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Learning & Thinking Style as a Major Determinant of Academic Achievement among School Students: An Analytical Study

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ABSTRACT

The present study was undertaken to study the effect of learning and thinking style on academic achievement of secondary school students. Academic achievement was treated as dependent variable whereas; learning and thinking style, locality and gender were treated as independent variables. A sample of 500 secondary school students was selected through multi-stage random sampling technique. Style of Learning and Thinking (SOLAT) test developed by Venkataraman (2011)[22] 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 2×2×2 factorial design. Levene'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. Further, no significant interaction effect of locality & gender was reported on academic achievement of secondary school students. Triple interaction effect of learning and thinking style, locality and gender on academic achievement of secondary school students was found to be significant. The findings of the present study has 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 according to them only then better and greater learning can be accomplished.

Keywords: Academic achievement, gender, learning & thinking style, locality

Styles depend upon cerebral dominance of an individual in retaining and processing different modes of information in his/her own style of learning and thinking. Style indicates the hemisphericity functions of the brain and students' learning strategy and information processing are based on the preferences of the brain area (Venkataraman 1994) [22]. Brain hemisphericity is the tendency of an individual to process information through the left hemisphere or the right hemisphere or in combination (Springer & Deutsch, 1993)[18]. Research has demonstrated that the left hemisphere operates in a linear, sequential manner with logical, analytical, propositional thought. On the other hand, the right hemisphere operates in a nonlinear, simultaneous fashion and deals with non-verbal information as well as dreams and fantasy (Oxford, Ehrman, & Lavine, 1991)[12]. The left hemisphere appears to be specialized for language, whereas the right hemisphere is specialized for visual-spatial and appositional thought. Kinsella (1995)[8] maintained that left hemispheric dominants are highly analytic, verbal, linear and logical learners, whereas right-hemispheric dominants are highly global, visual, relational, and intuitive learners. Whole-brain dominants are those who process information through both hemispheres equally and exhibit characteristics of both hemispheres. Those individuals have flexible use of both hemispheres (McCarthy, 1996)[9]. The differences in preference of

two hemispheres for information processing have been referred to as style of learning and thinking. Style of learning and thinking is cerebral dominance of an individual in retaining and processing modes of information. It identifies hemisphericity dominance by way of studying the hemisphere functions. It indicates a student's learning strategy and brain hemisphere preference in problem solving.

A good strategic learner must understand how to identify their learning goal, integrate the learning style, apply proper skills, and be self-regulated to achieve the best results from learning (Paris & Wingrad, 1990)[13] and (Zimmerman & Schunk, 2001) [23]. Learning problems are frequently not related to the difficulty of the subject matter but rather to the type and level of the cognitive processes required to learn the material (Keefe & Ferrell, 1990)[6]. It is believed that when teachers are able to analyze the differences and needs of their students, the educational process is likely to become optimized for both students and teachers.

One of the most significant advances in education has come from a considerable amount of research done in the area of learning & thinking style which recognizes that the students in classrooms have variety of differences in their learning & thinking style. To teach and learn more effectively, instructors and learners need to better understand and appreciate these individual differences and how they affect the learning process. Understanding individual learning & thinking style preferences has significant implications for learners: It helps them be aware of themselves, their abilities, how they learn, how they think and why they differ from peers. It also assists them in planning their learning and developing strategies that cope with different learning situations in order to make learning more meaningful and effective. This awareness has positive psychological effects for learners. They can gain self-esteem, motivation and feel more confident about themselves (Sarasin, 2006)[15].

Styles are not fixed, but changeable. Some individuals may have one preferred style at one stage and another preferred style at another stage. We need to recognize the preferred styles of students and ourselves. The efforts to understand learning and thinking styles and to learn to use them flexibly require the identification of an individual's preferred style of learning and thinking. Therefore, it is important for the teachers to know the students preferred styles, so that the teachers can capitalize the opportunities for students learning. Styles like abilities are not formed by birth. They are partly developed due to environmental condition. Teachers must eventually come forward to understand and identify the individuals preferred style of learning and thinking among students in academic areas.

Various studies have been conducted on learning & thinking style with different variables. Cano-Garcia, Hughes (2010)[1] reported that students' academic achievement was significantly related to students' learning & thinking style. Sharma and Neetu (2012)[16] observed that students' learning & thinking style and academic achievement were positively and significantly related to each other. Vengopal and Mridula (2013)[20] found a significant difference in the right hemisphere and left (brain) hemisphere preference for information processing among students. It was also found that there was significant difference between right and left hemisphere preference for information processing in boys and girls. Finding of the study conducted by Humera (2015)[5] revealed that majority of the students had right hemispheric dominant style of learning and thinking. Garima (2016)[3] found no significant effect of learning and thinking style on academic achievement of senior secondary schools students. Khan and Unnisa (2017)[7] reported a significant difference in academic achievement of students learned by right & left hemisphere, but no significant difference was found between academic achievement of boys & girls students learned either by right hemisphere or left hemisphere.

Thus, the review of related literature revealed that various studies were conducted on learning and thinking style including students, teachers and prospective teachers with respect to a number of variables. It was identified that many studies have been conducted in area of learning and thinking style separately at different levels. But the fact is that a very little amount of research has been carried out on academic achievement among school students in relation to their learning and thinking style learning and thinking style simultaneously. Therefore, the lack of researches in the present area motivated the researchers to take up the present topic and to study the effect of learning and thinking style, locality

and gender on academic achievement of secondary school students.

