3.0 INTRODUCTION

“A research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure.” In fact, the research design is the conceptual structure within which research is conducted; it constitutes the blueprint for the collection, measurement and analysis of data. Research design stands for advance planning of the methods to be adopted for collecting the relevant data and the techniques to be used for their analysis keeping in view of the research objectives.

Design of the study is an essential part of a research project. Because design provides a picture of what and how to do the work before starting. It has been determined from time to time that a suitable research design guards against the collection of irrelevant data and grate more economy. So in any research project, design provides the researcher a blueprint of research which dictates the boundaries of project and helps in controlling the experimental, extraneous error, variances of the problem under investigation etc. This is a descriptive study. It comprises career maturity, achievement motivation and self concept with scholastic achievement of adolescents.

The present chapter describes the design or plan of the study and highlights the details about the research procedure followed in conducting the study. As such, it is an important part of the research study and needs to be planned and carried out systematically to arrive at accurate judgments. It includes information about the population, the sample frame, the nature and form of data collection, tools, methods of collecting data and statistical techniques used for analysis of data etc. In order to achieve the objectives and the stated corresponding hypotheses, the following plan of the study has been followed.

The present study aims at examining the academic achievement of the secondary school students with reference to their meta-cognitive skills and emotional intelligence. Consequently, academic achievement has been taken as the dependent variable while the meta-cognitive skills and emotional intelligence have been taken as independent variables. Hence, the impact of all the three independent variables on all the dependent variables taken in the present study was measured and inferences have been drawn.
3.1 **DESIGN OF THE STUDY**

In the present study, descriptive method was used. The study was dealt in two phases.

I. **Comparison phase:** In this phase, comparison was made to study the academic achievement in relation to their meta-cognitive skills and emotional intelligence of the secondary school students. In the present study, each of the two independent variables (meta-cognitive skills and emotional intelligence) was varied at the different levels as shown as schematic design given in figure 3.1 & 3.2:-

![Schematic Design](image-url)

**META-COGNITIVE SKILLS**

**EMOTIONAL INTELLIGENCE**
II. Interaction phase: In this phase, an attempt was made to find out the interaction effect of the meta-cognitive skills and emotional intelligence of students on their academic achievement separately. An interaction effect of all the independent variables (meta-cognitive skills and emotional intelligence) on the dependent variable (academic achievement) in the present study was also explored separately. The subjects were given different designations and made groups to find out the interaction effect which were also being represented diagrammatically in the Fig 3.2.

- Interaction Effect of Meta-cognitive Skills and Emotional Intelligence on Academic Achievement

**HMSHEI:** High Meta-Cognitive Skills + High Emotional Intelligence

**HMSLEI:** High Meta-Cognitive Skills + Low Emotional Intelligence

**LMSHEI:** Low Meta-Cognitive Skills + High Emotional Intelligence

**LMSLEI:** Low Meta-Cognitive Skills + Low Emotional Intelligence

### 3.2 POPULATION

A population is any group of individuals that have one or more characteristics in common that are of the interest to the investigator. It may be all the individuals of a particular type or a restricted part of that group (Best, 1977). Thus a population refers to any collection of specified group of human beings or of non-human entities such as objects, educational institutions, time units, geographical areas or salaries etc. Secondary schools students studying 9th class in various schools located at Panipat District of Haryana State constituted the target population for the present study.

### 3.3 SAMPLE

Measuring the entire population is impracticable though not entirely impossible. So one has to draw a sample from the population concerned. 320 school students selected by the method of random sampling from the target population constituted the sample for the present investigation.
3.4 TOOLS USED

(1) Mangal Emotional Intelligence Inventory developed by Mangal & Mangal.
(2) Meta-cognitive Skills Scale developed by A Gupta in 2005.
(3) Achievement Test in Science developed by investigator herself.

3.4.1 Mangal Emotional Intelligence Inventory

The Mangal Emotional Intelligence inventory (Appendix A) is designed to measure the emotional intelligence in respect of four areas namely, intra-personal awareness, inter-personal awareness, intra-personal management and inter-personal management.

