positive significant correlation between Thinking Styles and Academic Achievement among Secondary school students.

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#### Introduction:-

“By Education I mean all-around development, drawing out of the best in the Child body, mind and spirit.” – Mahatma Gandhi.

**Corresponding Author:- Bettaswamy H.B.**

Address:- Assistant Professor, BGS B.Ed College, Kuvempunagar, Mysuru, Karnataka, India.

Education presumes that creative spark may be kept alive throughout life, and moreover that it maybe rekindled in those who are willing to devote a portion of their energies to the process of becoming intelligent. Educational approaches grow high functioning students who are physically, socially emotionally and intellectually engaged. Learner characteristics, items of the interior conditions such as learning style, age, maturity level, interest is essential in designing learning environments process. Many educators are still perplexed about the styles of students in learning and thinking process, what effects these styles have on children's performance in schools and why attention should be given to children's performance to assess their levels of ability.

According to William James (1895) Learning is the sum total of an individual's life experience acquitted through socialization process. It exceeds a mere acquisition of factual information or mastering of skills. Thinking is a pattern of behavior in which we make use of internal representations of problem. Thinking is problem solving process in which we use ideas or symbols in place of overt activities. It is essentially a cognitive ability. Most people are somewhat flexible in their use of styles, and to adopt themselves to the stylistic demands according to situations. It is important for the parents and teachers to understand the nature of the student's mind and its function and their different styles of learning and thinking. Styles depend upon the cerebral dominance of an individual in retaining and processing different modes of information in his own style of learning and thinking. The differences in preference of the two hemispheres for information processing have been referred to as styles of learning and thinking (SOLAT). It indicates a student's learning strategy and brain hemisphere preference in problem solving. It may be possible to train individuals to modify their information processing procedures to best fit their demands of the cognitive tasks. (Venkataraman 1994).

### **Concept Of Learning Styles**

David Kolb's (1971) defines that learning styles is a term generally used to describe an individual's natural or habitual pattern of acquiring and processing information in learning situations. Proponents for the use of learning styles in education said that teachers should assess the learning styles of their students and adapt their classroom methods to best fit each student's learning style. By recognizing and understanding our own learning styles, we can use techniques better suited to us. This improves the speed and quality of our learning. Learning style uses the three main sensory receivers: Visual, Auditory, and Kinesthetic (movement) to determine the dominant learning style. It is sometimes known as VAKT (Visual, Auditory, Kinesthetic, & Tactile). It is based on modalities that are channels by which human expression can take place and is composed of a combination of perception and memory. VAKT is derived from the accelerated learning world and seems to be about the most popular model nowadays due to its simplicity.

### **Concept Of Thinking Styles**

Thinking, Hannah Arendt (2002) once wrote thinking is "the quest for meaning". But just what is the nature of this quest? John Dewey clarified it a bit by defining thinking as that operation in which present facts suggest other facts (or truth) in such a way as to induce belief in the later upon the ground or warrant of the former. To be even more precise, thinking is the mental manipulation of sensory input and recalled perception of formulate thoughts, reason about or judge. The synonyms assigned to the verb to think suggest the many facts or dimensions of thinking. For instance, we use the word to think to mean to decide, and we use the verb to think to mean to believe. Indeed, the verbs to think is also synonymous with ponder, invent, weigh, imagine, anticipate, predict and form in the mind. Thinking involves and serves a multitude of functions. It is a complex phenomenon.

### **Concept Of Academic Achievement**

According to Malavika Ganguli, (1978) Achievement is the accomplishment of acquired efficiency in the performance of an individual in a given skill of body of knowledge. It means the knowledge attained or skills developed in the college subjects usually designated by test scorer or by marks assigned by the teacher/university or by both. Since academic achievement is the criterion for selection, promotion or recognition in various walks of life, the attention of educators is being increased on academic achievement. Academic achievement is defined as success in completion with standard of excellence.

### **Need And Significance Of The Study**

This study addresses the need for research into the relationship between achievement, thinking and learning styles. An insight gained from this study enables the learners to improve the existing learning situations as well as develop new, more effective programs for learners. This study gives additional information on the nature of achievement and specific relational qualities necessary for the identification of achievement in individuals. It is foremost important for

the teachers to focus their attention on student's favorite thinking styles before imparting the subject matter. If they fail to do so, the consequences may be serious because the teachers may tend to confuse styles of student's mind. Since the method of teaching adopted by the teachers often reflects their personal thinking style, the students who the same thinking styles of the teachers are only benefited and rewarded. Any subject can be taught in any way that is compatible with any style; students will seek learning activities that are compatible with their own preferred styles.

The important thing to understand is how we learn and process information, so we can help ourselves study in the way most conducive to us. Those individuals in the world who have learned to recognize and understand their own learning styles are the most likely to succeed. Knowing their own learning style also profits the students outside of an academic setting. It provides an indication as to their possible strengths and weaknesses. Though this does not ever serve as an excuse for not paying attention or producing substandard work, it may be able to give assistance in determining what career to pursue or how to go about completing work in their own profession. The study will also analyze the different thinking styles and learning styles of the students. So, the present study is needed.

## Reviews Of Related Literature:-

### Studies Related To Learning Styles;

**Shetty (2014)** examined on the "meta cognition levels of student teachers and their learning styles". It was found in the study that "there were higher levels of Meta cognition on the sample collected in the study". The sample of 172 was considered in the study. As per the research method was concerned the researcher have used the Descriptive Survey Method. While taking into consideration the nature of the data the researcher has used the t-test. The main purpose of using the t-test was that the researcher wanted to compare the mean scores on Meta cognition of student teachers those who have different learning styles. It was found that Extraversion, Sensing, Feeling and judging combination were very high among them.

**Singh, Goil and Rani (2015)** examined a study on learning styles preferences among 300 secondary school students. Central tendencies measure and chi-square test were computed through SPSS to analyze the data. The study revealed that visual style of learning was most preferred by students followed by auditory, tactile and kinesthetic learning style. The Learning styles of students were significantly influenced by mother educational level. The study also revealed that gender, place of living, religion and educational level of father not significantly impacted the learning styles of secondary students.

