CHAPTER II

REVIEW OF RELATED RESEARCH
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2.0 INTRODUCTION

In the field of education, as in other fields too, the researchers need to acquire up-to-date information about what has been thought and done in the particular area from which he intends to take up a problem for research.

Survey of related literature, besides forming one of the early chapters in a research report for orienting the readers serves some other purposes. Good, Bar and Scates (1954) have mentioned the following purposes of related research:

➢ To show whether the evidence already available solves the problem adequately without further investigation and thus to avoid the risk of duplication.

➢ To provide ideas, theories, explanations or hypotheses valuable in formulating the problem.

➢ To suggest methods of research appropriate to the problem.

➢ To locate comparative data useful in the interpretation of results and

➢ To contribute to the general scholarship of the investigator.

Bruce W. Tuckman (1978) has enumerated the following purposes of the review

➢ Discovering important variables.

➢ Distinguishing what has been done from what needs to be done.

➢ Synthesizing the available studies to have perspective.

➢ Determining meanings, relevance of the study and relationship the study and its deviation from the available studies.
Edward L. Vockell (1983) has pointed out the following two purposes:

1. The main purpose of the review is to put the hypothesis to be examined in the research report in to its proper context.

2. Secondary purpose of this part of the report is to provide readers with guidelines regarding where they can look to find more information and to establish the author’s credential by letting readers know that the researcher is aware of what has been going on with regard to the current and related topics.

In view of the importance of literature of related research, review was done in comprehensive manner and the same has been given in the present chapter.

(SECTION -I)

2.1 LEARNER’S COGNITIVE CHARACTERISTICS AND STYLES OF THINKING

A number of studies have been conducted on styles of thinking in relation to learner’s cognitive characteristics such as intelligence, creativity and academic achievement. Some research studies have been reviewed here with reference to these variables.

2.1.1 Intelligence and Styles of Thinking

Some studies are available on the relationship of intelligence and thinking styles. Here review of such studies has been provided:

Kirby and Das (1978) studied the relationship between information processing styles and cognitive abilities: Non-verbal intelligence measured through Raven’s Coloured Progressive Matrices was important variable. It was found that simultaneous processing was primarily related to spatial ability. It was also related to lesser extent, to
both memory and inductive-deductive reasoning abilities of the children. Both simultaneous and successive processing were related to memory ability. No evidence was found that either of the two modes of thinking could be equated to a reasoning or memory.

Torrance and Ball (1977) observed that in the analysis of data obtained from 161 students who had participated in summer programme. Those with right hemispheric preferences reported more application of learning to practical situation than those who had left hemispheric preferences.

Cody (1983) compared thinking styles of average, gifted and highly gifted students in grades 5 through 12. The investigator found that average intelligent students showed more integrated and left hemispheric style and gifted students had higher level of integrated style and right hemispheric style of thinking. Further highly gifted students indicated more integrated and right hemispheric style.

Mein (1986) reported that there were significant differences between the high verbal ability low performance, and high performance low verbal ability groups on the left-brain style and integrated-brain style scores latter group tended to be more integrated in style of thinking than former group.

Sherwood (1984) concluded that cognitive growth and onset of formed thinking showed no significant relationship on hemispheric styles of thinking.

Milburn (1984) studied the relationship between scores on your Style of Thinking by Torrance and Wechsler Intelligence Scale for Children Revised (WISCR). Using a stepwise discriminate analysis to determine the relationship between intelligence and hemispheric processing preferences, the most discriminating function was not found to be significant.
Kershner and Ledger (1985) found that there was statistically significant main effect of IQ: average children preferred left hemisphere style of thinking to a great extent than the gifted children.

Sternberg and Grigorenko (1993) studied the thinking styles of the gifted children. The findings indicated that the correlation of the measure of mental self-govt. with IQ. Three styles correlated significantly with scholastic aptitude of math (judicial, global and liberal, all positively), but not with SAT verbal. There was no difference between gifted and non-gifted children. However, on requiring children actually to do tasks, the gifted children proved to be more legislative, judicial and liberal than non-gifted children, but less executive.

Sumathy (1993) found that right hemisphere dominant students excel the left hemisphere dominant students in their divergent thinking.

Sternberg (1997) reported that the legislative and the judicial styles were positively correlated with scores on the ability test. The correlations were modest, however, for the legislative, 0.17 with analytical thinking, 0.19 with creative thinking, for the judicial style, 0.15 with analytical thinking, 0.20 with creative thinking, 0.23 with practical thinking. The executive style, in contrast, was negatively correlated with the scores on the test - 0.15 with analytical thinking, and -0.16 with creative thinking.

Thus it may be observed that intelligence appears to be a significant variable in case of styles of thinking.

2.1.2 Creativity and Styles of Thinking

Thinking styles have also been studied by some researchers in relation to creativity. For instance:

Wheatley (1977) concluded that right hemisphere style of thinking is the sight of creative thought.
Torrance and Moured (1978) and Torrance and Moured (1979) investigated styles of thinking of graduate students. In these investigations, left hemispheric style was found to be related to less creativity than right hemispheric style and integrated hemispheric style.

Torrance and Sato (1979) observed that hemispheric style of thinking scores were related with the scores of several indices of creative thinking.

Fitzgerald and Hattie (1983) conducted a study to evaluate your Style of Learning and Thinking Inventory and concluded that a model of right and left-brain dominance to creativity has little value. This study found evidence that conflicted with Torrance et al’s findings.

Torrance and Frasier (1983) found that creativity was positively related to the right hemisphere style and negatively related left hemisphere style of thinking.

Milburn (1984) investigated the hemispheric style of thinking preference and hemispheric processing abilities in high and low creative gifted preadolescents. Your Style of Learning and Thinking (Form-B), Weschler Intelligence Test and Rating Scale of Behavioural characteristics. The results revealed that the significant difference was found between preferences for left, right and integrated activities for both. Both groups appeared to prefer integrated activities.

