CHAPTER III

METHODOLOGY

3.0 INTRODUCTION

The present research was carried out to study metacognition and its association with selected student-related factors. The selected factors for this study were: Metacognitive Awareness [MA], Academic Self Concept [ASC], Learning Styles [LS], Hemispheric Dominance [HD], Academic Achievement [AA] and Gender Differences [GD].

The chronology of this scientific study can be traced as follows: defining the problem, formulation of hypotheses, selection of study variables and an appropriate research design on the basis of survey of the related literature and research.

The present chapter gives a description of the research design employed to verify the formulated hypotheses, population and sample, variables of study and their operational definitions, instrumentation and participants. It further describes the procedure of data collection and data analysis.

3.1 METHOD OF STUDY

‘Research’ refers to a systematic method consisting of enunciating the problem, formulating a hypothesis, collecting the data, analyzing the facts and
reaching certain conclusions towards the concerned problem [Kothari, 2004].

Research can be qualitative or quantitative.

A non experimental, quantitative approach has been adopted for this study. In this study the selected variables were not manipulated by the researcher but studied as they exist, because they are attributes of the respondents. However, the study relied on numeric and quantifiable data.

### 3.2 RESEARCH DESIGN

Research Design is defined as the plan and structure of investigation so conceived as to obtain answers to research questions (Kerlinger, 1995). It can also be considered as the blueprint or outline for conducting the study.

A descriptive, correlational research design was used to study objectives 1 to 4 that examine relations between metacognitive awareness and selected variables, i.e., academic self-concept (ASC), hemispheric dominance (HD), learning styles (LS) and academic achievement (AA). A two-group design was used to study objective 5 that examines gender differences (GD) in metacognitive awareness (MA) of students.

### 3.3 VARIABLES

#### 3.3.1 Variables of the Study

1. Metacognitive Awareness [MA]
   
i. Knowledge of Cognition [KC]
ii. Regulation of Cognition [RC]

2. Academic Self –Concept [ASC]

3. Hemispheric Dominance [HD]
   i. Left- Hemispheric Dominance  [LHD]
   ii. Right –Hemispheric Dominance [RHD ]
   iii. Whole- Brain Orientation  [ W]

4. Learning Styles [LS]
   i. Active / Reflective [ACT / REF ]
   ii. Sensing / Intuitive [ SEN / INT ]
   iii. Visual / Verbal [ VIS/ VER]
   iv. Sequential / Global [SEQ / GLO ]

5. Academic Achievement [AA]

6. Gender Differences  [GD]
   i. Male [M]
   ii. Female [F]

3.3.2 Operational Definitions of Variables

The following section deals with the operational definitions of the variables used in the study.

3.3.2.1 Metacognitive Awareness [MA] refers to the total score obtained by the respondent on Metacognitive Awareness Inventory [MAI].

3.3.2.2 Knowledge of Cognition [KC] refers to the total score obtained by the respondent on KC sub-scale of Metacognitive Awareness Inventory [MAI].
3.3.2.3 **Regulation of Cognition** [RC] refers to the total score obtained by the respondent on RC sub-scale of Metacognitive Awareness Inventory [MAI].

3.3.2.4 **Academic Self Concept** [ASC] refers to the total score obtained by the respondent on Academic Self Concept Scale [ASCS].

3.3.2.5 **Learning Style** [LS] refers to the profile derived from the assessment of four oppositional dimensions of learning styles as measured by Index of Learning Styles [ILS].

The four dimensions of learning style [i.e., eight learning styles] are operationally defined as follows:

3.3.2.6 **Active – Reflective Dimension** [AC-REF] refers to the total score obtained by the respondent on the Active –Reflective Dimension sub-scale of Index of Learning Styles [ILS].

3.3.2.7 **Sensing – Intuitive Dimension** [SEN-INT] refers to the total score obtained by the respondent on the Sensation –Intuitive sub-scale of Index of Learning Styles [ILS].

3.3.2.8 **Visual – Verbal Dimension** [VIS-VER] refers to the total score obtained by the respondent on the Visual – Verbal Dimension sub-scale of Index of Learning Styles [ILS].