**Satyanarayana & Hoovinabhavi (2016)** studied achievement motivation of university students in relation to their learning styles. Out of the total of 100 students 50 males and 50 females were taken as sample from Gulbarga University. Learning Style Inventory (K.S Mishra, 1971) & achievement motivation scale (Deo Mohan, 2002) were used as tools to collect data. Mean and F-ratio were used to analyze the data. The study showed that learning styles and academic motivation not significantly differ among university students. It also showed that significant relationship existed between gender and locality in relation to learning styles and academic motivation.

### Studies Related To Thinking Styles

**Bruce Vansledright, Liliana Maggions & Kim Reddy (2011)** study on teachers to teach historical thinking? The interplay between professional development programs and school systems cultures has the objective to compare the results of three nearly identical professional development programs implemented with the support of Teaching American History (TAH) grants. The study focuses on results from these programs efforts to reshape how the History teachers work with think about and teach History to their students. The History teachers in these three TAH program appear to be squeezed in between two counterpoised modes of thinking and operation. The views of the researchers after the study is that the teachers hold some overlapping and shared attitudes, what distinguishes them is the value placed on those attitudes. One champions and stresses one attitude over other while the other inverts that valuation. The belief appears to be that if teachers tell the story. The students will get it and it seems most efficient process.

**Nalcaci, Ahmet (2012)** study on the relationship between the individual values and critical thinking skills of prospective social sciences teachers aimed to determine the relationship between them. The sample of the study consists of 298 prospective teachers, who are first year, second year, third year and fourth year students. They were randomly selected and the data of the study have been obtained using a personal value scale and critical thinking scale. The research reveals that a positive significant result has been obtained among the scores for the critical thinking and personal value factor perceived by the prospective teachers. From the study it was also observed that personal values factors collectively predict 42% of the critical thinking score.

**Denise Lorraine Trombino (2013)** study on the experiences of secondary social studies teachers with historical thinking skills is a mixed method of study investigated secondary social studies teachers' college course experience with and classroom use of historical thinking skill. Questionnaire prepared by the investigator was distributed to 64 teachers in the mid-Atlantic region of the United States. Observation, interview, and analysis of instructional documents were used to gather data. The result revealed that high school social studies teachers showed a range of experience with and use of historical thinking skill. The teachers also reported more exposure to historical thinking skill in content courses than in method course. The majority of teachers reported limited exposure to and use of explicit instruction. The responses to the open-ended items suggested that teachers used historical thinking skill in college courses to varying degrees, they included sources in their lessons, and they desire specific training related to historical thinking skill and their teaching assignments. During the interview teachers reported more exposure to historical thinking skill in content courses as opposed to method courses. The classroom observations indicated that teachers incorporated diverse sources in to their lessons. Teachers used questioning techniques to involve students in critical analysis of source material.

**Studies Related To Academic Achievement**

**Singh, Malik and Singh (2016)** conducted a study to “examine the academic performance of 200 students on the basis of learning facilities, communication skills and proper guidance from parents”. The sample of 200 was taken in the study. As for as design of the study was concerned an “ex-post facto research design” was applied while taking into consideration the operation of the variables of the study. Simple random sampling for selection of the sample was used in the study. As per the analysis technique was concerned multiple regression results presented that learning facilities, communication skills and proper guidance from parents were the significant predictors of academic achievement.

**Sarkar and Bankim (2017)** explored the academic achievement and adjustment of 120 students (60 boys & 60 girls) on the basis of age and gender. For selection of the sample, the researcher has used simple random sampling. As per the method was concerned the researcher have used the descriptive survey method. On the basis of the results regarding the gender there was no significant difference in academic achievement. Furthermore, “a significant relationship was found in academic achievement” and adjustment between students in the adolescent period.

**Dooley (2018)** conducted a study on “academic achievement of students on the basis of gender, location of the school and management type”. The researcher took the sample of 210 students. Thus, it was exposed in the study that, significant difference existed in academic achievement while considering the locality of the school and management type of school. Also found that students belonging to urban and government schools had better academic achievement as compared to rural and private schools.

**Statement Of The Problem**

**“Impact of Learning and Thinking styles on Academic achievement among secondary school students of Mysuru district”**

**Objectives Of The Study:-**

1. To assess the Levels of Left Hemisphere, Right Hemisphere, and Whole Hemisphere of secondary school students
2. To assess the Levels of Academic Achievement of secondary school students
3. To find out the relationship between Left Hemisphere, Right Hemisphere, Whole Hemisphere and Academic Achievement
4. To find out the association Between Gender and Area with Left Hemisphere, Right Hemisphere, Whole Hemisphere and Academic Achievement.

**Hypotheses Of The Study:**

- H1: The levels of Left Hemisphere, Right Hemisphere, and Whole Hemisphere are not uniformly distributed among secondary school students
- H2: The levels of academic achievement are not uniformly distributed among secondary school students
- H3: There will be relationship between Left Hemisphere, Right Hemisphere, Whole Hemisphere and Academic Achievement
- H4: There will be significant association Between Gender and Area with Left Hemisphere, Right Hemisphere, Whole Hemisphere and Academic Achievement.

## Operational Definitions

### Learning Style

Learning styles have been widely defined “as the individual preference process to use in learning. Each student has his/her own style frequently used for understanding, analyzing, manipulating, processing, interpreting and assimilating the concept”

### Thinking Style

Thinking style is defined as a habitual pattern or preference in how individual’s process information, approach problems and make decisions. It reflects cognitive, emotional and behavioral tendencies.

## Variables Of The Study

### MAIN VARIABLES

1. Thinking Style.
2. Learning Style.
3. Academic Achievement.

### Background Variables

1. Gender (Boys & Girls)
2. Locality (Rural & Urban)

Type of School (Govt. Aided & Unaided/Private)

## Research Methodology:-

The researcher has selected the survey research method of descriptive type. In this study, researcher has selected samples of 240 respondents from the different schools of Mysuru district, population and administered the tools of the study that is SOLAT inventory. Academic Achievement Scores were collected through examination results for data information.