Procedure of Standardization

In the beginning a list of 100 items was prepared. The list was presented to a group of 5 judges and only those items were retained about which the judges were unanimous on their retention. It led to the elimination of 30 items. The remaining 150 items were subjected to item analysis which led to the elimination of 50 items. The final test of 100 items was administered on a large sample of 2200 students.

Reliability of the Test

Reliability of the inventory was examined through three different methods namely, split half method, K-R formula and Test-Re-Test method. The reliability by using these methods was found .89, .90 and .92 respectively which shows that the test is highly reliable.

Validity of the Test

The validity for the inventory has been established by adopting factorial and criterion approaches which was found fairly high.

Scoring Procedure of Inventory

Scoring can be done by hand or with the help of stencil. The mode of response to each of the item of the inventory is in the form of a forced choice i.e. either yes or no, indicating complete agreement or disagreement with the proposed statement respectively. For scoring one mark is provided for the response indicating presence of emotional intelligence and zero for the absence of emotional intelligence.
Administration of the inventory

It is a self-administrating inventory. The cooperation of the students on whom it is to be administered is quite essential. Therefore the user should win over their confidence. The user as well as the examinee should read the instructions, given on the front page of the test booklet carefully. There is a provision of separate response sheets for writing responses to the items of the inventory. Therefore, examinees should be instructed not to write anything on the test booklet.

3.4.2 Meta-cognitive Skills Scale

This scale measures meta-cognitive skills in the seven areas namely self-awareness, self-planning, self-problem solving, self-regulation, self-monitoring, self-reflection, and self evolution. The scale comprises of 35 items related to these seven areas. The test has been given in the appendix B.

Detailed Description of the Different Areas of the Test

(a) Self-awareness:- Self-awareness plays a central role in children’s formation of schema, according to Piagetian constructivist. Pairs, Byrnes and Paris describe developmental changes in children’s self-awareness in detail stating that in a way, it is to consciously identify what one already knows, to define the learning level, to consider one’s personal resources to consider the task requirements, to determine how one’s performance will be evaluated, to consider one’s motivation level and to determine the level of anxiety.

(b) Self Planning: Planning means deciding in advance about the future course of action. The Planning starts with the estimation of time required for competing each task. After it, the study time is to be planned into one’s schedule & priorities set up then make a checklist of what needs to be happened while organizing the material. And finally take the necessary steps to learn by using strategies like out-linking memories, diagrammatics, etc.

(c) Self- Monitoring: Self-monitoring can be described as multistage process involving observation and recording of one’s own behaviour (Mace & kratochwill , 1988). In a simpler language, it means to keep track of what worked and what did not work, to
monitor one’s own learning by questioning, self-testing, to keep one’s motivation and concentration high and to check one’s comprehension while listening or reading.

**d) Self-Reflection:** Reflection can be considered a part of self-evaluation also, but here it needs to be discussed quite distinctively. Reflect means to reflect on learning process; whatever learning has been gained, one’s response to it can be categorized as reflection. In a way, it means to promote one’s own feedback.

**e) Self-regulation:** The term self-regulation refers to learner’s ability to make adjustments in their own learning process in response to their perception regarding their current status of learning. The concept of self-regulation overlaps heavily with the preceding two terms; its focus is primarily on the ability of the learners themselves to monitor their own learning (without internal stimuli or persuasion) and to maintain the attitudes necessary to invoke and employ these strategies on one’s own. To learn most effectively, the students should not only understand what strategies are available and what purposes these strategies will serve, but also to become capable of adequately selecting, employing, monitoring and evaluating the use of these strategies.