Taggart et al. (1985) reported that verbal fluency, figural fluency, verbal flexibility - all were positively correlated to right hemispheric dominance.

Kershfler and Ledger (1985) reported that highly creative children irrespective of their IQ, preferred integrated styles of thinking. Further, high IQ-low creative children had greater preference for right hemispheric style of thinking.
Goldsmith (1987) conducted a study to explore the relationship of creative style to the level of creativity using data from 96 college students on Kirton Adaption-Innovation Inventory (A measure of Creative Style) and from other scales - What kind of person are you? Something about myself and Jackson’s Personality Inventory Innovation-Risk subscales.

The results revealed that most of the inter-correlations were positive and moderate in size, indicating that three creative scales mix creative level with creative styles to different degrees.

Mitchell (1987-88) reported that hemisphere styles of thinking and creative measurement were significantly related. More creative students tended to have higher level of right hemisphere style.

Al-Sabaty and Gary (1989) explored the relationship between creativity and right, left and integrated thinking styles. The two creative measures (How do You Think Inventory and Thinking positively with Sounds and Words) and Your Style of Learning and thinking (SQLAT) were administered to 109 undergraduate students. The HDYT scores were positively related with right thinking style and negatively correlated with left thinking style scores. The results of TCSW were not so clear. The findings were consistent with the notion that right hemispheric thinking style was related to known traits of creative people.

Borgert (1990) found that both right and left hemisphere preference groups demonstrated an increase in creativity.

Kunlar, Holman and Redegeair (1991) found that the differences in creativity styles of Freshman students in relation to their creativity level. The data analysis yields that creative group showed (a) employing a greater number of techniques in order to be creative than somewhat creative group and the least creative group and (b) To be less motivated in their creative efforts by the goal of a developing a final product than the least creative group. When item analysis was done a significantly
greater percentage of creative students, relative to the less creative ones, were found to report "new ideas possess them and guide them through competition almost automatically", "working in many ideas simultaneously", "having a lot of ideas both workable and non workable", "showing the creative products to other people and enjoying the process of creative new ideas whether they lead to a final product or not."

Sternberg and Lubart (1995) found that legislative and liberal styles of creative thinking were associated with creative strategies.

It is evident that certain thinking styles are more conducive for the development of creativity among the students.

2.1.3 Artistic Potential, Problem Solving Ability and Styles of Thinking

A few studies are available on the relationship of above-mentioned variable and thinking styles:

Wagner (1978) concluded that there is a perceptive account on the relationship between drama and the right hemisphere.

Torrance and Frasier (1983) reported that artistic potential was negatively related to left hemisphere style.

Houtz and Frankel (1988) found that students categorized as having integrated style solved more high imagery anagrams than students with other styles of thinking.

Sengoltaiah (1989) found that right hemisphere dominant students are at higher level in problem solving ability in mathematics at high school level.

2.1.4 Academic Achievement and Styles of Thinking

Some researchers in western countries have explored the relationship between styles of thinking and academic achievement of students. Here an attempt has been made to review these studies:
Samples (1976) and Paddy and Hostler (1979) found that right hemispheric children were under achievers.

Black (1983) reported that matching of teaching hemisphere style produce significant learning outcomes.

Mc Bratney (1983) observed that students receiving right brain instruction scored significantly higher on language subject of the CTBS. However, the second hypothesis stating that students receiving right brain style instruction score significantly higher in the Spelling subject of the CTBS was not statistically supported.

Sinatra (1983) and Harness et. al (1984) concluded that students who show right hemisphere strengths seem to be at a greater risk for difficulties in reading and learning in school than those who show left hemispheric strengths.

Torrance and Frasier (1983) found that academic performance was negatively related to left hemisphere style of thinking.

Brennan (1984) found that there was no significant difference evidenced in students with left and right-brained style on a test of mathematics achievement.

Jarsonbeck (1984) reported that there were more rights among low achieving students and more lefts among higher achieving maths students.

Okabayashi and Torrance (1984) reported that under achievers had significantly higher scores on right style of thinking their high achieving counterparts. The under achievers were also lower than the other two groups on the integrative style.

Taggart and Torrance (1984) reported that left hemispheric preference scores relate positively to hard science performance more than right hemispheric preference.
Borg (1985) did not find any relationship between hemisphericity and grade point averages.

Holler (1985) reported that there was no significant relationship between reading achievement and thinking styles.

Grun (1986) reported that hemispheric styles were unrelated to grade point averages.

Taylor (1986) explored the relationship of brain dominance to student success in selected classes at Tri-Country technical college. Torrance's Human Information Processing Survey (HIP survey) was used to assess brain dominance. The study yielded the following results: brain dominance did not influence classroom success.

Bruno (1988) observed that data yielded significant differences in math's achievement when students were matched / mismatched with instrumental strategies congruent incongruent with their hemisphere styles. Students achieved significantly higher when taught with complementary instructional strategies.

Roubinek (1989) concluded that thinking style was not related to reading achievement.

Kummerow (1989) found that there was no significant relationship between the hemisphere dominance and the variables like academic success.

Donna et al. (1990) reported that neither hemisphericity style was related to reading achievement.

Voelz (1994) reported that brain based style affect grades (teacher made achievement) but not achievement knowledge (standard achievement).

Epstein, Pacini Raj and Heier (1996) reported that need for cognition thinking style was positively related to GPA of college
students— for men, women and total sample. but faith in intuition was not observed to relate to achievement either for men, women or total group.

May (1997) found in his study those students with left hemispheric style function easily in acquisition of new habit patterns / information.

Sternberg (1997) reported that the legislative style showed significant correlation with the final examinations (0.14) and with an independent project (0.17). The judicial style showed significant correlation with the final exam (0.18) and the independent project (0.15), as well as with quality of homework (0.21). The executive style showed a negative correlation with evaluation of the independent project (0.18).