3.3.2.9 **Sequential – Global Dimension** [SEQ –GLO] refers to the total score obtained by the respondent on the Sequential – Global Dimension sub-scale of Index of Learning Styles [ILS].

3.3.2.10 **Hemispheric Dominance** [HD] refers to the dominant brain orientation as measured by Styles of Learning and Thinking [SOLAT] [Youth Version].
3.3.2.11 **Left hemispheric dominance** [L-HD] refers to the total Left-brain dominance score [L] of the respondent as measured by Styles of Learning and Thinking [SOLAT] [Youth Version].

3.3.2.12 **Right hemispheric dominance** [R-HD] refers to the total Right-brain dominance score [R] of the respondent as measured by Styles of Learning and Thinking [SOLAT] [Youth Version].

3.3.2.13 **Whole brain-orientation** [W] refers to the total Whole-brain orientation score [W] of the respondent as measured by Styles of Learning and Thinking [SOLAT] [Youth Version].

3.3.2.14 **Academic Achievement** [AA] refers to total percentage of marks [P] obtained by the respondent in Xth grade annual examinations conducted by CBSE, Board, India.

3.3.2.15 **Gender Differences** [GD] refer to gender of the respondent, i.e., male [M] or female [F].

3.3.2.16 **Students of Class Eleven** refers to male or female individuals studying in class eleven falling in the age group of 15-17 years.

### 3.3.3 Control of Extraneous Variables

The various extraneous factors that could influence the study outcomes were controlled in the following manner.

**Age:** All the students included in the study were between 15-17 years age range.

**Schools:** All students were from English medium school that are affiliated to CBSE Board in Roorkee city.
Sex: Both sexes were equally represented in the study.

Education: All respondents were studying in class eleven.

Tests: The same tests were administered to all the respondents in the same manner.

3.4 NULL HYPOTHESES

The following null hypotheses were formulated to test the research hypotheses.

Hypothesis -1 [H0-1]: There no significant correlation between metacognitive awareness as measured by Metacognitive Awareness Inventory [MAI] and academic self-concept as measured by Academic Self Concept Scale (ASCS) in class eleven students.

Hypothesis -2 [H0-2]: There is no significant correlation between metacognitive awareness as measured by Metacognitive Awareness Inventory [MAI] and hemispheric dominance as measured by the Styles of Learning and Thinking (SOLAT) in class eleven students.

Sub Hypothesis 2.1 [H0-2.1]: There is no significant correlation between metacognitive awareness as measured by Metacognitive Awareness Inventory [MAI] and left hemispheric dominance as measured by the Styles of Learning and Thinking (SOLAT) in class eleven students.

Sub Hypothesis 2.2 [H0-2.2]: There is no significant correlation between metacognitive awareness as measured by Metacognitive Awareness Inventory [MAI] and right hemispheric dominance as measured by the Styles of Learning and Thinking (SOLAT) in class eleven students.
Sub Hypothesis 2.3 [H0-2.3]: There is no significant correlation between metacognitive awareness as measured by Metacognitive Awareness Inventory [MAI] and whole brain dominance as measured by the Styles of Learning and Thinking (SOLAT) in class eleven students.

Hypothesis 3 [H0-3]: There is no significant correlation between metacognitive awareness as measured by Metacognitive Awareness Inventory [MAI] and learning styles as measured by Index of Learning Styles (ILS) in class eleven students.

Sub Hypothesis 3.1[H0-3.1]: There is no significant correlation between metacognitive awareness as measured by Metacognitive Awareness Inventory [MAI] and active-reflective dimension of learning styles as measured by Index of Learning Styles (ILS) in class eleven students.

Sub Hypothesis 3.2 [H0-3.2]: There is no correlation between metacognitive awareness as measured by Metacognitive Awareness Inventory [MAI] and sensation-intuitive dimension of learning styles as measured by Index of Learning Styles (ILS) in class eleven students.

Sub Hypothesis 3.3[H0-3.3]: There is no significant correlation between metacognitive awareness as measured by Metacognitive Awareness Inventory [MAI] and visual-verbal dimension of learning styles as measured by Index of Learning Styles (ILS) in class eleven students.