## Design Of The Study

The study is of survey in nature where in the mention variables like learning and thinking styles, achievement of students is surveyed and relationship between these variables is studied.

## Sample And Sampling Procedure

For this study, samples of 240 students from different schools were taken. The sample comprised of Boys & Girls studying in 8 & 9 standards in Government, Aided & Unaided Schools of Urban & Rural background. Simple Random Sampling technique was used. The questionnaire (SOLAT) which consisted of 50 items were given and achievement test which was based on common state syllabus.

Sampling Procedure											
Total 240											
Urban 120						Rural 120					
Govt. 40		Aided 40		Unaided 40		Govt. 40		Aided 40		Unaided 40	
M	F	M	F	M	F	M	F	M	F	M	F
20	20	20	20	20	20	20	20	20	20	20	20

## Development And Validation Of Instruments For The Study

To study the major objectives, the tests developed were,

1. SOLAT tool.
2. Achievement test.

### Solat Tool

SOLAT (Styles of learning and thinking) tool developed by Venkataraman (1994) is used in the present study. It is a modified version of the tool developed by Torrance. It is identified hemisphere dominance by way of studying the hemisphere functions and indicates the learning and thinking styles and brain hemisphere preference. It is the analysis

and synthesis of learning for retention and thinking is cognitive ability with a problem-solving behavior to achieve some purpose with symbolic activity. Style indicates hemisphere function of the brain and learning strategy.

### Achievement Test

In order to study the achievement of students, the units taught in the class were considered for constructing achievement test. Objective type questions were constructed along with short answer type and essay type questions. While constructing the test items the behavioral objectives were kept in mind.

### Administration And Scoring Of The Instruments

Two tests were conducted and administered to 240 students of the schools. The achievement duration was 60 mins, SOLAT tool of 30 mins. Clear instructions and directions were given to the students before the test and how to precede each of them.

Academic achievement refers to the level of schooling successfully completed and the ability to attain success in students' studies. Academic achievement (or academic performance) is the outcome of education the extent to which a student, teacher or institution has achieved their educational goals. The question paper consisted of objective short and essay type questions. The students were expected to answer accordingly. Key scores were prepared before the scoring and marks were allotted accordingly. The final score was calculated by summing up.

### Statistical Techniques

The data analyzed by appropriate statistical techniques manually and by using SPSS software. Descriptive statistics: Mean, Standard Deviation and Percentile Analysis Inferential statistics t-test, One-way ANOVA. Pearson's correlation coefficient.

### Analysis of Results:-

#### SECTION I: DEMOGRAPHY AND DESCRIPTIVE STATISTICS FOR THE SELECTED SAMPLE

**Table 4.1:-** Distribution of the selected sample of secondary school students by various demographic factors.

Variable	Sub variable	Frequency	Percent
Total sample		240	100.0
Class	8th std	80	33.3
	9th std	160	66.7
Age	14	80	33.3
	15	160	66.7
Area	Urban	120	50.0
	Rural	120	50.0
School Type	Govt.	82	34.2
	Aided	80	33.3
	Unaided	78	32.5
Gender	Male	128	25.0
	Female	112	54.2

**Class:** The sample consists of 240 secondary school students, with 80 students (33.3%) in the 8th standard and 160 students (66.7%) in the 9th standard.

**Age:** In terms of age, the sample is evenly split. There are 80 students (33.3%) who are 14 years old and 160 students (66.7%) who are 15 years old.

**Area:** The sample includes 120 students (50.0%) from urban areas and an equal number of 120 students (50.0%) from rural areas.

**School Type:** Among the students, 82 (34.2%) attend government schools, 80 (33.3%) attend aided schools, and 78 (32.5%) attend unaided schools.

**Gender:** The sample consists of 128 male students (45.8%) and 112 female students (54.2%).

**Section II:****Levels Of Left Hemisphere, Right Hemisphere, Whole Hemisphere And Academic Achievement**

Levels of Left Hemisphere, Right Hemisphere, Whole Hemisphere

**Table 4.2:-** Distribution of the selected sample of secondary school students by various levels of Left Hemisphere, Right Hemisphere, Whole Hemisphere and Academic Achievement.

Variable	Levels	Frequency	Percent	Test statistics
Left Hemisphere	Low	6	2.5	$X^2=450.475$ ; $P=.001$
	Average	156	65.0	
	High	78	32.5	
Right Hemisphere	Low	2	0.8	$X^2=140.700$ ; $P=.001$
	Average	235	97.9	
	High	3	1.3	
Whole Hemisphere	Low	0	0	$X^2=228.150$ ; $P=.001$
	Average	237	98.8	
	High	3	1.3	

**Left Hemisphere:**

The distribution of students in terms of Left Hemisphere functioning reveals that 6 students (2.5%) fall into the "Low" category, 156 students (65.0%) are in the "Average" category, and 78 students (32.5%) belong to the "High" category. The chi-square test ( $X^2=450.475$ ,  $p=0.001$ ) demonstrates a highly significant difference between frequencies of Left Hemisphere levels and the students, indicating that majority of them average level of Left Hemisphere functioning.

**Right Hemisphere:**

The distribution based on Right Hemisphere functioning indicates that 2 students (0.8%) are in the "Low" category, 235 students (97.9%) are classified as "Average," and 3 students (1.3%) are in the "High" category. The chi-square test ( $X^2=140.700$ ,  $p=0.001$ ) shows a highly significant difference between frequencies of Right Hemisphere levels, indicating that majority of them had average level of right Hemisphere functioning.

**Whole Hemisphere:**

In the case of Whole Hemisphere functioning, there are no students in the "Low" category, 237 students (98.8%) are classified as "Average," and 3 students (1.3%) fall into the "High" category. The chi-square test ( $X^2=228.150$ ,  $p=0.001$ ) indicates a highly significant difference between frequencies of Whole Hemisphere levels indicating that a large majority of them average level of Left Hemisphere functioning.