Sternberg (1997) observed that in public school, in legislative and executive styles both significantly predicted academic achievement (correlation of 0.36 and 0.29), suggesting different subgroup of teachers rewarding different things. The hierarchical style was also significantly related to academic achievement (0.29). In academically oriented private school, significant predictors of achievement were the judicial style (0.56), the liberal style (0.58) and the oligarchic style (0.55). In private school emphasizing emotional education, significant predictors were the legislative style (0.52), the global style (0.42), the liberal style (0.44), the conservative style in the negative direction (-0.38) and the hierarchic style (0.48). In the private Catholic school significant predictors of achievement were the executive style (0.51), the local style (0.39), the liberal style in the negative direction (-0.42), the conservative style (0.49) and the hierarchic style (0.51).

Grigorenko and Sternberg (1997) studied the relationship of styles of thinking abilities and academic performance. Participants were high school students, ranging in age from 13 to 16 years. Sternberg and Wagner's Thinking Styles Questionnaire (104 Items) and set of Thinking Styles Tasks for students Sternberg Triarchic Abilities Test and
Academic Performance guide by independent rates were used in the study. The results of the study show that after controlling for levels of abilities, styles of thinking contribute to prediction of academic performance. The correlation pattern suggests that judicial (+), legislative (+) and executive (-) style showed significant associations with academic performance. The relationship was significant in case of former two cases.

Sternberg (1997) investigated whether students do better in classrooms where their styles match rather than mismatch the style of their teachers? It was noted that students performed better and were positively evaluated by the teachers when the student’s styles matched rather than mismatched the styles of their teachers. In other words, the students performed better when they were more like their teachers stylistically, independent of actual level of achievement.

Zhang and Sternberg (1998) conducted a study to explore the relationship of thinking style abilities, and academic achievement among Hong Kong University students. The data included the participant University entrance examination test scores as well as their self-rated analytical, creative and practical ability levels. The data analysis revealed that the thinking styles that tended to be positively associated with A-level achievement tests were the one that were conservative, hierarchical and internal. But legislative, liberal and external tended to be negatively associated with students academic achievement. It was also noted that global thinking style was significantly and positively associated with academic scores where as the local thinking style was significantly and negatively associated with academic achievement scores. Multiple regression analysis showed that thinking styles served as predictors of academic achievement over and above abilities.

It is apparent that different thinking styles are differentially related to academic achievement of the college and school students.
(SECTION - II)

2.2 LEARNER'S NON-COGNITIVE (PSYCHOLOGICAL) CHARACTERISTICS AND THINKING STYLES

2.2.1 Personality and Thinking Styles

Some researchers have explored relationship between personality and thinking styles. These have been reviewed here as under:

Mackinnon (1961) observed that the relationship between adapters and innovators on the one hand, and extraversion-introversion on the other hand, is unclear. In a study of male architects reported that those architects judged to be creative by experts in the field also indicated a clear preference for introversion.

Zelniker and Jeffrey (1976) hypothesized that reflective children differ from impulsive children in their information processing strategies. They found that the reflective children used a left hemisphere, analytic-cognitive style and the impulsive children used a right hemispheric, global cognitive style.

Kirton (1976) using his Inventory and Eysenck Personality Inventory, reported that a significant correlation of 0.46 between extraversion and creativity style with two heterogeneous samples from England.

Edward (1979) found that person with left hemispheric style is more rational and person with right hemispheric style is more emotional.

Andrews (1980) reported that anxious persons, bold and frustrated persons are lacking in right / left integrated styles of thinking.

Karne and Kirton (1982) examined the relationship between scores on two inventories (Kirton Adaptation-Innovation Inventory and MBTI) using a heterogeneous sample of 109 management students.
Subjects claimed work experience in a variety of organizations (Industrial, Commercial, Military and Government). Approximately two-third of the subjects was British and remaining one-third represented 14 nationalities.

Analysis of their scores gave significant positive correlations between total Kirton scores and the Myers-Briggs dimensions of intuition, perception and intuition and perception combined. Scores on each of the Kirton subscales also correlated significantly with the Myers-Briggs intuition score, perception score and the combined intuition-perception.

**Peterson (1983)** suggested four distinctive modes of thinking of categories of mental experience derived from knowledge, thus indicating the link between human behaviour and knowledge.

**Taggart (1984)** concluded that most of the correlations between MBTI personality types and thinking styles were significant.

**Karnes (1985)** found that there was a significant overlap between hemisphere measures and children’s personality Questionnaire’s specific variables.

**Taggart et al. (1985)** noticed that there was negative significant relationship between left hemisphere style of thinking and MBTI intuition personality type.

**Heller (1986)** cited evidence that extroverted people were found to exhibit significantly more right hemispheric style than both normal and introverted persons.

**Sternberg and Grigorenko (1993)** reported that correlations were computed with MBTI as well as Gregorc measure of mind styles. For the MBTI 30 out of the 128 correlations were found statistically significant whereas for Gregorc, 22 out of 52 were significant.

**Jacobson (1993)** studied relationship between styles of creative thinking and personality types among United States service sector
managers and compared to results found among British management students with work experience. Managers in the service sector were more innovative than population in general. Statistically significant positive correlation was found between Kirton's Innovative Style and the Myers-Briggs intuitive and perceptive dimensions. A statistically significant positive correlation was also found between Kirton's Innovative Style and the Myers-Briggs extraversion and feeling dimensions.

 Epstein et al. (1996) studied individual differences in intuitive experimental and analytical-rational thinking styles. The results reported in the study revealed that there was negative significant relationship between analytical thinking style and depression, anxiety and stress in college life. Intuitive style of thinking was also negatively related to anxiety, stream and depression but the magnitude was smaller than former.

 Epstein, Pacini, and Denes (1996) reported inverse relation between racist attitudes and analytical styles of thinking.

 Saleh (1997) found that majority of participants who were identified as having right hemispheric style of thinking was intuitive, feeling and perceiving oriented. Most of the participants who were oriented as having left hemispheric style of thinking were sensing, thinking and judging oriented.