**f) Self-Problem-Solving:** The obvious standing point for this section on problem solving is to consider the definition of a “problem”. According to Duncker (1945), “A problem arises when a living organism has a goal but does not know how this goal is to be reached.” A similar definition was offered by Mayer (1990), who argued that problem solving is a “cognitive processing directed at transforming a given situation into a goal situation when no obvious method of solution is available to the problem solver.” Burder (2000) specified and transferred this theory to a mathematical context, describing that reduction (simplification of the problem situation); reversibility (reversion of the ways of thought and problem solving steps); attention of aspects (pay attention to a complete aspects at the same time/recognition of dependence of things and its targeted variation); change of aspects (change of assumption and criteria, restructuring of facts) as aspects of mental flexibility transmitted to the mathematical context.

**g) Self-Evaluation:** Guided self-evaluation experiences can be introduced through individual conferences and checklists focusing on thinking process. Gradually self-evaluation will be applied more independently. As students recognize that learning
activities in different disciplines are similar, they will begin to transfer learning strategies to new situations. In essence, it means checking one’s learning against a standard.

III Procedure of Standardization

In the beginning, 70 items were taken to measure the meta-cognitive skills. These 70 items were administered on a group of 100 students of class IX of the age between 13th to 15th years. The items which were not properly understood by students were needed out. The items were also given to 10 experts who were requested to rate each item with regard to their language relevance to meta-cognitive skill areas Finally, 35 items were retained for measurement of the meta-cognitive skills of students in different areas.

III Reliability

The scale comprising of 35 items & has the test –retest reliability coefficient of .73 which is highly reliable.

IV Validity

The Content validity of the Scale was established by experts rating. The content validity was found to be fairly high.

V Scoring Procedure of Meta-cognitive skills scale

The scoring Procedure of the meta-cognitive scale is very easy. This scale contains thirty–five items, each item being a statement to be related in a five points scale i.e. a) Strongly Agree (SA); b) Agree (A); c) Don’t know (DK); d) Disagree (DA); e) Strongly disagree (SD).

VI Administration of the scale

The investigator read out the instruction written on the front page of the Meta-cognitive skills scale before the subjects. Again, the students were asked to read the instructions, if they were facing any difficulty in understanding the instructions.

(a) The Meta-cognitive scale was administered in groups. The students were asked to make their response to each item of the test in the form of a five point Likert scale by a tick mark (✓) for any one alternative of each item.
(b) There being no time limit for the students to record the responses, they were advised to compete the test as soon as possible. After completion of the scale, the consumable booklets were collected back from the students. The instructions were attached with the Meta-cognitive skills scale to help the students to record their responses.

### 3.4.3 Science Achievement Test

Achievement test is a systematic procedure for measuring a representative sample of learning tasks (Gronlund, 1988). It refers to the assessment of the outcomes of formal instruction in cognitive domain (Dwyer, 1982). It aids both teacher and the students in assessing learning readiness, monitoring learning process, diagnosing learning difficulties and evaluating learning outcomes (Gronlund, 1977). To achieve the objectives of the present study, an achievement test in Science was constructed by the investigator from three units of IX grade Science syllabus. It was employed to assess the previous knowledge of the students in the content to be taught and to measure the final achievement of the students, after teaching the contents. Different steps followed in developing the test are written below:

**Planning the Test**

Planning stage of a test includes the nature of the test items and the statement of conditions under which it will be administrated. Without an advanced plan, directly a plunge into item writing is likely to produce a lopsided test. A test constructed without a blue print is likely to be overloaded with relatively impermanent and less important material. So test specifications should be drawn up before preparing any items to guard against disproportions in coverage of the syllabus.

The investigator thoroughly studied the syllabus of the test and various question papers, question banks. After that the researcher decided as to how many questions were to be set for different objectives. Further he decided under which unit /topic a particular question was to be set. Thereafter, the paper setter decided how all the questions were to be distributed over different objectives and content areas so as to obtain the weightage decided in the Design. The three dimensions of the Blueprint consist of content area in horizontal rows and objective and forms of questions in vertical columns. The blue print is given in Table- 3.1 as under:
Table 3.1
Blue Print of Achievement Test in Science