Variables Involved

1. **Dependent Variable**
   - Academic Achievement
2. **Independent Variables**
   - Learning & Thinking Style (Right & Left Hemisphericity)
   - Locality (Urban & Rural)
   - Gender (Male & Female)

Objectives of the Study

1. To study the effect of (a) learning & thinking style, (b) locality, and (c) gender on academic achievement of school students..
2. To find out the interaction effect of (a) learning & thinking style and locality; (b) learning & thinking style and gender; and (c) locality and gender on academic achievement of school students.
3. To find out the interaction effect of learning & thinking style, locality and gender on academic achievement of school students.

Hypotheses of the Study

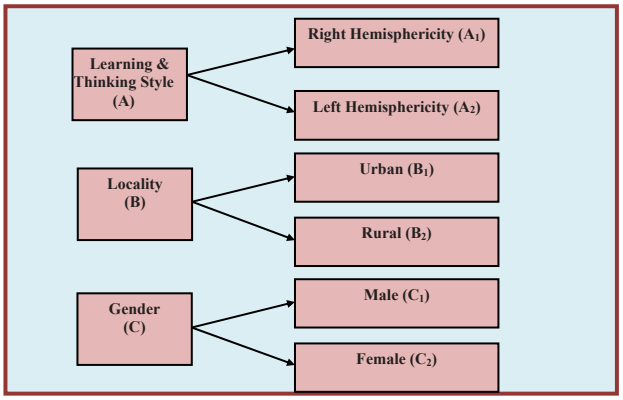
H_{01}: There exists no significant effect of (a) learning & thinking style, (b) locality, and (c) gender on academic achievement of school students.

H_{02}: There exists no significant interaction effect of (a) learning & thinking style and locality; (b) learning & thinking style and gender; and (c) locality and gender on academic achievement of school students.

H_{03}: There exists no significant interaction effect of learning & thinking style, locality and gender on academic achievement of school students.

Methodology

In the present study, descriptive survey method was used. The independent variables i.e. learning & thinking Style (Right Hemisphericity & Left Hemisphericity), locality (Urban & Rural), and gender (Male & Female) were divided into two categories which is shown below.



Sample

At the outset, a sample of 500 secondary school students was selected through multi-stage random sampling technique. The sample was further classified on the basis of their learning & thinking Style, locality and gender. As per the norms given in manual the hemisphericity dominance was determined on the basis of the highest score in three categories (Right, Left & Integrated Hemisphericity) of dominance, as far as a group testing or score is concerned. In the present study, only those students were selected who were having only right and left hemisphericity. The strength of right hemisphere preferred students was 256 and the strength of left hemisphere preferred students was 221. Therefore, a sample of 477 students was considered for computing the data as 23 students having integrated hemisphericity were not considered in the study. In this way, as per the requirement of the 2×2×2 cells of the paradigm, distribution of cells for analysis of interaction effect of learning & thinking style, locality and gender on academic achievement of school students has also been illustrated in the Fig. 1.

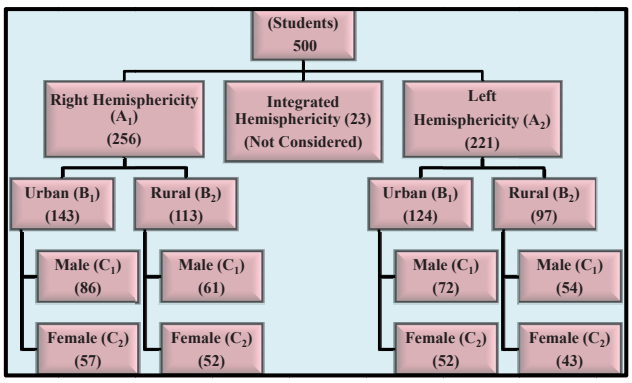


Fig. 1: Distribution of cells for Analysis of Interaction Effect of Learning & Thinking Style, Locality and Gender on Academic Achievement of School Students

Tool Used

In the present study, the Indian version of the SOLAT test developed by Venkataraman (2011) [22] was used to measure learning & thinking style of school students in terms of hemisphericity functions of their brain. In this tool, 1 to 25 items measure learning styles and 26 to 50 items measure thinking styles. Therefore, this tool containing 50 items was administered to school students to collect the data pertaining to their learning styles as well as thinking styles. The reliability coefficient of correlation for the right hemisphere function was found to be 0.89. For the left hemisphere function the coefficient of correlation was found to be 0.65. The coefficient of correlation for the integrated score was 0.71. The validity coefficient of correlation was 0.842 for the right hemisphere part; 0.621 for the left hemisphere part and 0.678 for the integrated part. The correlation coefficients reveal that the SOLAT tool possesses reasonable level of concurrent validity.

Statistical Techniques Used

The data were analyzed using descriptive as well as inferential statistics. The Three-Way Analysis of Variance (ANOVA) with 2×2×2 factorial design was computed using SPSS version 20 to study the main effects and interaction effects of the independent variables i.e. learning & thinking style, locality and gender on academic achievement of secondary school students. Levene's Test of Homogeneity of Variance was used to test the assumption of homogeneity of variance before applying Three-Way ANOVA. Wherever F-value was found significant, then t-test was employed for further exploration.

DATA ANALYSIS AND DISCUSSION

The main objective of the present study was to find out the main and interaction effects of learning & thinking style, locality and gender on academic achievement of school students. The independent variables i.e. learning & thinking style, locality and gender were coded as A, B, C respectively and were varied into two ways as: Right Hemisphericity (A_1) & Left Hemisphericity (A_2); Urban (B_1) & Rural (B_2); and Male (C_1) & Female (C_2). Means and SDs of different sub-samples have been presented in the Table 1 and Fig. 2. The summary of ANOVA (2×2×2) has also been presented in Table 2, which is analyzed in terms of main effects and interaction effects.