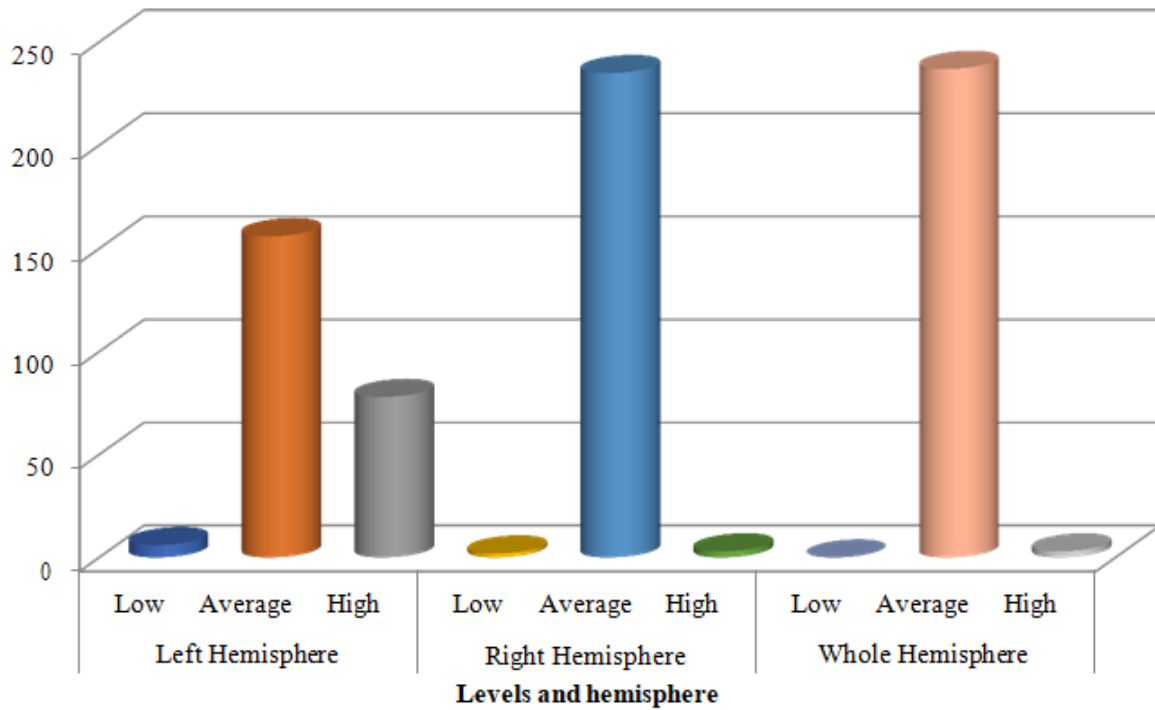
**Levels Of Academic Achievement****Table 4.2:-** Distribution of the selected sample of secondary school students by various levels of Academic Achievement.

Variable	Levels	Frequency	Percent	Test statistics
Academic Achievement	<60%	22	9.2	$X^2=63.175$ ; $P=.001$
	60-80%	107	44.6	
	>80%	111	46.3	

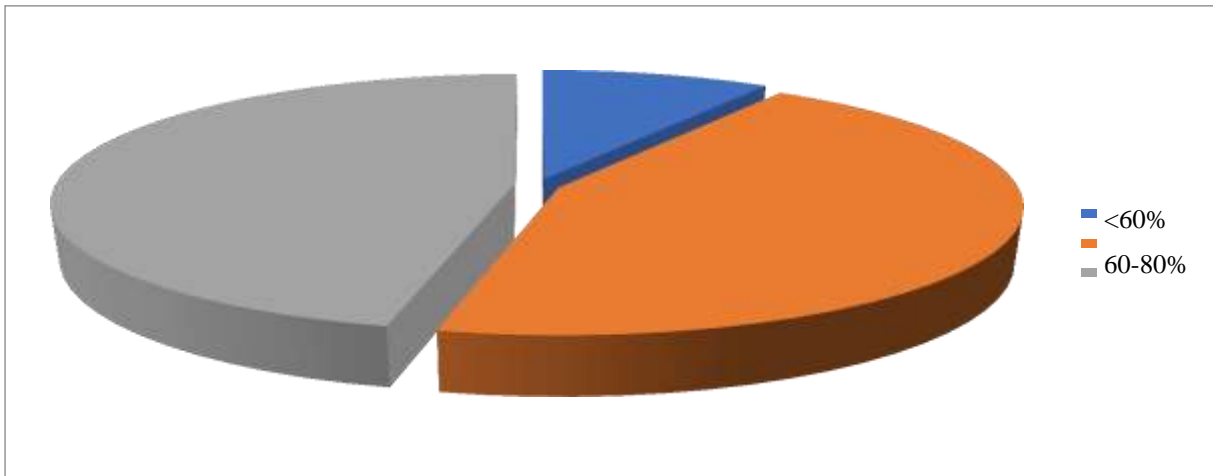
**Academic Achievement:**

The distribution of students based on academic achievement levels is as follows: 22 students (9.2%) achieved less than 60%, 107 students (44.6%) scored between 60-80%, and 111 students (46.3%) achieved more than 80%. The chi-square test ( $X^2=63.175$ ,  $p=0.001$ ) demonstrates a highly significant difference was observed between academic achievement levels and the students, indicating that majority of the students had their academic achievement in the range of >80% and 60-80%.

**Graph 4.1:-** Distribution of the selected sample of secondary school students by various levels of Left Hemisphere, Right Hemisphere and Whole Hemisphere.



**Graph 4.2:-** Distribution of the selected sample of secondary school students by various levels of Academic Achievement.



**Section III: Correlation Between Left Hemisphere, Right Hemisphere, Whole Hemisphere And Academic Achievement**

**Table 4.3:-** Results of Pearson’s correlation coefficient between Left Hemisphere, Right Hemisphere, Whole Hemisphere and Academic Achievement.