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Unit</th>
<th>Instructional Objectives</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Knowledge (MCQ)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Understanding (MCQ)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Application (MCQ)</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Atoms &amp; Molecules</td>
<td>1(4)</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1(6)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1(2)</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Fundamentals of Life</td>
<td>1(3)</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1(5)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1(3)</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Motion &amp; Its laws</td>
<td>1(2)</td>
<td>07</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1(3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1(2)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>09</td>
<td>30</td>
</tr>
<tr>
<td>Percentage</td>
<td></td>
<td>46.66</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>23.33</td>
<td></td>
</tr>
</tbody>
</table>

Note: MCQ = Multiple Choice Questions

Numbers of questions are within brackets and the marks are outside the brackets.

For the purpose of constructing Achievement Test, objectives were defined in behavioural terms from selected units of Science textbook of class IX prescribed by CBSE board. Since the major concern here was to test the academic achievement, accordingly, it was decided to test the three areas of cognitive domain, i.e., knowledge, understanding and application. The weightage given to the different instructional objectives is given in the table 3.2 as under:

Table 3.2
Weightage to Instructional Objectives /Learning Outcomes

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Objectives</th>
<th>Marks</th>
<th>%age of Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Knowledge</td>
<td>18</td>
<td>30</td>
</tr>
<tr>
<td>2.</td>
<td>Understanding</td>
<td>28</td>
<td>46.66</td>
</tr>
<tr>
<td>3.</td>
<td>Application</td>
<td>14</td>
<td>23.33</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>60</td>
<td>100</td>
</tr>
</tbody>
</table>

Writing of Questions

The next step after the finalization of the Blueprint was writing of appropriate items in accordance with the broad parameters set out in the Blueprint. Researcher has to standardize the test, so she has framed about 50 items, because some of them will be modified or rejected during Tryout stage (Appendix C).
Marking Scheme

The fifth step was to prepare the ‘Marking Scheme’. The marking scheme helped to prevent inconsistency in judgment. It includes scoring key (given in Appendix C-1), which was prepared in respect of objective type questions.

Question-wise Analysis

This step was to ensure that there was no imbalance in the question paper. During question-wise analysis, the researcher has analyzed each question on various parameters stated in the Blueprint.

Pre-Try-Out

For the pre-try-out the test was printed and administrated on a sample of 30 students of class IX, who had already studied the contents covered in the test. Detailed instructions were provided to the students. During pre-try-out, some students found difficulty in understanding the language of questions, the investigator noted down that questions and made appropriate corrections side by side. The main purpose of the pre-try-out was to identify the non-functional alternatives among multiple-choice questions and to indicate very difficult and very easy items, which was fulfilled very carefully. Many false assumptions, slips, oversights were corrected in this process. No time limit was set for pre-try-out test. It was found that students took on an average 80 minutes to answer all the questions. The scoring was done with the help of scoring key, which has already been prepared by the Investigator herself. According to Conard (1957), pre-try-out is useful in identifying any major weakness, omission, ambiguity and inadequacies of items as well as useful in identifying any weakness or vagueness in directions or instructions.

Try-Out

After making the required improvements, the test was printed and it was administrated on a sample of 200 students of class X, who had already studied the contents covered in the test. The scoring was done with the help of scoring key, which has already been prepared by the Investigator herself. There was one mark (1) for a correct answer and zero (0) for an incorrect answer.
**Item Analysis**

The following steps were followed for the item analysis.

1. All the 200 sheets were arranged in the descending order from highest score scripts at the top to the lowest scores ones at the bottom.

2. The 55 upper scripts with highest scores were selected and labeled as “upper group”. The 55 scripts with lowest scores were labeled as “lower group” and the middle group of the scripts was set aside. The top 27.5% of 200 students (55 answer sheets) and bottom 27.5% were taken into the consideration for computing internal discrimination index and difficulty value. The middle 45% (90 Answer Sheets) of the total no. of answer sheets were kept aside.