Sub Hypothesis 3.4[H0-3.4]: There is no significant correlation between metacognitive awareness as measured by Metacognitive Awareness Inventory [MAI] and sequential-global dimension of learning styles as measured by Index of Learning Styles (ILS) in class eleven students.
Hypothesis -4 [H0-4]: There is no significant correlation between metacognitive awareness as measured by Metacognitive Awareness Inventory [MAI] and academic achievement as measured by cumulative percentage of marks [P] obtained in Xth standard annual examinations.

Hypothesis -5 [H0-5]: There is no significant difference between metacognitive awareness as measured by Metacognitive Awareness Inventory [MAI] of male and female students of class eleven.

3.5 POPULATION

“‘Population’ is any group of individuals that has one or more common characteristic that are of interest to the researcher. Population is the entire collection of people from which the data is to be collected in order to arrive at generalizations.” [Best and Kahn, 1970. p.13].

Population for the present study consists of all class eleven students enrolled in English medium schools affiliated to Central Board of Secondary Education [CBSE Board] during the academic year 2009-2010 in Roorkee City, Uttarakhand, India. The age range of the students is from 15-17 years. CBSE Board is a central government initiated K-12 Education in India. The characteristics of the population of the study are given in table 3.1.
Table 3.1: Characteristics of the Population

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade</td>
<td>Class Eleven</td>
</tr>
<tr>
<td>Age</td>
<td>15 to 17 years</td>
</tr>
<tr>
<td>Gender</td>
<td>Male, Female</td>
</tr>
<tr>
<td>Education Board</td>
<td>Central Board of Secondary Education</td>
</tr>
<tr>
<td>Medium of Instruction</td>
<td>English</td>
</tr>
<tr>
<td>Geographic Location</td>
<td>Roorkee, Haridwar district, Uttarakhand,</td>
</tr>
</tbody>
</table>

Reasons for selecting population with following specific characteristics-

Eleventh class students: Class eleven is the transitional phase from high school stage [10th] to college stage. This phase of education involves higher levels of learning compared to the previous stages and requires metacognitive skills.

Another reason for selecting class eleven is, in India, the class eleven students do not have board examinations. Therefore, school administrators and students were willing to cooperate in research as this would not interfere in their study programs.

English medium schools: The administered standardized tools were in English, and the prerequisite to respond to these questionnaire is fluency in English. Hence students from English medium schools were selected.

CBSE Board affiliated schools: The curriculum followed in Central Board of Secondary Education [CBSE] schools is uniform throughout India. This creates an ecological uniformity which facilitates the generalizability of the findings.
A preliminary survey of the Roorkee City and an internet search revealed that there are a total of 14 CBSE English Medium schools in Roorkee city and the list of schools is given in Appendix –B.

**Geographic Location of the Population**

Roorkee is a city located in Haridwar district, which is in the state of Uttarakhand, India. Roorkee is located between the rivers Ganga and Yamuna, about 180 km north of the Indian capital New Delhi [Appendix-A]. It is located on the banks of the Ganga canal on the National highway between Delhi and Dehradun. This city is best known for Indian Institute of Technology (IIT) Roorkee (Wikipedia.org).

### 3.6 SAMPLE

Sample is a subset of the population that represents the population to be studied. The ultimate test of a sample design is how well it represents the characteristics of the population it purports (Kothari, 2004).

Selection of the sample for the present study was done in two stages. The first stage was the selection of schools. There are 14 CBSE English medium schools in Roorkee city[ Appendix-B]. Using a simple random *without replacement* ('WOR' - no element can be selected more than once in the same sample) method, six schools [one-third of total population of schools ] were selected.
The gender distribution of class eleven students enrolled during the academic year 2009-10 in the selected schools is given in table 3.2. This information was collected personally from school administration of the selected schools. In addition, the information was also gathered from the official website of School Education Government of Uttarakhand.

Table 3.2: Distribution of student by gender in class eleven students in the selected schools.