 Wolfradt (1999) investigated the relationship between thinking style (rational and intuitive), schizotypal traits intolerance of ambiguity, self-efficacy and anomalous experiences. Correlational analysis showed that the anomalous experience were closely related to schizotypal traits and thinking styles. Intuitive thinkers scored highest on interpersonal aspect of schizotypal and interpersonal intolerance of ambiguity.

 Sood (2003) reported that students having extrovert and introvert type of personality exhibited significant difference on judicial thinking
style. Extroverts were found to be higher on judicial thinking style than introvert type students. However on 12 thinking styles viz. legislative, executive, monarchic, hierarchical, oligarchic, anarchic, global, local, internal, external, liberal and conservative style. He further found that students in sensing type of personality were higher than intuitive type of students on executive thinking style and intuitive type of students were higher than sensing type of students on monarchic and oligarchic styles. On rest of the thinking styles (10), no significant differences were found between the two groups. Students possessing thinking type of personality were found to score lower an oligarchic and anarchic style than students possessing feeling type personality. Reverse was the case for external thinking style. On this style feeling type personality were found to be superior to students having thinking type of personality. Students having perception type of personality were found superior to students having judgment type personality on judicial style. On rest of the thinking styles, no significant differences emerged.

2.2.2 Locus of Control and Styles of Thinking

Negligible exploration has been made on the association of locus of control and style of thinking.

Borg (1985) reported that co-efficient of correlation indicated insignificant relationship between locus of control and style of thinking.

2.2.3 Self- Esteem and Styles of Thinking

Some research studies have been conducted on the relationship of self-esteem and styles of thinking.

Vingiano (1989) found that students with left hemisphere style viewed themselves in a positive light while right hemisphere style of thinking groups were negative in their perception.
Persinger and Makarec (1991) reported that right hemisphere style of thinking displayed the lowest self esteem in both male and female groups. People with greater left hemisphere style characteristic display an elevated sense of self-esteem.

Epstein, Pacini, Denes-Raj and Heier (1996) found that analytical rational style of thinking was positively correlated with self-esteem of undergraduate students. Intuitive experimental style of thinking was also related to self-esteem in the same direction but magnitude was smaller.

It may be stated that personality types / traits and other factors like self-esteem and locus of control have been studied in context of styles of thinking. It has been found that thinking style is a manifestation of personality.

2.2.4 Motivation and Styles of Thinking

A little exploration has been done in the relationship between motivation and styles of thinking.

Suresh (1990) concluded that there was significant positive correlation between integrated functioning of hemisphere style and achievement motivation and a significant motivation and a significant negative relationship with anxiety.

Epstein et al. (1996) reported that need for cognition thinking was negatively related to depression anxiety and stress in college life. The correlation with faith in intuition were to the same direction but were in smaller magnitude. Also, in women group, faith in intuition style was not found to be related to depression and stress, it was negatively associated with anxiety.

2.2.5 Adjustment and Styles of Thinking

Negligible amount of research was available on the relationship adjustment and thinking style for example:
Epstein et al. (1996) found that analytical rational style of thinking were both associated with a variety of self report measure of adjustment. Although the two modes of thinking made significant and independent contribution in predicting those variables, the contribution was greater for analytical thinking style.

2.2.6 Leadership Behaviour and Styles of Thinking

Adams (1988) observed that creative thinking style was not related to their leader effectiveness.

Epstein, Pacini, and Denes (1996) reported that analytical rational thinking style was significantly and positively correlated with dominance characteristics of undergraduate students. Correlation of dominance with intuitive direction but magnitude was smaller as compared to analytical style.

2.2.7 Openness to Experience and Styles of Thinking

One study could be traced on the subject cited above:

Raina and Vats (1983) found that openness to inner experience was positively related to right hemisphere style, however, left hemisphere style was not found to be related with openness to experience.

2.2.8 Styles of Learning and Styles of Thinking

Some investigators have made attempts to study the relationship between styles of learning and styles of thinking. Review of such studies has been presented here under:

(Bogen, Fisher and Bogen, 1965, Gozzaniga, 1970 and Spery 1968, Galin, 1971, Duke and Ornstein, 1974) have confirmed what John Hughlings Jackson asserted in 1878 that our brain consists of two distinctive but automatically tasks as reading speaking analytical
reasoning and arithmetic, the right hemisphere is better at spatial tasks, recognizing faces and music.

Dunn et al. (1982) found that student with right hemisphere style indicated strong preferences for an informal setting, music rather than silence, some from oral intake and low light while studying. they also frequent breaks.

Brennan (1984) reported that global / analytic cognitive styles were related to right and left hemisphere style respectively.

Taggart (1984) studied the relationship between style of thinking and learning and reported that right styles thinking dislike structure in learning, independent thinker prefer high intake food and drink. Left thinkers dislike noise and learning in variety of ways, they prefer formal room design.

Bruno (1988) reported that there was statistically significant correspondence between thinking styles (hemisphericity) and learning style preferences specifically for the simultaneous process or there exists a significant correspondence between the elements of requiring sound, needing tactile and kinesthetic materials, intake and mobility when learning and their hemispheric preferences.

Dunn et al. (1990) found that there was significant relationship between students, hemispheric processing preferences and their diagnosed learning styles. Students with right hemisphere style preferred informal sound available, intake accessible environments, and students with left hemispheric preferred than opposite and bright light.

Above mentioned review hints that styles of thinking influence styles of learning of students.
(SECTION - III)

2.3 LEARNER’S NON-COGNITIVE (BACKGROUND) CHARACTERISTICS AND STYLES OF THINKING

Some researchers have explored background variables influence the styles of thinking. The results, however, have been inconclusive. Moreover, research in this perspective has been conducted in Western countries. A little research is traceable which pertains to non-western countries in this context. This section presents the review of studies concerning the association between selected background variables and thinking styles:

2.3.1 Gender and Styles of Thinking

Some research studies have been undertaken on gender differences in styles of thinking. For instance:

**Mc. Carthy (1980)** reported that both males and females preferred right style. The second choice was left for males and integrated for females.