Table 1: Means and SDs of Sub Samples of 2×2×2 Design for Academic Achievement of School Students with respect to Learning & Thinking style (A), Locality (B) and Gender (C)

Learning & Thinking Style	Locality	Male (C_1)	Female (C_2)
Right Hemisphericity (A_1) (256)	Urban (B_1) (143)	N= 86 Mean= 87.03 SD= 10.16	N= 57 Mean= 89.92 SD= 9.67
	Rural (B_2) (113)	N= 61 Mean= 83.75 SD= 10.20	N= 52 Mean= 79.73 SD= 11.31
Left Hemisphericity (A_2) (221)	Urban (B_1) (124)	N= 72 Mean= 86.95 SD= 9.29	N= 52 Mean= 90.21 SD= 9.58
	Rural (B_2) (97)	N= 54 Mean= 80.14 SD= 9.95	N= 43 Mean= 91.55 SD= 6.13

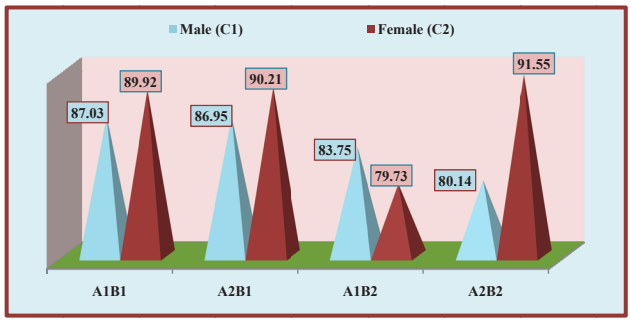


Fig. 2: Mean Scores of Sub Samples of 2×2×2 Design for Academic Achievement of School Students with respect to Learning & Thinking Style, Locality and Gender

Table 2: Summary of Three Way ANOVA (2×2×2 Factorial Design) for Academic Achievement of School Students with respect to Learning & Thinking Style, Locality and Gender

Source of Variance	df	Sum of Squares (SS)	Mean Sum of Squares (MS)	F - ratios
Main Effects				
(Learning & Thinking Style) (A)	1	508.32	508.32	**5.36***
(Locality) (B)	1	2568.92	2568.92	**27.09****
(Gender) (C)	1	1311.41	1311.41	**13.83****
Double Interaction Effects				
Interaction (A×B)	1	460.02	460.02	**4.85***
Interaction (A×C)	1	1785.19	1785.19	**18.83****

Interaction (B×C)	1	10.98	10.98	**0.11(NS)**
Triple Interaction Effect				
Interaction (A×B×C	1	1626.86	1626.86	**17.16****
Between Cells	7	51943.19	—	—
Within Cells	469	44461.12	94.80	—
Total	**476**	—	—	—

*** Significant at 0.01 level * Significant at 0.05 level NS = Not Significant*

❒ ***Main Effects of Learning & Thinking Style, Locality and Gender on Academic Achievement of School Students***

Learning & Thinking style (A)

It can be inferred from the Table-2 that F-ratio 5.36 for main effect of learning & thinking style on academic achievement of school students is significant at 0.05 level which depicts that there is a significant difference between the academic achievement of students learned by right & left hemisphere. Therefore, the null hypothesis H_{01} (a), 'There exists no significant effect of learning & thinking style on academic achievement of school students' is not retained. From the mean scores, it is inferred that students learned by left hemisphere have slightly higher academic achievement (86.95) in comparison to students learned by right hemisphere (85.41). This finding is in congruence with the finding of Khan and Unnisa (2017)[7] who also investigated a significant difference between the academic achievement of students learned by right & left hemisphere. But on the other hand, this result is in contrast with the result of Garima (2016)[3] who indicated that there was no significant difference between academic achievement of students learned by right & left hemisphere.

Locality (B)

It is palpable from the Table 2 that F- ratio 27.09 for the main effect of locality on academic achievement of school students is significant at 0.01 level leading to the inference that there is a significant difference between the academic achievement of school students studying in urban and rural area. Therefore, the null hypothesis H_{01} (b), 'There exists no significant effect of locality on academic achievement of school students' is not retained. In terms of mean scores, it can be seen that urban students have significantly higher academic achievement (88.25) in comparison to rural students (83.42). This result is in agreement with the result of Frederick (2011)[2], Onah (2011)[10] and Owoeye & Yara (2011)[11] who also reported that a significant difference was there between the academic achievement of rural and urban students.

Gender (C)

The Table 2 clears that the F-ratio 13.83 for the main effect of gender on academic achievement of school students is significant at 0.01 level which reveals that there is a significant difference between the academic achievement of male and female students. In this case the null-hypothesis H_{01}(c), 'There exists no significant effect of gender on academic achievement of school students' is not retained. In the context of mean scores, it is inferred that female students have significantly better academic achievement (87.74) than that of male students (84.91). The present finding is in line with the finding of Suneeta and Mayuri (1999)[19], Singh & Singh (2007)[17] and Gupta & Suman (2017)[4] who also reported that gender was found to be an important variable in deciding the high academic performance of students.