<table>
<thead>
<tr>
<th>S.No</th>
<th>School</th>
<th>Boys</th>
<th>Girls</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kendriya Vidyalay</td>
<td>43</td>
<td>39</td>
<td>82</td>
</tr>
<tr>
<td>2</td>
<td>Greenway Sec.School</td>
<td>90</td>
<td>45</td>
<td>135</td>
</tr>
<tr>
<td>3</td>
<td>St. John’s Sec.School</td>
<td>27</td>
<td>08</td>
<td>35</td>
</tr>
<tr>
<td>4</td>
<td>Montfort Sec.School</td>
<td>78</td>
<td>22</td>
<td>100</td>
</tr>
<tr>
<td>5</td>
<td>Army Sec.School</td>
<td>71</td>
<td>65</td>
<td>136</td>
</tr>
<tr>
<td>6</td>
<td>St. Anns Sec.School</td>
<td>0</td>
<td>168</td>
<td>168</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>309</td>
<td>347</td>
<td>645</td>
</tr>
</tbody>
</table>

In the second stage of sampling, students were selected from each selected school to be included in the sample. With the permission of the class teacher, every alternate student’s name in the class attendance register was collected and coded to be included in the sample. This method of selection has ensured that each student had an equal chance of selection. In this manner the data was collected from 350 respondents.
When the collected data of the 350 respondents was checked for missing values and outliers, 24 cases were discarded. As a result the final sample has been reduced to 326. The sample distribution school-wise is given in Table 3.3.

**Table 3.3: Sample distribution school-wise**

<table>
<thead>
<tr>
<th>S.No</th>
<th>School</th>
<th>Boys</th>
<th>Girls</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kendriya Vidyalay</td>
<td>22</td>
<td>20</td>
<td>42</td>
</tr>
<tr>
<td>2</td>
<td>Greenway Sec.School</td>
<td>45</td>
<td>22</td>
<td>67</td>
</tr>
<tr>
<td>3</td>
<td>St.John’s Sec.School</td>
<td>13</td>
<td>04</td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td>Montfort Sec.School</td>
<td>38</td>
<td>11</td>
<td>49</td>
</tr>
<tr>
<td>5</td>
<td>Army School Sec.School</td>
<td>35</td>
<td>32</td>
<td>67</td>
</tr>
<tr>
<td>6</td>
<td>St.Anns Sec.School</td>
<td>0</td>
<td>84</td>
<td>84</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>153</strong></td>
<td><strong>173</strong></td>
<td><strong>326</strong></td>
</tr>
</tbody>
</table>

According to David Van Amburg [cited by Mitchell & Jolley, 2005, p. 285] when the population size is \( \leq 1000 \) then the required sample size is 278 [desired accuracy is within 5% at the 95% confidence level]. Therefore, the sample size of 326 the present study is within the accepted criteria. The sample distribution by gender is given in table 3.4.

**Table 3.4: Sample distribution by gender**

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>139</td>
<td>47.77%</td>
</tr>
<tr>
<td>Female</td>
<td>152</td>
<td>52.23%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>291</td>
<td>100%</td>
</tr>
</tbody>
</table>
3.7 TOOLS USED

On the basis of the research objectives and hypotheses the following four standardized self-report instruments were selected to measure the selected variables.

1. Metacognitive Awareness Inventory [MAI] developed by Schraw and Dennison (1994). [Appendix- E]


3. Index of Learning Styles [ILS] developed by Felder and Solomon’s [1991,1994] [Appendix- G]

3. Styles of Learning and Thinking [SOLAT] developed by Torrance et al. [1988].

In addition, a Personal Data Sheet (PDS) [Appendix-D] was used to collect background demographic information and Percentage of marks obtained in Xth standard examinations.

3.7.1 Metacognitive Awareness Inventory (MAI)

The Metacognitive Awareness Inventory (MAI), developed and tested by Schraw and Dennison (1994) was used in this study to measure the metacognitive awareness (MA) (See Appendix-E). The MAI is a self-report instrument to test metacognitive awareness of adolescents and adults; and it consists of 52 statements. The 52 items are classified into two broader categories: Knowledge of Cognition [KC] and Regulation of Cognition [RC]. Schraw and Dennison (1994) found that the internal consistency of MAI as .93 to .88. They also reported a statistically significant relationship between knowledge and regulation of cognition (r =.54 and
This significant correlation between KC and RC supports the two-component theory of metacognition.