Variables		Academic Achievement
Right	Correlation	-.050
	P value	.439
	Correlation	-.063



<b>Left</b>	P value	.330
	Correlation	.147*
<b>Whole</b>	P value	.022

#### Academic Achievement and Right Hemisphere:

The correlation between Academic Achievement and Right Hemisphere is not statistically significant with a Correlation of  $-.050$  ( $p=0.439$ ), suggesting that there is no significant relationship between academic achievement and the Right Hemisphere.

#### Academic Achievement and left Hemisphere:

The correlation between Academic Achievement and left Hemisphere is statistically non-significant with a Correlation of  $-.063$  ( $p=0.330$ ), indicating that the scores on left hemisphere and academic achievement are independent of each other.

#### Academic Achievement and Whole Hemisphere:

The correlation between Academic Achievement and Left Hemisphere is statistically significant with a Correlation of  $.147^*$  ( $p=.022$ ), suggesting a weak positive relationship between Academic Achievement and the Left Hemisphere. This means that as the functioning in the Left Hemisphere increases, there is an increase in the academic achievement.

#### Section IV: Association Between Gender And Area With Left Hemisphere, Right Hemisphere, Whole Hemisphere And Academic Achievement

##### Gender and Hemisphere

**Table 4.4:-** Association of Right Hemisphere by gender and results of Chi-square test.

<b>Right Hemisphere</b>		<b>Gender</b>		<b>Total</b>
		<b>Male</b>	<b>Female</b>	
Low	Frequency	5	1	6
	Percent	3.9%	0.9%	2.5%
Moderate	Frequency	84	72	156
	Percent	65.6%	64.3%	65.0%
High	Frequency	39	39	78
	Percent	30.5%	34.8%	32.5%
Total	Frequency	128	112	240
	Percent	100.0%	100.0%	100.0%
Test statistics		Chi-square test=2.534; P= .282		

The table 4.4. provides the frequency distribution of right hemisphere levels (categorized as Low, Moderate, and High) among secondary school students, with data separated by gender.

Among male students, 5 (3.9%) fall into the Low category, 84 (65.6%) are in the Moderate category, and 39 (30.5%) are in the High category. For female students, 1 (0.9%) is in the Low category, 72 (64.3%) are in the Moderate category, and 39 (34.8%) are in the High category. The total sample size is 240 students, with 6 (2.5%) in the Low category, 156 (65.0%) in the Moderate category, and 78 (32.5%) in the High category.

The Chi-square test results ( $\chi^2 = 2.534$ ,  $p = 0.282$ ) indicate that there is no statistically significant association between students' gender and their right hemisphere levels. This suggests that there is statistical similarity in the proportions of male and female students with Low, Moderate, or High right hemisphere levels among the secondary school students in the sample.

##### Gender and left hemisphere

**Table 4.5:-** Association of Left Hemisphere by gender and results of Chi-square test.

<b>Left Hemisphere</b>		<b>Gender</b>		<b>Total</b>
		<b>Male</b>	<b>Female</b>	
Low	Frequency	0	2	2
	Percent	0.0%	1.8%	0.8%
Moderate	Frequency	126	109	235
	Percent	98.4%	97.3%	97.9%

High	Frequency	2	1	3
	Percent	1.6%	0.9%	1.2%
Total	Frequency	128	112	240
	Percent	100.0%	100.0%	100.0%
Test statistics		Chi-square test=2.508; P= .285		

The table 4.5 presents the frequency distribution of left hemisphere levels (categorized as Low, Moderate, and High) among secondary school students, with data separated by gender.

Among male students, there are no students (0.0%) in the Low category, 126 (98.4%) in the Moderate category, and 2 (1.6%) in the High category. For female students, 2 (1.8%) are in the Low category, 109 (97.3%) are in the Moderate category, and 1 (0.9%) is in the High category. The total sample size is 240 students, with 2 (0.8%) in the Low category, 235 (97.9%) in the Moderate category, and 3 (1.2%) in the High category.

The Chi-square test results ( $\chi^2 = 2.508$ ,  $p = 0.285$ ) indicate that there is no statistically significant association between students' gender and their left hemisphere levels. This suggests that the proportions of male and female students with Low, Moderate, or High left hemisphere levels among the secondary school students in the sample are the same statistically.

### Gender and whole hemisphere

**Table 4.6:-** Association of Whole Hemisphere by gender and results of Chi-square test.

Whole Hemisphere		Gender		Total
		Male	Female	
Low	Frequency	-	-	-
	Percent	-	-	-
Moderate	Frequency	125	112	237
	Percent	97.7%	100.0%	98.8%
High	Frequency	3	0	3
	Percent	2.3%	0.0%	1.2%
Total	Frequency	128	112	240
	Percent	100.0%	100.0%	100.0%
Test statistics		Chi-square test=2.658; P= .103		

The table 4.6 presents the frequency distribution of whole hemisphere levels (categorized as Low, Moderate, and High) among secondary school students, with data separated by gender.

Among male students, there are no students (0.0%) in the Low category, 125 (97.7%) in the Moderate category, and 3 (2.3%) in the High category. For female students, there are no students (0.0%) in the Low category, 112 (100.0%) in the Moderate category, and 0 (0.0%) in the High category. The total sample size is 240 students, with no students (0.0%) in the Low category, 237 (98.8%) in the Moderate category, and 3 (1.2%) in the High category.

The Chi-square test results ( $\chi^2 = 2.658$ ,  $p = 0.103$ ) indicate that there is no statistically significant association between students' gender and their whole hemisphere levels. suggesting that there is no significant difference in the proportions of male and female students with Low, Moderate, or High whole hemisphere levels among the secondary school students in the sample.