❒ ***Double Interaction Effects of Learning & Thinking Style, Locality and Gender on Academic Achievement of School Students***

Learning & Thinking style (A) × Locality (B)

Table 2 concludes that F-ratio, for the interaction between learning & thinking style and locality is 4.85 which is found to be significant at 0.05 level leading to the conclusion that learning & thinking style and locality interact with each other in relation to academic achievement of school students. Therefore, the null hypothesis H_{02} (a), 'There exists no significant interaction effect of learning & thinking style and locality on academic achievement of school students' is not retained. Hence, it is inferred that there is significant interaction effect of learning & thinking style and locality on academic achievement of school students. For further investigation, t-test was applied to find out the significant difference between mean scores of academic achievement of different groups for learning & thinking style and locality. The results have been shown in the Table 3. The mean scores for academic achievement of different groups for learning & thinking style and locality have been also presented in the form of Fig. 3.

Table 3: 't'-values for Mean Scores of Academic Achievement of School Students for Different Groups of Learning & Thinking Style and Locality (A×B)

Groups	N		Mean		S.D		't'-values
A_1B_1 vs A_2B_1	143	124	88.18	88.32	10.04	9.51	**0.11(NS)**
A_1B_2 vs A_2B_2	113	97	81.90	85.20	10.86	10.17	**2.29***
A_1B_1 vs A_2B_2	143	97	88.18	85.20	10.04	10.17	**2.25***
A_1B_2 vs A_2B_1	113	124	81.90	88.32	10.86	9.51	**4.86****
A_1B_1 vs A_1B_2	143	113	88.18	81.90	10.04	10.86	**4.79****
A_2B_1 vs A_2B_2	124	97	88.32	85.20	9.51	10.17	**2.34***

***Significant at 0.01 level *Significant at 0.05 level NS = Not Significant*

A_1 = Right Hemisphericity *A_2 = Left Hemisphericity*

B_1 = Urban Students *B_2 = Rural Students*

An inspection of the Table 3 reveals that the t-value (0.11) for urban students having right hemisphericity (A_1B_1) and left hemisphericity (A_2B_1) is found to be insignificant at 0.05 level leading to the inference that there is no significant difference between academic achievement of urban students having right hemisphericity and left hemisphericity. An examination of the Table-3 depicts that t-value (2.29) for rural students with right hemisphericity (A_1B_2) and left hemisphericity (A_2B_2) is significant at 0.05 level. From the analysis of mean scores, it can be concluded that rural students with right hemisphericity possess significantly lower academic achievement (81.90) as compared to rural students with left hemisphericity (85.20). As seen in the Table 3, the t-value (2.25) for urban students with right hemisphericity (A_1B_1) and rural students with left hemisphericity (A_2B_2) is found to be significant at 0.05 level. From the mean scores, it is inferred that urban students with right hemisphericity have significantly higher academic achievement (88.18) than rural students with left hemisphericity (85.20).

The Table 3 also shows that t-value (4.86) for rural students with right hemisphericity (A_1B_2) and urban students with left hemisphericity (A_2B_1) is found to be significant at 0.01 level. It may be concluded from the mean scores that academic achievement of rural students with right hemisphericity is significantly lower (81.90) as compared to urban students with left hemisphericity (88.32). This Table 3 also examines that the t-value (4.79) for urban students with right hemisphericity (A_1B_1) and rural students with right hemisphericity (A_1B_2) is found significant at 0.01 level. It can be inferred from the comparison of mean scores that urban students with right hemisphericity possess significantly higher academic achievement (88.18) than rural students with right hemisphericity (81.90). Further, it is shown in the Table-3 that the t-value (2.34) for urban students with left hemisphericity (A_2B_1) and rural students with left hemisphericity (A_2B_2) is found to be significant at 0.05 level. It is concluded from the mean scores that urban students with left hemisphericity have significantly higher academic achievement (88.32) as compared to rural students with left hemisphericity (85.20).

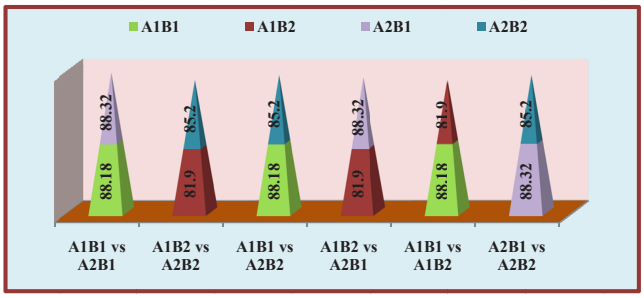


Fig. 3: Mean Scores for Interaction Effect of Learning & Thinking Style and Locality on Academic Achievement of School Students

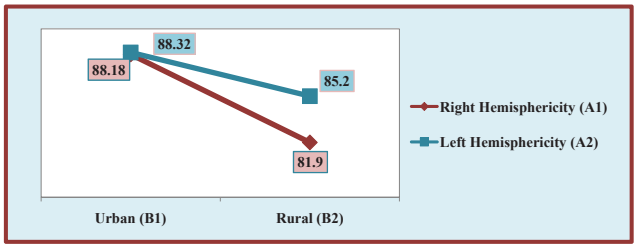


Fig. 4: Interaction Effect of Learning & Thinking Style and Locality (B×C) on Academic Achievement of School Students

The interaction effect of learning & thinking style and locality (A×B) on academic achievement of school students has been also presented in the form of line graph in Fig. 4. In this Fig. 4., 2×2 Design interaction effect is found significant. This can be shown graphically when B_1 and B_2 are marked on the X axis at any distance and on Y ordinate a scale is taken for the mean values. The mean M_{11}=88.18 and M_{12}=81.90 are marked for plotting line A_1. Similarly, A_2 line is drawn by marking M_{21}= 88.32

and M_{22}=85.20. In the below figure, A_1 and A_2 lines intersect at a point which shows that interaction effect between A and B is found highly significant.