The participants of the study rated the 52 statements on a five-point Likert scale. Three scores were generated for each respondent: Scores for knowledge of cognition, regulation of cognition, and metacognitive awareness. Metacognitive awareness score was derived by summing scores of KC and RC scores. Higher scores correspond to greater metacognitive knowledge and greater metacognitive regulation. In the present study, the obtained Cronbach alpha coefficient of 0.879 denotes a high reliability for the local sample.

3.7.2 Academic Self Concept Scale (ASCS)

Academic Self-Concept Scale (ASCS) was developed by Reynolds et al. (1980) (see Appendix C). This scale measures attitudes, feelings, and perceptions related to one’s intellectual or academic skills (Reynolds et al., 1980).

Academic Self-Concept Scale consists of 40 Likert-type items and is keyed in the direction such that a high score indicates a positive academic self-concept. Each item on the ASC is assessed on a four-point Likert-type scale ranging from 1 [strongly agree] to 4 [strongly disagree]. The scale has seven sub-scales: grade and effort, study habits, peer evaluation of academic ability, self-confidence in academic ability, satisfaction with college, self-doubt regarding ability, and self-evaluation of external standards (Reynolds et al., 1980).
The ASC scale has been validated against Rosenberg’s Self-Esteem Scale (1965) and GPA for a sample of 427 college students with correlations of .45 and .40 (p<.001) respectively (Reynolds, et al., 1980). In another study, further analysis of the instrument was done based on a sample of 589 undergraduate college students. The Academic Self-concept scale was correlated with GPA, general self-concept, and social desirability. It provides additional support for construct, convergent and divergent validity of the measure (Reynolds, 1988). Internal consistency reliability estimates investigated by Reynolds et al (1980) yielded an $\alpha$ of .91 for the total scale of the ASCS when tested on 427 students. Lampert (2007) has recorded alpha coefficient of 0.91.

In the present study the total score of all 40 statements is taken as general Academic Self Concept (ASC) score. Thus a subject can get a minimum of 40 to a maximum of 160 score on this scale. In the present study, the obtained Cronbach alpha coefficient of 0.751 denotes a high reliability for the local sample.

### 3.7.3 STYLES OF LEARNING AND THINKING

[SOLAT’ YOUTH VERSION]

Styles of Learning and Thinking (SOLAT) was developed by Torrance et al., (1988). This is a self-report inventory and was designed to determine a student’s right or left cerebral hemispheric dominance or the integration of both. The SOLAT questionnaire consists of 28 items, each having two responses. The respondent could select one of the two statements or both. The first response is associated with left
hemispheric dominance, the second response is with right hemispheric dominance, and choosing both responses would reflect an integration of the hemispheres for a particular question. The number of L’s (Lefts) and the number of R’s (Rights) and the number of W’s in which both are checked (Whole-Brained) are counted and totaled. Cronbach’s alphas were 0.77 and 0.74 for analytical and holistic scales, respectively (Zhang, 2002). Further Zhang cites the statement of Torrance (1988) regarding validity, he says due to a lack of studies validity can be drawn from ‘earlier versions of the measure that have been tested and developed. In the present study, Cronbach alpha coefficient of 0.719 denotes a high reliability for the local sample.

3.7.4 Index of Learning Styles (ILS)

The Index of Learning Styles (ILS)] was developed by Richard Felder and Barbara Solomon (1991, 1994), to assess Learning style preferences. ILS is a self-report instrument and is based on the Felder-Silverman Learning Style Model (Felder and Silverman, 1988). This instrument consists of 44 statements that assess four dichotomous dimensions of learning styles; namely, sensing / intuitive, visual / verbal, active / reflective, and sequential / global dimensions. Each learning style dimension could be measured through 11 forced-choice questions, each question with two options (a or b) corresponding to one or the other category of the dimension (e.g., visual or verbal). The Sensing-Intuitive (SEN-INT) scale and the Visual – Verbal (VIS-VER) scale both were found to have reliability in excess of 0.7, whereas the Active- Reflective (ACT-REF) and Sequential- Global (SEQ-GLO) scales had Cronbach alphas of 0.60 and 0.56, respectively. The ILS follows a preference format
and in such situation the correlation among the items tend to be low (Litzinger, et al. 2005).