### Gender and academic achievement

**Table 4.7:-** Association of Academic Achievement by gender and results of Chi-square test.

Academic Achievement		Gender		Total	
		Male	Female		
<60%	Frequency	13	9	22	
	Percent	10.2%	8.0%	9.2%	
60-80%	Frequency	55	52	107	
	Percent	43.0%	46.4%	44.6%	
		Frequency	60	51	111

>80%	Percent	46.9%	45.5%	46.2%
Total	Frequency	128	112	240
	Percent	100.0%	100.0%	100.0%
Test statistics		Chi-square test =.477 <sup>a</sup> ;P=.788		

The table 4.7 provides the frequency distribution of academic achievement levels (categorized as <60%, 60-80%, and >80%) among secondary school students, with data separated by gender. For male students, there are 13 (10.2%) in the <60% category, 55 (43.0%) in the 60-80% category, and 60 (46.9%) in the >80% category. Among female students, there are 9 (8.0%) in the <60% category, 52 (46.4%) in the 60-80% category, and 51 (45.5%) in the >80% category. The total sample size is 240 students, with 22 (9.2%) in the <60% category, 107 (44.6%) in the 60-80% category, and 111 (46.2%) in the >80% category.

The Chi-square test results ( $\chi^2 = 0.477$ ,  $p = 0.788$ ) indicate that there is non-significant association between students' gender and their academic achievement levels indicating varying proportions of male and female students achieving <60%, 60-80%, or >80% academic achievement levels among the secondary school students in the sample.

Area with Left Hemisphere, Right Hemisphere, Whole Hemisphere and Academic Achievement

#### Area and right hemisphere

**Table 4.8:-** Association of Right Hemisphere by area and results of Chi-square test.

Right Hemisphere		Area		Total
		Urban	Rural	
Low	Frequency	6	0	6
	Percent	5.0%	0.0%	2.5%
Average	Frequency	88	68	156
	Percent	73.3%	56.7%	65.0%
High	Frequency	26	52	78
	Percent	21.7%	43.3%	32.5%
Total	Frequency	120	120	240
	Percent	100.0%	100.0%	100.0%
Test statistics		Chi-square test =5.004;P=.082		

The table 4.8 displays the frequency distribution of right hemisphere levels (categorized as Low, Average, and High) among secondary school students, with data separated by the area of residence (Urban and Rural).

For students residing in Urban areas, there are 6 (5.0%) in the Low category, 88 (73.3%) in the Average category, and 26 (21.7%) in the High category. Among students residing in Rural areas, there are no students in the Low category, 68 (56.7%) in the Average category, and 52 (43.3%) in the High category. The total sample size is 240 students, with 6 (2.5%) in the Low category, 156 (65.0%) in the Average category, and 78 (32.5%) in the High category.

Additionally, Chi-square test results ( $\chi^2 = 5.004$ ,  $p = 0.082$ ) indicate that there is no statistically significant association between the area of residence (Urban or Rural) and right hemisphere levels among the secondary school students. This suggests that there is a static similarity in the proportions of students from Urban or Rural areas with Low, Average, or High right hemisphere levels in the sample.

#### Area and left hemisphere

**Table 4.9:-** Association of Left Hemisphere by area and results of Chi-square test.

Left Hemisphere		Area		Total
		Urban	Rural	
Low	Frequency	6	0	6
	Percent	5.0%	0.0%	2.5%
Average	Frequency	88	68	156
	Percent	73.3%	56.7%	65.0%
High	Frequency	26	52	78
	Percent	21.7%	43.3%	32.5%
Total	Frequency	120	120	240

	Percent	100.0%	100.0%	100.0%
Test statistics		Chi-square test =5.004 <sup>a</sup> ;P=.082		

The table 4.9 illustrates the distribution of left hemisphere levels (categorized as Low, Average, and High) among secondary school students, with data separated by their area of residence (Urban and Rural).

Among students residing in Urban areas, there are 6 (5.0%) in the Low category, 88 (73.3%) in the Average category, and 26 (21.7%) in the High category. In contrast, for students living in Rural areas, there are no students in the Low category, 68 (56.7%) in the Average category, and 52 (43.3%) in the High category. The total sample size consists of 240 students, with 6 (2.5%) in the Low category, 156 (65.0%) in the Average category, and 78 (32.5%) in the High category.

The Chi-square test results ( $\chi^2 = 5.004$ ,  $p = 0.082$ ) indicate that there is no statistically significant association between the area of residence (Urban or Rural) and left hemisphere levels among the secondary school students, indicating that the proportions of students from Urban or Rural areas with Low, Average, or High left hemisphere levels in the sample are statistically the same.

### Area and whole hemisphere

**Table 4.10:-** Association of Whole Hemisphere by area and results of Chi-square test.

Whole Hemisphere		Area		Total
		Urban	Rural	
Low	Frequency	6	0	6
	Percent	5.0%	0.0%	2.5%
Average	Frequency	88	68	156
	Percent	73.3%	56.7%	65.0%
High	Frequency	26	52	78
	Percent	21.7%	43.3%	32.5%
Total	Frequency	120	120	240
	Percent	100.0%	100.0%	100.0%
Test statistics		Chi-square test =5.004 <sup>a</sup> ;P=.082		

The table 4.10 displays the distribution of whole hemisphere levels (categorized as Low, Average, and High) among secondary school students, with data separated by their area of residence (Urban and Rural).

For students residing in Urban areas, there are 6 (5.0%) in the Low category, 88 (73.3%) in the Average category, and 26 (21.7%) in the High category. Conversely, students living in Rural areas do not fall into the Low category, with 68 (56.7%) in the Average category and 52 (43.3%) in the High category. The total sample size includes 240 students, with 6 (2.5%) in the Low category, 156 (65.0%) in the Average category, and 78 (32.5%) in the High category.

Furthermore, the Chi-square test results ( $\chi^2 = 5.004$ ,  $p = 0.082$ ) suggest that there is non-significant association between the area of residence (Urban or Rural) and whole hemisphere levels among the secondary school students, implying that there is no statistically significant difference in the proportions of students from Urban or Rural areas exhibiting Low, Average, or High whole hemisphere levels in the sample.