Learning & Thinking Style (A) × Gender (C)

As it is depicted in the Table 2 that F- ratio 18.83 for the interaction between learning & thinking style and gender is found to be significant at 0.01 level leading to the inference that learning & thinking style and gender interact with each other in relation to academic achievement of school students. Therefore, the null hypothesis $H_{02}(b)$ 'There exists no significant interaction effect of learning & thinking style and gender on academic achievement of school students' is not retained. Therefore, it is deduced that there is significant interaction effect of learning & thinking style and gender on academic achievement of school students. Further, it is subjected to t-test computation to find out the significant difference between mean scores of academic achievement of different groups for learning & thinking style and gender. The results have been shown in the Table 4. The mean scores for academic achievement of different groups for learning & thinking style and gender have been also presented in the form of Fig. 5.

Table 4: 't'-values for Mean Scores of Academic Achievement of School Students for Different Groups of Learning & Thinking Style and Gender (A×C)

Groups	N		Mean		S.D.		't'-values
A_1C_1 vs A_2C_1	147	126	85.67	84.03	10.27	10.12	**1.33(NS)**
A_1C_2 vs A_2C_2	109	95	85.06	90.82	11.62	8.19	**4.17****
A_1C_1 vs A_2C_2	147	95	85.67	90.82	10.27	8.19	**4.36****
A_1C_2 vs A_2C_1	109	126	85.06	84.03	11.62	10.12	**0.72(NS)**
A_1C_1 vs A_1C_2	147	109	85.67	85.06	10.27	11.62	**0.43(NS)**
A_2C_1 vs A_2C_2	126	95	84.03	90.82	10.12	8.19	**5.56****

***Significant at 0.01 level NS = Not Significant*

A_1 = Right Hemisphericity *A_2 = Left Hemisphericity*

C_1 = Male Students *C_2 = Female Students*

Table-4 discloses that t-value (1.33) for male students with right hemisphericity (A_1C_1) and male students with left hemisphericity (A_2C_1) is found to be insignificant at 0.05 level that leads to the conclusion that students of these groups don't differ significantly with respect to their academic achievement. The t-value (4.17) for female students with right hemisphericity (A_1C_2) and left hemisphericity (A_2C_2) is found significant at 0.01 level. From the comparison of mean scores, it is concluded that female students with right hemisphericity possess significantly lower academic achievement (85.06) as compared to female students with left hemisphericity (90.82). The same Table-4 depicts that t-value (4.36) for male students with right hemisphericity (A_1C_1) and female students with left hemisphericity (A_2C_2) is found to be significant at 0.01 level leading to the conclusion that students of these groups differ significantly with respect to their academic achievement. From the comparison of mean scores, it is deduced that male students with right hemisphericity have significantly lower academic achievement (85.67) than female students with left hemisphericity (90.82).

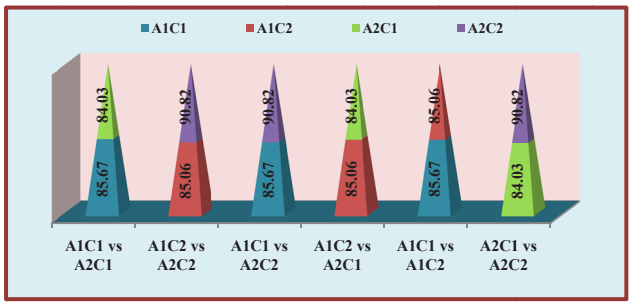


Fig. 5: Mean Scores for Interaction Effect of Learning & Thinking Style and Gender on Academic Achievement of School Students

As it is shown in the Table 4, the t-values (0.72) for female students with right hemisphericity (A_1C_2) and male students with left hemisphericity (A_2C_1) and another t-value (0.43) for male students with right hemisphericity (A_1C_1) and female students with right hemisphericity (A_1C_2) are found to be insignificant at 0.05 level leading to the inference that students of these groups don't differ significantly with respect to their academic achievement. However, the Table 4 further discloses that t-value (5.56) for male students with left hemisphericity (A_2C_1) and female students with left hemisphericity (A_2C_2) is found to be significant at 0.01 level. From the comparison of mean scores, it is inferred that male students with left hemisphericity

possess significantly lower academic achievement (84.03) than female students with left hemisphericity (90.82).

The interaction effect of learning & thinking style and gender (A×C) on academic achievement of school students has been also presented in the form of line graph in Fig. 6. In this Fig. 6, 2×2 Design interaction effect is found significant. This can be shown graphically when C_1 and C_2 are marked on the X axis at any distance and on Y ordinate a scale is taken for the mean values. The mean M_{11}= 85.67 and M_{12}= 85.06 are marked for plotting line A_1. Similarly, A_2 line is drawn by marking M_{21}= 84.03 and M_{22}= 90.82. This figure shows a highly significant interaction effect of learning & thinking style and gender (A×C) on academic achievement of school students as two lines (A_1 and A_2) intersect with each other.