**Mc. Golve (1980) and Levy (1980)** found that woman students were superior in left hemispheric style and men in right hemispheric style.

**Tan William (1981) and Afloti (1981)** reported that both males and females at high school level preferred integrated style and males preferred right hemisphere style.

**Gilligan (1982)** observed that stereotypes about differences in thinking styles associated with gender are widely held in western society. Rational thinking / logical thinking are associated with masculinity whereas intuitive/ feeling thinking is associated with femininity.

**Raina and Vats (1983)** observed that females had higher scores in right hemisphere style of thinking in comparison to males but the differences in mean scores was not statistically significant.
Gupta and Gupta (1984) found that females tended to have more preference for integrated style and males tended to possess more preference for right hemisphere style at college level.

Stellern et al. (1984) found that elementary females prefer integrated style while men prefer right style of thinking.

Kreshner and Ledger (1985) reported that there was no sex difference in thinking styles of primary school children.

Soliman (1989) reported that males scored significantly higher than females on the right hemisphere style. Further males scored significantly higher than females on the left hemisphere style. Also females scored significantly higher than males on the integrated style of thinking.

Habencht et al. (1990) did not find any significant difference in styles of thinking of male and female students.

Manfort (1990) also did not observe any significant difference in the styles of thinking of man and woman students.

Nah Carol (1990) found that right hemispheric preference was associated with female.

Verma (1994) reported that male students had greater inclination toward left hemispheric style than female students.

Epstein et al. (1996) found that rational style was associated with masculinity whereas intuitive feeling style thinking was associated with femininity.

Block and Kremen (1996) reported that women who disconfirm the stereotype of femininity by being very rational or intellectually critical may be subject to problem with interpersonal relation.

Saleh (1997) found significantly gender differences. Men leaned more towards left-brain dominating style than females.
Grigorenko and Sternberg (1997) found that student's styles of thinking did not vary across sex variable. Both male and female students had almost similar thinking styles.

Zhang and Sachs (1997) reported that men tended to be more global in their style of thinking than women.

Zhang (1999) conducted a study on thinking styles of university students in Hong Kong. The sex difference did not emerge as significant factor in thinking styles.

Mohan Sundaram and Kumar (2000) found that there is association between hemisphericity and sex of students at higher secondary level. Girls are right hemisphere dominated (Boys 28.78%; Girls 71.21%) and boys left hemisphere dominant (Boys 51.26%; Girls 48.73%).

Sood (2000) reported that female students tend to employ external style of thinking more than male students. However, on rest of the 12 styles of thinking viz, legislative, executive, judicial, hierarchical, oligarchic, anarchic, global, local, internal, liberal and conservative no significant differences were found between male and female students.

Verma, Saroj (2001) undertook a study to ascertain the differences in thinking styles of college students based on sex, course type and residential background. Gender differences were observed in some thinking styles. Female students scored significantly higher than male students on legislative and executive style. On the other hand, male students scored significantly higher than female students on monarchic style. On rest of the thinking styles sex differences did not emerge as significant.

Verma, Amila (2001) studied gender difference in thinking styles of senior secondary students. The data were collected through Sternberg's Thinking Style Inventory. Statistical analysis yielded that female students were superior to male students on executive thinking style.
Kumari, Vandana (2004) found that there were no significant differences in thinking styles of male and female postgraduate students of second semester. But in fourth semester students, female were found to be significantly higher on anarchic thinking style.

2.3.2 Age and Styles of Thinking

Grigorenko and Sternberg (1997) also found significant effect on thinking styles.

Sternberg (1997) reported that teachers become more executive, local and conservative with age. Older teachers were found to be higher than younger on above-mentioned styles.

Zhang and Sachs (1997) reported that age factor matters in thinking styles. Older students were significantly more judicial than younger peers.

Zhang (1999) found that participants thinking styles were different by age at university level. Participants who were 33 years old or older scored significantly higher on judicial thinking style than those between 19 and 26 years old. 27 years older scored significantly higher on liberal style and younger scored higher on conservative style. Older also scored higher hierarchical and external styles than younger.

2.3.3 Birth order and Styles of Thinking

Sternberg and Grigorenko (1995) investigated the relationship of birth order and styles of thinking. They found that birth order was related to thinking styles namely legislative, liberal and hierarchical styles being latter born.

Sternberg (1997) reported that latter born siblings tended to be more legislative than earlier born siblings. It is consistent with the past finding that first-born siblings tend to be more accepting of societal dictates than are later born.
Zhang (1999) found that there was no significant difference in thinking styles of university students by birth order

2.3.4 Socio-Economic Status and Styles of Thinking

Sternberg & Grigorenko (1993) and Zhang (1999) did not observe any significant difference in thinking styles of university students based on level of parental education.

Sternberg and Grigorenko (1995) found that style of thinking related to two demographic variables - socio-economic status on the basis of parental education and birth order.

Sternberg (1997) reported that socio-economic level related negatively to the judicial, local, conservative and oligarchic styles. In other words students belonging to lower SES were found higher than students belonging to higher SES on above-mentioned styles of thinking. The results are consistent with a notion that greater authoritarianism is found in the individuals of lower socio-economic class.

Socio-economic status (based on father’s education) comes to be related to executive style, judicial style and conservative style. It had positive relation with legislative style and hierarchical style. Father’s occupational level has also found to be negatively related to judicial, local, conservative and oligarchic styles of thinking.

To sum up it may be said that thinking styles of students are influenced by certain background variables. It is also in consonance of theories of styles that they are partly socialized.

2.3.5 Academic Disciplines/Stream and Styles of Thinking

Several investigators made attempts to examine differences in thinking styles of students belonging to different academic majors and disciplines. Some studies have been reviewed in this context in following paragraphs:
Srinivas Iyengar (1974) the best approach to mathematics, physics, chemistry, biology, history, sociology, poetry, music, art is to see them all as petals of the same flower, notes of single piece of music, tints of same apocalyptic rainbow arc, rays that feel the same central illumination.