In the present study the total scores for each dimension are computed according to the method used by Felder and Solomon (1994). Total scores for each dimension were computed by summing the scores of the “a” answers for relevant questions and subtracting the sum of the “b” answers for the relevant questions. (or vice versa if the “b” total is greater than the “a” total). Each of the four dimensions of the Index of Learning Styles total score ranges from 0 -11, and the two dimensions of each scale are inversely related to each other. The eight learning styles of the four dimensions of ILS scale were abbreviated as: Active (ACT) or Reflective (REF), Sensing (SEN) or Intuitive (INT), Visual (VIS) or Verbal (VER), and Sequential (SEQ) or Global (GLO). Scoring sheet for ILS is given in Appendix-H.

3.8 DATA COLLECTION

3.8.1 Sources of Data

This research used primary data that was collected using four selected standardized tests from the selected sample of class eleven students studying in six English Medium CBSE schools of Roorkee City, Uttarakhand, India.

3.8.2 Procedure

Four standardized self-report instruments (reported in Section 3.6) were used to measure the variables selected. In addition, a Personal Data Sheet [PDS] [Appendix-D]
was used to collect basic demographic data of the respondents.

The researcher visited the selected CBSE higher secondary schools to take prior appointment with the Principal / Head of the institution. The purpose of the study was explained to the school principals/ head of the institution and the permission was obtained to conduct the study. With the help of the class teachers the sample was selected from each school.

A letter of Informed Consent ([Appendix- C] was issued to each participant student and their approval was taken before conducting the study. The administration of the instruments on the sample was done in class room setting. A non-threatening and cooperative atmosphere was created in the setting by first explaining the purpose of study. After explaining the purpose of study, the survey booklet was given to each of the participants. The participant students were requested to give their responses to the questionnaires. It was ensured that the entire procedure was the same for every group. The investigator was always present and available for any clarifications sought by the participants during the administration. Information about the respondents’ marks obtained in class X were collected from school’s office, as well as from the Personal Data Sheet filled by the respondent.

3.9 DATA ANALYSIS

The raw scores of the student assessment were coded and recorded in MS Excel spreadsheet; and transferred to SPSS [Statistical Package for Social
Sciences]. Data was checked for missing values and outliers, and such cases were discarded. The data was checked for normality. The data found to be normally distributed, therefore, parametric statistical techniques were used in data analysis. Cronbach alpha reliability coefficients were calculated to estimate the reliability for the four tools used, i.e. MAI, SOLAT, ILS and ASCS. MS Excel and SPSS 11.5 were used for various statistical procedures employed in the study.

### 3.10 STATISTICAL TECHNIQUES USED

- Kolmogorov-Smirnov test was applied to test normality of data.
- Descriptive Statistics were generated for the data obtained on all variables.
- Cronbach alpha reliability coefficients of the four standardized tools used were computed to test reliability for the present sample.
- Pearson’s product moment correlation coefficient was used to test hypotheses 1 to 4, which were proposed to test the correlations of metacognitive awareness with academic self-concept, hemispheric dominance, learning styles and academic achievement.
- Significance of difference between means of two groups [male and female] t-test was used to test hypotheses 5, which was proposed to measure the differences between boys and girls on metacognitive awareness.

**Graphs Plotted:**

- Histogram and Q-Q plots were also generated for the data obtained on all variables.
3.11 ETHICAL CONSIDERATIONS

The respondents were informed about the purpose of the study. They were also given a letter of informed consent. Due precautions were taken to maintain the confidentiality of the information and identity of the respondents.

3.12 SUMMARY

The chapter 3 described research methodology of the study. The population, procedures used in sample selection, data collection and data analysis were explained. Description of the tools used in the study were also given.
REFERENCES


Educational Statistics from Official Website of School Education Govt. of Uttarakhand

http://schooleducation.uk.gov.in/pages/display/63-educational-statistics_sept-21010