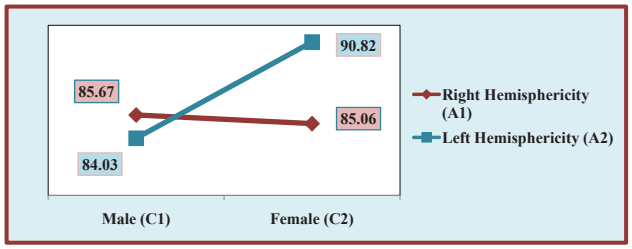


Fig. 6: Interaction Effect of Learning & Thinking Style and Gender (A×C) on Academic Achievement of School Students

Locality (B) × Gender (C)

A close inspection of Table 2 indicates that the F-ratio 0.11 between locality and gender is found to be insignificant at 0.05 level leading to the inference that locality and gender do not interact significantly with each other in relation to academic achievement of school students. Therefore, the null hypothesis $H_{02}(c)$, 'There exists no significant interaction effect of locality and gender on academic achievement of school students' is retained. Therefore, it is inferred that there is no significant interaction effect of locality and gender on academic achievement of school students. This result is in contrast with the result of Raju (2013)[14] who reported that gender and locality had significant influence on academic achievement of 7th class students.

❒ ***Triple Interaction Effect of Learning & Thinking Style, Locality and Gender on Academic Achievement of School Students***

Learning & Thinking Style × Locality × Gender (A×B×C)

An inspection of the Table 2 indicates that the F-ratio 17.16 for the interaction between learning & thinking style, locality and gender with respect to academic achievement of school students is found to be significant at 0.01 level which leads to the inference that learning & thinking style, locality and gender interact with each other in relation to academic achievement. Therefore, the null hypothesis H_{03}, 'There exists no significant interaction effect of learning & thinking style, locality and gender on academic achievement of school students' is not retained here. Thus, it is concluded that there is significant interaction effect of learning & thinking style, locality and gender on academic achievement of school students. For further exploration, t-test was employed to find out the significant difference between mean scores of academic achievement of different groups for learning & thinking style, locality and gender. The results have been shown in the Table 5. The mean scores for academic achievement of different groups for learning & thinking style, locality and gender have been also presented in the form of Fig. 7.

Table 5: 't'- values for Mean Scores of Academic Achievement of School Students for Different Groups of Learning & Thinking Style, Locality and Gender (A×B×C)

Sl. No.	Groups	N		Mean		S.D.		't' - values
1	$A_1B_1C_1$ vs $A_2B_2C_2$	86	43	87.03	91.55	10.16	6.13	3.16**
2	$A_1B_1C_2$ vs $A_2B_2C_1$	57	54	89.92	80.14	9.67	9.95	5.25**
3	$A_1B_2C_2$ vs $A_2B_1C_1$	52	72	79.73	86.95	11.31	9.29	3.8**
4	$A_1B_2C_1$ vs $A_2B_1C_2$	61	52	83.75	90.21	10.20	9.58	3.47**
5	$A_1B_1C_1$ vs $A_1B_1C_2$	86	57	87.03	89.92	10.16	9.67	1.72(NS)
6	$A_1B_1C_1$ vs $A_1B_2C_1$	86	61	87.03	83.75	10.16	10.20	1.92(NS)
7	$A_1B_1C_1$ vs $A_1B_2C_2$	86	52	87.03	79.73	10.16	11.31	3.82**
8	$A_1B_1C_2$ vs $A_1B_2C_1$	57	61	89.92	83.75	9.67	10.20	3.39**
9	$A_1B_1C_2$ vs $A_1B_2C_2$	57	52	89.92	79.73	9.67	11.31	5.04**

10	$A_2B_2C_2$ vs $A_2B_2C_1$	43	54	91.55	80.14	6.13	9.95	6.95**
11	$A_2B_2C_2$ vs $A_2B_1C_2$	43	52	91.55	90.21	6.13	9.58	0.82(NS)
12	$A_2B_2C_2$ vs $A_2B_1C_1$	43	72	91.55	86.95	6.13	9.29	3.21**
13	$A_2B_2C_1$ vs $A_2B_1C_2$	54	52	80.14	90.21	9.95	9.58	5.32**
14	$A_2B_2C_1$ vs $A_2B_1C_1$	54	72	80.14	86.95	9.95	9.29	3.93**
15	$A_1B_1C_1$ vs $A_2B_1C_1$	86	72	87.03	86.95	10.16	9.29	0.05(NS)
16	$A_1B_1C_1$ vs $A_1B_1C_2$	86	52	87.03	90.21	10.16	10.20	1.84(NS)
17	$A_1B_1C_1$ vs $A_2B_2C_1$	86	54	87.03	80.14	10.16	9.95	3.95**
18	$A_1B_1C_2$ vs $A_2B_1C_1$	57	72	89.92	86.95	9.67	9.29	1.76(NS)
19	$A_1B_1C_2$ vs $A_2B_1C_2$	57	52	89.92	90.21	9.67	9.58	0.15(NS)
20	$A_1B_1C_2$ vs $A_2B_2C_2$	57	43	89.92	91.55	9.67	6.13	1.03(NS)
21	$A_1B_2C_1$ vs $A_1B_2C_2$	61	52	83.75	79.73	10.20	11.31	1.98*
22	$A_1B_2C_1$ vs $A_2B_1C_1$	61	72	83.75	86.95	10.20	9.29	1.88(NS)
23	$A_1B_2C_1$ vs $A_2B_2C_1$	61	54	83.75	80.14	10.20	9.95	1.93(NS)
24	$A_1B_2C_1$ vs $A_2B_2C_2$	61	43	83.75	91.55	10.20	6.13	4.87**
25	$A_1B_2C_2$ vs $A_2B_1C_2$	52	52	79.73	90.21	11.31	9.58	5.11**
26	$A_1B_2C_2$ vs $A_2B_2C_1$	52	54	79.73	80.14	11.31	9.95	0.19(NS)
27	$A_1B_2C_2$ vs $A_2B_2C_2$	52	43	79.73	91.55	11.31	6.13	6.49**
28	$A_2B_1C_1$ vs $A_2B_1C_2$	72	52	86.95	90.21	9.29	9.58	1.90(NS)