Kaltsounis (1979) also studied the relationship of hemisphericity to different types of achievement among 103 students in a school for the deaf. Using the Stanford Achievement Test, he found negative correlation with right score for both reading and Comprehension (r = 0.23) and mathematics (r = 0.2). There was significant positive relationship for the integrated scale scores for reading comprehension (r = 0.35), social studies (r = 0.33) and science (r = 0.31).

Ghosh (1980) in a study of graduate and undergraduate student in a school business and observed that a group of subjects scored significantly lower on the right hemisphere style than the national norms.

Silbey (1980) in a study of graduate and undergraduate students in a school business and observed that a group of subjects scored significantly lower on the right hemisphere style than the national norms.

Schwab expanded Snow's categories to three the investigative (natural science), the appreciative discipline (arts) and the decisive (social science).

Agor (1983) investigated thinking styles of members of American Society of Public Administration and found that dominant thinking style of government managers was intuitive or integrative style.

Lash (1983) found that students of computer programming had left hemisphere style of thinking.

Raina and Vats (1983) reported that arts students had greater scores on right hemisphere style of thinking in comparison to science students but the difference in mean scores was not significant.
Coulson and Strickland (1986) found significant differences in styles of thinking of chief executive officers and superintendents of schools. Chief executive officers were described as cerebral right thinkers and superintendents as left thinkers.

Taylor (1986) found that student's choice of major was not related to brain dominance.

Grun (1986) observed that certain styles of thinking were found to be associated with specific academic major.

Kienholtz and Hritzuk (1986) studied the thinking styles of architecture and medical students who scores were significantly different. The architecture students preferred the idealist thinking style while the medical students favoured the realist thinking style.

Wegston (1989) studied the relationship between creative style and quality of problem definition in MBA students. Also, creative style was studied in relation to type of undergraduate major and years of experience in occupation. Creative style was measured by Kirton Adaptation-Innovation Inventory (KAI). The results showed a statistical significant relationship between creative style and academic major. Nearly twice as many business majors were innovative rather than adopters, with ratios reserved for computer science and accounting majors.

Monfort (1990) reported that students who had chosen major could be differentiated significantly by their scores on thinking styles. Students majoring in accounting, management, finance, computer science, nursing, criminal justice and elementary education scored high on left hemisphere style of thinking. Conversely students who are majoring in interior design, music, journalism, art and architecture had higher scores in right hemisphere style of thinking. Students who scored a right brain thinking style founded to choose major which required spatial / temporal, visualization rather majors which were dependent on language base.
Lavach (1991) reported that humanities subjects depended on a more diffuse and perhaps, divergent thinking style. They exhibited right hemisphere style, whereas natural science subjects appear to prefer a more integrated or left hemispheric style. Social science students exhibited the similar preference for styles of thinking.

Huang and Sisco (1994) reported that students of social science or humanities and of natural science scored as more idealistic than those in engineering. Students of natural science and engineering scored as more analytical than those from social science or humanities, and engineering students scored as more realistic than those of other majors. This group of students preferred the analytical thinking style most and the synthesist style least.

Sternberg and Grigorenko (1995) reported a significant effect of disciplines / subjects on thinking styles. Humanities teachers were found more liberal than science teachers were found more local than humanities teachers were.

Saleh (1997) reported that there was significant effect relationship between brain hemispheric styles and academic majors students majoring in business science and engineering fields tended to possess left hemisphere style of thinking whereas students majoring in arts, literature, education, nursing, law communication fields tended to possess right brain dominant style.

Zhang and Sachs (1997) found that students of natural Science and technological subjects had more global thinking style than those in areas of social science and humanities.

Mishra (1998) more recently reported that in general students belonging to commerce, management and fine arts mostly prefer right hemisphere style of thinking On contrary, students belonging to arts prefer to use right hemisphere style of thinking. Science students, however, were found to use left and right hemisphere style of thinking.
Sood (2000) in his study of diversity in thinking styles of tertiary students found that science students were significantly higher on legislative, oligarchic and anarchic style than arts students but no significant difference was observed between science and art group of students on executive, judicial, monarchic, hierarchical, global, local, internal, external, liberal and conservative style of thinking. Sood further found that science students were higher on judicial, hierarchical and anarchic styles of thinking as compared to commerce students. While commerce students were higher on monarchic style of thinking. On rest of the thinking styles no significant differences were noticed between science and commerce students. On comparing thinking styles on commerce and art students, no significant differences were found in the thinking styles of the two groups.

Attri (2001) explored styles of thinking of professional students. Sternberg and Wagner’s tool of styles of thinking (104 Item inventory) was used. The data analysis reveal that (i) students of engineering, medical, law, BBA and BCA were at par with legislative style, executive style, judicial style, monarchic style, hierarchic style, oligarchic style, anarchic style, global style, local style, internal style, liberal style, and conservative style. However, they showed significant differences on external style of thinking. B.ECI. students were found to be significantly higher on external style than medical, law, BBA and BCA students.

Verma, Saroj (2001) concluded in her study that professional and non-professional students differed on oligarchic, anarchic and local style of thinking. Non-professional students scored significantly higher on oligarchic and anarchic styles whereas professional students on local style.

Verma, Amila (2001) made an inquiry into the impact of stream on thinking styles. The investigation was conducted on or senior
secondary students and styles were measured through Sternberg’s Thinking Style Inventory. The data analysis indicated that there was significant effect of stream on some thinking styles. No significant difference emerged in thinking styles of arts and science students except for judicial and internal thinking styles. Science students obtained higher mean score on judicial thinking style whereas arts students score higher on external style of thinking.

Kumari Vandana (2004) observed that in second semester students of major two streams (languages, natural sciences) did not differ significantly on thinking styles except judicial one. In this style, language group was found to be superior to natural science group. Students of natural science group were found to be higher on legislative, executive, global, external and liberal thinking styles. On the other hand, social science group students were found to be higher on hierarchic thinking style. In fourth semester, students of language group showed significantly greater inclination for legislative, judicial, oligarchic, local and executive thinking styles. In comparison to their counterparts social science group. However, on liberal style, social science group exhibited their superiority over language group. The language group also obtained significantly higher scores on legislative, executive, judicial and hierarchic thinking style than natural science group. Social science students scored greater than natural science students on anarchic style of thinking.