### Area and academic achievement

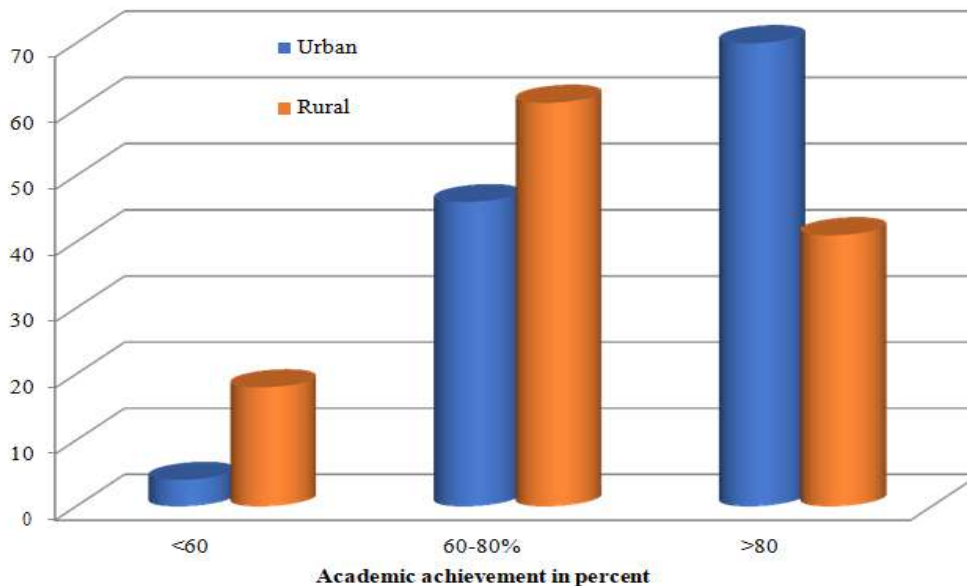
**Table 4.11:-** Association of Academic Achievement by area and results of Chi-square test.

Academic Achievement		Area		Total
		Urban	Rural	
<60%	Frequency	4	18	22
	Percent	3.3%	15.0%	9.2%
60-80%	Frequency	46	61	107
	Percent	38.3%	50.8%	44.6%
>80%	Frequency	70	41	111
	Percent	58.3%	34.2%	46.2%
Total	Frequency	120	120	240
	Percent	100.0%	100.0%	100.0%
Test statistics		Chi-square test = 18.588 <sup>a</sup> ;P=.001		

The table 4.11 illustrates the distribution of academic achievement levels (categorized as <60%, 60-80%, and >80%) among secondary school students, segregated by their area of residence (Urban and Rural).

For students living in Urban areas, there are 4 (3.3%) in the <60% category, 46 (38.3%) in the 60- 80% category, and 70 (58.3%) in the >80% category. Conversely, students in Rural areas consist of 18 (15.0%) in the <60% category, 61 (50.8%) in the 60-80% category, and 41 (34.2%) in the >80% category. The overall sample includes 240 students, with 22 (9.2%) in the <60% category, 107 (44.6%) in the 60-80% category, and 111 (46.2%) in the >80% category. Moreover, the Chi-square test results ( $\chi^2 = 18.588$ ,  $p = 0.001$ ) indicate a statistically significant association between the area of residence (Urban or Rural) and academic achievement levels among secondary school students. This implies that there is a significant association in the proportions of students from Urban and Rural areas achieving varying levels of academic performance in the sample. Urban students had significantly higher levels of academic achievement than rural students.

**Graph 4.3:-** Distribution of the selected sample by area and levels of academic achievement.



#### Verification of Hypothesis:

##### **H1: The levels of Left Hemisphere, Right Hemisphere, and Whole Hemisphere are not uniformly distributed among secondary school students**

The left hemisphere is specialized for language and analytical, logical, and linear thinking, while the right hemisphere is specialized for visual-spatial thought and deals with non-verbal information (Yeliz Yazgan, 2018). Mathematically gifted individuals tend to have better cooperation between the left and right hemispheres of the brain (Harnam Singh, 2004). Studies have found varying levels of left-brain dominance among students, with some studies indicating a moderate level of left-brain dominance (VedalaveniChowdappa Suresh, 2020), (Khanal L,2023).

One study found no significant relationship between hemispheric preference scores and academic performance among preclinical medical students. Another study found no significant difference in cumulative grade point average between students with left-brain dominance and those with right-brain dominance (Donald M. Hurwitz, 2005). Overall, the search results suggest that the levels of left and right hemisphere dominance are not uniformly distributed among students, and that there may be a relationship between hemispheric dominance and academic achievement, although the results are not consistent across studies. Further research is needed to confirm these findings and to better understand the relationship between hemispheric dominance and academic achievement.

##### **H2: The levels of academic achievement are not uniformly distributed among secondary school students**

A study conducted on undergraduate medical students in Thailand found that there is a significant association between learning styles and high academic achievement (Jiraporncharoen W, 2015). The study found that students with the assimilating learning style had the highest academic achievement, while students with the diverging learning

style had the lowest academic achievement. Another study conducted at a technical college in Georgia found that learning style is associated with student performance. The study found that students with the converge learning style had higher grades than students with other learning styles. A study conducted on nursing students found a significant relationship between learning styles and academic achievement (Shirazi, F., & Heidari, S., 2019). A study conducted on high school students found that students who were aware of their learning style had improved academic performance. The study found that college students who were tested on their learning style and were given appropriate education according to their learning style profile achieved higher academic performance than other students.

A study conducted on secondary school students in Turkey found that there is no significant relationship between learning styles and academic performance (Nursen İlçin, 2018). The study found that students with the visual learning style had the highest academic performance, while students with the kinesthetic learning style had the lowest academic performance. Overall, the studies suggest that there is a relationship between learning styles and academic achievement among secondary school students, although the results are not consistent across studies. Some studies found that students with certain learning styles had higher academic achievement, while others found no significant relationship between learning styles and academic performance. It is important to note that these studies have limitations, such as small sample sizes and different methods of measuring learning styles and academic achievement. Therefore, further research is needed to confirm these findings and to better understand the relationship between learning styles and academic achievement among secondary school students.