*** Significant at 0.01 level * Significant at 0.05 level NS= Not Significant*

A_1 = *Right Hemisphericity* A_2 = *Left Hemisphericity*

B_1 = *Urban Students* B_2 = *Rural Students*

C_1 = *Male Students* C_2 = *Female Students*

An examination of the Table 5 reveals that t-value (3.16) for urban male students with right hemisphericity ($A_1B_1C_1$) and rural female students with left hemisphericity ($A_2B_2C_2$) is found to be significant at 0.01 level leading to the inference that students of these groups differ significantly with respect to their academic achievement. From the comparison of mean scores, it can be inferred that urban male students with right hemisphericity possess significantly lower academic achievement (87.03) than rural female students with left hemisphericity (91.55). It is depicted in the Table 5 that t-value (5.25) for urban female students with right hemisphericity ($A_1B_1C_2$) and rural male students with left hemisphericity ($A_2B_2C_1$) is found to be significant at 0.01 level. In the context of mean scores, it can be deduced that urban female students with right hemisphericity have significantly higher academic achievement (89.92) than rural male students with left hemisphericity (80.14). An inspection of the Table 5 illustrates that the t-value (3.8) for rural female students with right hemisphericity ($A_1B_2C_2$) and urban male students with left hemisphericity ($A_2B_1C_1$) is significant at 0.01 level. It can be deduced from the mean scores that rural female students with right hemisphericity possess significantly lower academic achievement (79.73) than urban male students with left hemisphericity (86.95).

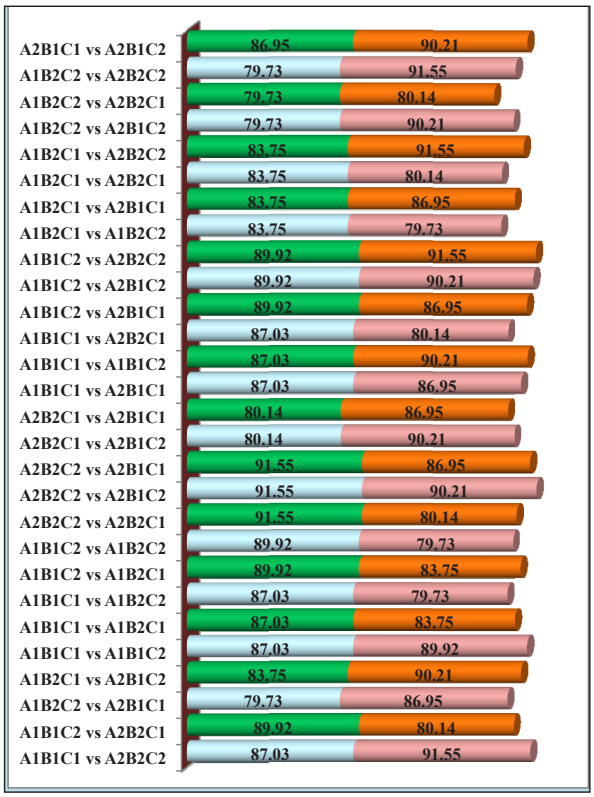


Fig. 7: Mean Scores for Interaction Effect of Learning & Thinking Style, Locality and Gender (A×B×C) on Academic Achievement of School Students

Table 5 further reveals that t-value (3.47) for rural male students with right hemisphericity ($A_1B_2C_1$)

and urban female students with left hemisphericity ($A_2B_1C_2$) is found to be significant at 0.01 level leading to the inference that students of these groups differ significantly with respect to their academic achievement. From mean scores, it can be concluded that rural male students with right hemisphericity have significantly lower academic achievement (83.75) than urban female students with left hemisphericity (90.21). A glimpse at the Table-5 indicates that t-value (3.82) for urban male students with right hemisphericity ($A_1B_1C_1$) and rural female students with right hemisphericity ($A_1B_2C_2$) is significant at 0.01 level. From the mean scores, it may, therefore, be concluded that urban male students with right hemisphericity possess significantly higher academic achievement (87.03) than rural female students with right hemisphericity (79.73).

An inspection of the Table 5 indicates that t-value (3.39) for urban female students with right hemisphericity ($A_1B_1C_2$) and rural male students with right hemisphericity ($A_1B_2C_1$) is significant at 0.01 level. From the comparison of mean scores, it can, therefore, be concluded that urban female students with right hemisphericity have significantly higher academic achievement (89.92) than rural male students with right hemisphericity (83.75). The Table 5 further indicates that t-value (5.04) for urban female students with right hemisphericity ($A_1B_1C_2$) and rural female students with right hemisphericity ($A_1B_2C_2$) is found to be significant at 0.01 level. It may, therefore, be inferred from the mean scores that urban female students with right hemisphericity possess significantly higher academic achievement (89.92) than rural female students with right hemisphericity (79.73). The t-value (6.95) vide Table-5 for rural female students with left hemisphericity ($A_2B_2C_2$) and rural male students with left hemisphericity ($A_2B_2C_1$) is significant at 0.01 level. From the mean scores, it may, therefore, be concluded that rural female students with left hemisphericity have significantly higher academic achievement (91.55) than rural male students with left hemisphericity (80.14). An examination of the Table-5, further depicts that t-value (3.21) for rural female students with left hemisphericity ($A_2B_2C_2$) and urban male students with left hemisphericity ($A_2B_1C_1$) is significant at 0.01 level. From the mean scores, it can be concluded that rural female students with left hemisphericity have significantly higher academic achievement (91.55) than urban male students with left hemisphericity (86.95).