It is apparent that academic major differences have been found in certain styles of thinking of the students using different tools of thinking styles. A little research is available on styles of thinking as measured by thinking style inventory by Sternberg.

2.3.6 College Class and Styles of Thinking

Theory of mental self-government also predicts an effect of college class.
Sternberg (1997) reported that in a study of school, teachers were found more legislative but less executive at the lower grades than at the upper grades.

Zhang and Sach (1997) observed that higher-class students (research students) tend to employ external thinking style more than the non-research students do. B. Ed. students were more likely to employ monarchic and local thinking styles than students from higher classes (PC.Ed. and M.Ed. Programme). Further former scored lower on global style than the later.

Zhang (1999) found that the participants of different college class levels did not yield significant differences in thinking styles.

2.3.7 Type of Institution and Styles of Thinking

A few studies could be located on relationship of styles of thinking to type of institution.

Sternberg and Grigorenko (1995) found no significant impact of type school (public school, academically oriented private school and elementary secondary catholic school) on styles of thinking of students.

Sternberg (1997) reported that styles of thinking differed significantly depending upon the type of school where the teachers were serving. The data analysis revealed that with regard to the legislative style the highest mean was shown by the teachers in the private school emphasizing emotional education. The lowest mean was in the public high school.

With regard to the executive style, the highest mean was in the elementary-secondary catholic school. The lowest mean was in the private school emphasizing emotional education. With regard to judicial style, the highest mean was in the academically oriented, prestigious private school. The lowest mean was in the private school emphasizing emotional education.
Sternberg (1997) reported that different school systems rewarded different thinking styles and moreover, that what they rewarded seemed to fit with stylistic character of the schools. For six out of seven planned analyses, it was found that there was significant effect of school ideology on teacher’s styles. Either teachers tend to gravitate toward schools that fit them ideologically or else they tend to become like the place they are in.

Zhang (1999) also did not find any significant difference in thinking styles of students in different type of institutions.

There was no association between hemisphericity and type of school (Government and Private).

2.3.8 Grades / Levels of Education and Styles of Thinking

Tagga (1984) asserts that left hemisphere thinking styles predominates the schools and right thinking styles predominates in college.

2.3.9 Race / Culture and Styles of Thinking

Some studies have been reported on the association of race, culture and styles of thinking. For example

Ten Houten et al. (1972) conducted that black students were having significantly more right hemisphere style of thinking than the Caucasian students.

Tsunoda (1978) studied thinking styles of the Japanese and found that their way of thinking is different from that of western people. He described the difference as the ‘Japanese Mind’ as opposed to the ‘Western Mind’.

Torrance and Sato (1979) found significant difference between Japanese and United States students in hemisphere style. They cited evidence from Tsunoda’s research that cultures and educational systems influence the way people use their minds.
Tsunoda (cited by Torrance and Sato, 1979) discovered characteristic differences in ways of native Japanese educated in Japan and their counterparts educated in western countries in process of information. Tsunoda also found that second and third generations of Japanese descent born and raised to environment where western languages are spoken such as United States and Brazil, develop exactly the same pattern of left hemisphere functioning style as westerners.

Harrison and Bramson’s (1982) studied that the most popular thinking style among their samples of American subjects was the idealist style and the second most popular thinking style was the analyst style.

Hale (1986) had reported the similar findings on the relationship of styles of thinking and race factor.

Chapelle and Roberts (1986) studied cognitive styles of Japanese, Spanish and Arabic Learners of English as Second language. They also noted that the Japanese groups were significantly different from the other groups in their cognitive styles.

Soliman and Torrance (1986) conducted research on Japanese, American and Kuwaiti college students learning and thinking styles and observed that the Japanese students preferred an intuitive approach, the Kuwaiti students preferred a logical approach and the American students favoured and integrated approach to problem solving.

Habenicht et al. (1990) found that there was no significant difference in styles of thinking of black and Caucasian children.

Huang (1993) studied the relationship of thinking styles among selected Chinese and North American adult students in higher education. Thinking styles were measured through Harison and Barmson’s Thinking Style Inventory. The findings revealed that the relationships were observed between country difference and the pragmatist thinking styles, between major and idealist, analyst and thinking styles. Negative relationships were
noted among several thinking styles. An interaction was found between country difference and the gender difference on the idealist thinking style.

**Huang and Sisco (1994)** made the comparative study of thinking styles of Chinese and American adult students in higher education, using the Inquiry Mode Questionnaire by Harrison and Bramson. The analysis showed that Chinese students scored as more pragmatic than the American group and the Chinese men and American women scored as more idealistic than the Chinese women and American men.

**Bogen (1995)** concluded that certain races including Afro-American, Native Americans and Japanese appears more right hemisphere in their style of thinking than Euro-American Caucasian.

**Epstein et al. (1996)** found that styles of thinking play an important role in interpersonal relationship Intuitive thinking style was positively associated with reported secure relationship with both a current intimate partner and for man only, with a mother. Analytical style, though directly related to rational, non-aggressive tactics for dealing with interpersonal conflicts was associated with having fewer sex partners, a dismissive avoiding relationship style for women and avoidant, insecure models of father.

**Verma, Amila (2001)** explored the relationship between culture and thinking style in her study on senior secondary students: Thinking styles were assessed through Sternberg’s Thinking Style Inventory. The data analysis revealed that there was significant effect of culture on certain thinking styles. Tribal and non-tribal students differed in executive, judicial, local and external style of thinking. The non-tribal students were superior to tribal students in executive, local and external styles of thinking whereas students found to be higher in judicial style than non-tribal students. Interaction between culture and gender was also observed for global style of thinking.
2.3.10 Residence, Locality and Styles of Thinking

Mohan Sundaram and Kumar (2000) reported that there is an association between hemisphericity and locality of students. It is inferred that urban students were right hemisphere dominant (Rural – 43.2%, Urban – 56.07%) and rural students were left hemisphere dominant (Rural - 66.40; Urban - 33.79%).