**H3: There will be relationship between Left Hemisphere, Right Hemisphere, Whole Hemisphere and Academic Achievement**

A study conducted on preclinical medical students studying medicine and dentistry found no statistically significant relationship between academic achievement and hemispheric preference scores (Essmat A Mansour, 2017) (Khanal L, et.al, 2.23). The study compared the right and left hemisphere preferences for processing information with academic performance of medical students in both theory and practical exams. The mean hemispheric scores for the right hemisphere, left hemisphere, and whole brain were 26.51, 14.5, and 6.76, respectively. High achievers in theory exam and practical exam received a higher left-hemispheric score and whole- brain score than low achievers; however, the difference in the mean value of hemispheric score was statistically not significant. Another study conducted on nursing students found a significant positive correlation between academic achievement and left hemisphere dominance (Khanal L, Shah S, 2023)

The study aimed to investigate the relationship between hemispherical brain dominance and academic achievement among nursing students. The results showed that the left hemisphere dominance was significantly associated with academic achievement. A cross-sectional study conducted on medical students found a significant positive correlation between academic achievement and left hemisphere dominance (VedalaveniChowdappa Suresh, 2020)

The study aimed to assess brain dominance and its correlation with academic achievement among medical students. The results showed that the left hemisphere dominance was significantly associated with academic achievement. A study conducted on business and accounting students found a significant positive correlation between academic achievement and left hemisphere dominance (Tan Keat, 2016). The study investigated the relationships between learning styles and academic achievement and brain hemispheric dominance and academic performance in business and accounting courses. The results showed that the left hemisphere dominance was significantly associated with academic achievement. A study conducted on learners' brain hemisphericity found that the left hemisphere dominant learners had a higher degree of vocabulary retention than the right hemisphere dominant learners (Ali Soyooof, 2014). The study investigated the effects of learners' brain hemisphericity on their degree of vocabulary retention. The results showed that the left hemisphere dominant learners had a higher degree of vocabulary retention than the right hemisphere dominant learners. Overall, the studies suggest that there is a weak positive relationship between academic achievement and left hemisphere dominance. However, some studies found no statistically significant relationship between academic achievement and hemispheric preference scores. It is important to note that these studies have limitations, such as small sample sizes and different methods of measuring academic achievement and hemispheric dominance. Therefore, further research is needed to confirm these findings.

**H4: There will be significant association Between Gender and Area with Left Hemisphere, Right Hemisphere, Whole Hemisphere and Academic Achievement.**

A study conducted on medical students found no significant difference in hemispheric dominance between male and female students (Suresh, 2020). The study found that left hemisphere dominance was significantly associated with academic achievement. Another study found that inter-hemispheric connectivity was stronger in women, while intra-hemispheric connectivity was stronger in men (Andrea Scheuringer, 2020). The study did not investigate the relationship between hemispheric dominance and academic achievement. A study conducted on high school students found that there was no significant relationship between brain dominance and cumulative grade point average (Donald M. Hurwitz, 2001). The study aimed to determine if the brain dominance of high school students is a determining factor for their cumulative grade point average. The results showed that there was no significant difference in the cumulative grade point average between male and female students with left-brain dominance and those with right-brain dominance. The studies suggest that there is no significant difference in hemispheric dominance between male and female students, and that there may be a relationship between hemispheric dominance and academic achievement, although the results are not consistent across studies. Further research is needed to confirm these findings and to better understand the relationship between gender, hemispheric dominance, and academic achievement among secondary school students.

### Major Findings Of The Study:-

1. The distribution of students in terms of Left Hemisphere functioning reveals that highly significant difference between frequencies of Left Hemisphere levels and the students, indicating that majority of them average level of Left Hemisphere functioning.
2. The distribution based on Right Hemisphere functioning shows a highly significant difference between frequencies of Right Hemisphere levels, indicating that majority of them had average level of right Hemisphere functioning.
3. In the case of Whole Hemisphere functioning, a highly significant difference between frequencies of Whole Hemisphere levels indicating that a large majority of them average level of Left Hemisphere functioning.
4. The distribution of students based on academic achievement levels is demonstrates a highly significant difference was observed between academic achievement levels and the students, indicating that majority of the students had their academic achievement in the range of >80% and 60-80%.
5. The correlation between Academic Achievement and Right Hemisphere is not statistically significant with a Correlation of  $-.050$  ( $p=0.439$ ), suggesting that there is no significant relationship between academic achievement and the Right Hemisphere. The correlation between Academic Achievement and left Hemisphere is statistically non- significant with a Correlation of  $-.063$  ( $p=0.330$ ), indicating that the scores on left hemisphere and academic achievement are independent of each other.
6. The correlation between Academic Achievement and Left Hemisphere is statistically significant with a Correlation of  $.147^*$  ( $p=.022$ ), suggesting a weak positive relationship between Academic Achievement and Left Hemisphere. This means that as the functioning in the Left Hemisphere increases, there is an increase in the academic achievement.

### Educational Implications

1. Teachers can benefit from this study to know the learning and thinking styles of students and they can develop effective teaching strategies.
2. Helps to understand about individual differences among school children.
3. Result of present study will help the parents and teachers to perceive their children and their natural tendencies of how they think, act and learn in different situations.
4. Present study reveals that school children depends upon right and left cerebral hemispheric dominance so teacher should adopt those teaching strategies that improve functioning of right and left hemisphere as it is possible to modify a children's preferred style of learning and thinking.
5. Teachers being self-reflective and explicit about the role of learning and thinking styles can make teaching more effective and enhance students learning outcomes.
6. Different teaching techniques and strategies can be adapted to activities and influence the brain hemisphere functions of the brain.

### Conclusion:-

Learning styles students in this study have more dominant in Hemisphericity. There are also various kinds of thinking styles in the present study made an influence on learning outcomes. It is also proven that there are significant differences in learning and academic achievement due to the learning and Thinking styles. The findings of the present

study have an implication for teachers that they should find out the dominant part of their students' brains first and then use the appropriate classroom techniques, methods and tools. Results of the study revealed that Active Learning Styles were effective in enhancing the Thinking Styles and Academic Achievement among the secondary school students.

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