An inspection of the Table 5 depicts that t-value (5.32) for rural male students with left hemisphericity ($A_2B_2C_1$) and urban female students with left hemisphericity ($A_2B_1C_2$) is found to be significant at 0.01 level. From the mean scores, it can be deduced that rural male students with left hemisphericity possess significantly lower academic achievement (80.14) as compared to urban female students with left hemisphericity (90.21). It is depicted in the Table 5 that the t-value (3.93) for rural male students with left hemisphericity ($A_2B_2C_1$) and urban male students with left hemisphericity ($A_2B_1C_1$) is significant at 0.01 level. In the context of mean scores, it can be deduced that rural male students with left hemisphericity have significantly lower academic achievement (80.14) than urban male students with left hemisphericity (86.95). An examination of the Table 5 indicates that t-value (3.95) for urban male students with right hemisphericity ($A_1B_1C_1$) and rural male students with left hemisphericity ($A_2B_2C_1$) is found to be significant at 0.01 level. From the comparison of mean scores, it can, therefore, be concluded that urban male students with right hemisphericity have significantly higher academic achievement (87.03) as compared to rural male students with left hemisphericity (80.14). It is also evident from the Table-5 that t-values (1.98) for rural male students with right hemisphericity ($A_1B_2C_1$) and rural female students with right hemisphericity ($A_1B_2C_2$) is found to be significant at 0.05 level only leading to the inference that students of these groups differ significantly with respect to their academic achievement. From the mean scores, it can be concluded that rural male students with right hemisphericity have significantly better academic achievement (83.75) than rural female students with right hemisphericity (79.73).

The t-value (4.87) vide Table 5, for rural male students with right hemisphericity ($A_1B_2C_1$) and rural female students with left hemisphericity ($A_2B_2C_2$) is significant at 0.01 level. It may, therefore, be concluded from the mean scores that rural male students with right hemisphericity possess significantly lower academic achievement (83.75) than rural female students with left hemisphericity (91.55). It is depicted in the Table-5 that t-value (5.11)

for rural female students with right hemisphericity ($A_1B_2C_2$) and urban female students with left hemisphericity ($A_2B_1C_2$) is found to be significant at 0.01 level. In the context of mean scores, it can be inferred that rural female students with right hemisphericity have significantly lower academic achievement (79.73) than urban female students with left hemisphericity (90.21). It is also evident from the Table-5, that t-value (6.49) for rural female students with right hemisphericity ($A_1B_2C_2$) and rural female students with left hemisphericity ($A_2B_2C_2$) is found to be significant at 0.01 level. From the comparison of mean scores, it can be concluded that rural female students with right hemisphericity possess significantly lower academic achievement (79.73) as compared to rural female students with left hemisphericity (91.55).

In contrast the same Table 5 further indicates that t-values 1.72, 1.92, 0.82, 0.05, 1.84, 1.76, 0.15, 1.03, 1.88, 1.93, 0.19, and 1.90 for the groups $A_1B_1C_1$vs $A_1B_1C_2$, $A_1B_1C_1$vs $A_1B_2C_1$, $A_2B_2C_2$vs $A_2B_1C_2$, $A_1B_1C_1$vs $A_2B_1C_1$, $A_1B_1C_1$vs $A_2B_1C_2$, $A_1B_1C_2$vs $A_2B_1C_1$, $A_1B_1C_2$vs $A_2B_1C_2$, $A_1B_1C_2$vs $A_2B_2C_2$, $A_1B_2C_1$vs $A_2B_1C_1$, $A_1B_2C_1$vs $A_2B_2C_1$, $A_1B_2C_2$vs $A_2B_2C_1$ and $A_2B_1C_1$vs $A_2B_1C_2$ respectively have been found to be insignificant at 0.05 level leading to the conclusion that students of these groups do not differ significantly with each other in relation to their academic achievement.

EDUCATIONAL IMPLICATIONS

The finding of the present study revealed that students learned by left hemisphere had slightly higher academic achievement in comparison to students learned by right hemisphere. It is considered that no one is totally left-brained or right-brained however, probably everyone has a dominant side of the brain. Left brained children have analytical thinking. They always want to know the rules and follow them. They take in information through analysis, observation and thinking. Their language abilities are so refined and also good at processing symbols and mathematical formulas. Right brained ones use mostly their feelings about something to decide if it is true or not. Their minds move rapidly from one thought to another and this causes difficulties in finishing their assignments. They are holistic, creative, imaginative & visual learners and singing, music, art, writing, designing, anything based on creativity are easy for them. They view their opinions through their own personal experiences and backgrounds. The reason responsible for poor academic achievement of right brained school students may be the left-brain strategies which are most often used in classrooms by left brained teachers, who themselves love order, sequence and planning which results in their academic achievement. Right brained learners do not always get the rewards or understanding of a different way to process information and feel inadequate. To solve this problem teacher should find out the dominant part of their students' brains and use the appropriate classroom techniques, methods and tools according to them only then better and greater learning can be accomplished. Discussions may be arranged on general problems, world affairs from the reading of daily newspapers and magazines. Games based on verbal materials, numerical, events and meditation can be encouraged after class hours in order to activate the preferred dominant style of learning and thinking style among students.

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