Verma B.P.(1994) concluded that there was no significant difference in thinking styles of rural and urban students.

Zhang and Sachs (1997) observed that students belonging to different residential locations did not show any significant difference in their thinking styles.

Verma, Saroj (2001) concluded that rural students scored significantly higher on thinking hierarchical style and lower on oligarchic style than urban students. On rest styles viz, liberal and conservative no significant differences were discerned.

Sood (2003) reported that tertiary level student belonging to rural and urban areas did not differ on any of the 13 thinking styles measured through Sternberg’s Thinking Style Inventory. They were more or less equal on legislative, executive, judicial, monarchic, hierarchical, oligarchic, global, local, internal, external, liberal and conservative styles of thinking.

2.4 A RESUME OF STUDIES

1. Intelligence and Thinking Styles

Kirby and Das (1978), Torrance and Ball (1977), Cody (1983), Mein (1986), Sherwood (1984), Milburn (1984), Kreshner and Ledger 1985), Sternberg and Grigorenko (1993) and Sternberg (1997) explored the relationship of cognitive ability with thinking styles. High, average and low levels of intelligence were found to be significantly related to certain thinking styles.
2. Creativity and Thinking Styles


3. Artistic Potential, Problem Solving Ability and Thinking Styles

Wagner (1978), Torrance and Frasier (1983), Houtz and Frankel (1988) and Sengultaiah (1989) reported that right and integrative styles of thinking were positive related to artistic and left hemispheric style was negatively related to artistic.

4. Academic Achievement and Thinking Styles

5. Personality and Thinking Styles


6. Locus of Control and Thinking Styles

Only one study could be located on the association between of control and thinking styles that is of Borg (1985). In this no significant correlations was reported.

7. Self-Esteem and Thinking Styles

A little research has been conducted to investigate the relationship of self-esteem and thinking styles. Vingiano (1989), Persinger and Makarec (1991), Epstien et al. (1996) paid attention towards this and reported that there was link between hemispheric styles of thinking and self-esteem of the students.

8. Motivation and Thinking Styles

Suresh (1990) and Epstein (1996) found relationship between achievement motivation, anxiety, stress and depression with thinking styles.

9. Adjustment, Leadership, Openness in Experience and Thinking Styles

Thinking styles seemed to shows significant relation with adjustment. (Epstein, et. al., 1996) and openness in experience (Raina and Vats, 1983). Adams (1988) found that thinking styles was not related to
leader effectiveness. However, analytical style had positive significant relationship with dominance characteristics.

10. Styles of Learning and Thinking Styles

Several researchers (Dunn et.al. 1982; Brennan, 1984; Taggart, 1984; Bruno, 1988; Dunn et.al. 1990) have found relationships between styles of learning and styles of thinking.

11. Gender and Thinking Styles

Several researchers found significant difference in thinking styles of male and female students (Mc Glove, 1980; Tanwilliam, 1981; Alloti. 1981; Gilligan, 1982; Gupta, 1984; Stellern et.al. 1984; Soliman, 1984; Nah Carol, 1990; Verma, 1994; Saleh, 1997; Zhang and Sachs, 1997; Mohan Sundram and Kumar, 2000; and Verma, 2001; Verma, 2001; Kumari Vandana, 2001) However, it may be noted this gender difference was noted with regard to few thinking styles. On other measured styles of thinking male and females have been fond alike.

12. Age, Birth Order and Thinking Styles


Sternberg and Grigorenko (1995) and Sternberg (1997) reported significant relations between birth order and thinking styles whereas Zhang (1999) did not report any significant relationship between the two variables.

13. Socio - Economic Status and Thinking Styles

The relationship between the above mentioned two variables was studied by some researchers. Sternberg (1997) found the SES was related to judicial, local, conservation and oligarchic styles. Sternberg and Grigorenko (1995) also supported the relation of SES with some thinking styles. However, Sternberg and Grigorenko (1993) did not observe any relationship between the SES and thinking styles.
14. Academic Stream, Disciplines and Thinking Styles


15. College Class, Levels of Education and Thinking Styles

Taggart (1984) and Zhang and Sachs (1997) found differences in thinking styles of school and colleges and of lower and upper classes, but Zhang (1999) did not indicate such differences in thinking styles.

16. Type of Institution and Thinking Styles

Sternberg (1997) found institutional differences in thinking styles whereas Sternberg and Grigorenko (1995) and Zhang (1999) did not support the relationship of the two - type of institution and thinking styles.

17. Race, Culture and Thinking Style

Several studies (Ten Houten et.al, 1972; Tsunoda (1978), Torrance and Sato (1979); Harrison and Brarnson (1982); Hale (1986), Chapelle and Roberts (1986), Soliman and Torrance (1986); Huang (1993) and Sisco (1994); Bogen (1995), Epstein et.al. (1986) and Verma (2001) reported impact of culture and race on certain thinking styles.
18. **Residence Locality and Thinking Styles**

Conflicting results were there with regard to the association of residence locality and thinking styles. Mohan Sundaram and Kumar (2000) and Verma Saroj (2001) reported significant relationship between residence locality of the students and thinking styles while Verma (1994) and Zhang and Sachs (1997) did not find any significant relationship between residence locality and thinking styles.

In View of the above-mentioned resume of research studies it is evident that there is scarcity of the researches on thinking styles of college students with special reference to personality, intrinsic/extrinsic motivation of science/arts/commerce streams. In India, the theme of thinking style is in infancy stage. Therefore, it warrants that researches be conducted in this field in Indian socio-cultural ethos.

The review of related studies provided base for selection of the present study, its hypothesis, methodology, design and statistical analysis of the data.