**Difficulty Value**

After the formation of two groups, the number of correct responses to an item in each group was marked and tabulated. The difficulty in answering of an item is indicated by the total number of students, who answered it correctly. The larger will be the total number, the easier will be the item. Item difficulty was estimated by determining the percentage of students, who answered the item correctly. The percentage was converted into proportions. The average of the proportions of correct responses on each item in the two end groups was taken to be an estimate of the difficulty value of that particular item. This point of view is supported by Guilford (1954). Formula for computing the difficulty value ‘dv’ of each item was:

\[
d_v = \frac{P_U + P_L}{2}
\]

Where \( d_v \) = difficulty value of the items.

\( P_U \) = proportions of correct responses to the items from the upper group.

\( P_L \) = proportions of correct responses to the items from the lower group.
Internal Consistency Discrimination Index (rb)

The relationship between the total scores derived from a test and item scores are referred to as internal consistency discrimination index (rb) of an item. This was found by reading the bi-serial coefficient of correlation between item and total score from the J.C. Flanagan’s abac (Appendix C-2). Flanagan’s abac was designed for use, when the sample has been restricted to the highest and lowest 27% of the total score distribution and middle 46% of the examinees of the total score have been eliminated. The proportion of examinees passing the item in the upper criterion group was read on the ordinate and the corresponding proportion from the lower criterion group was read on the abscissa. The value of the coefficient rb was read at the intersection of perpendiculars at these values. When the difficulty values and the internal consistency discrimination indices of each item had been determined, as stated above, items for final draft were selected. The list of the items showing ‘dv’ and ‘rb’ are given in Appendix C-3.

Item Selection for Final Draft

Final selection of the items was made on the basis of difficulty value and discrimination index of each item. Lindman (1971) emphasized that easy items should be introduced in a test in order to encourage the students of low ability and some difficult items should be included to challenge the abler students. However, in the interest of constructing a measuring instrument of maximum quality and utility, items were selected whose difficulty value lies in the range .30 to .79. The investigator selected most of the items of medium difficulty and a few of higher and lower difficulty values were also included. Garrett (1967) regarded those items satisfactory which are having validity indices of 0.20 or more. Thorndike (1955) considered an item with a validity co-efficient as high as 0.25 as an outstanding ‘valid’ item.

Grunlund (1988) states, “Zero discrimination power (0.00) is obtained, when an equal number of students in each group answer correctly. Negative Discrimination power is obtained, when more students in lower group answer correctly than the students in the upper group. Both types of items should be removed from norm-referenced tests. The distribution of the items finally selected according to dv and rb has been given in Table 3.3.
Table 3.3
The Distribution of Difficulty Value (dv) and Internal Consistency Discrimination Index (rb) of All the Items

<table>
<thead>
<tr>
<th>Difficulty Value (dv)</th>
<th>F</th>
<th>Discrimination Indices(rb)</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>.00-.09</td>
<td>02</td>
<td>.00-.09</td>
<td>05</td>
</tr>
<tr>
<td>.10-.19</td>
<td>01</td>
<td>.10-.19</td>
<td>06</td>
</tr>
<tr>
<td>.20-.29</td>
<td>07</td>
<td>.20-.29</td>
<td>08</td>
</tr>
<tr>
<td>.30-.39</td>
<td>07</td>
<td>.30-.39</td>
<td>12</td>
</tr>
<tr>
<td>.40-.49</td>
<td>09</td>
<td>.40-.49</td>
<td>08</td>
</tr>
<tr>
<td>.50-.59</td>
<td>05</td>
<td>.50-.59</td>
<td>08</td>
</tr>
<tr>
<td>.60-.69</td>
<td>05</td>
<td>.60-.69</td>
<td>03</td>
</tr>
<tr>
<td>.70-.79</td>
<td>06</td>
<td>.70-.79</td>
<td>--</td>
</tr>
<tr>
<td>.80-.89</td>
<td>05</td>
<td>.80-.89</td>
<td>--</td>
</tr>
<tr>
<td>.90-.99</td>
<td>03</td>
<td>.90-.99</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

Ebel’s (1979) criteria and guidelines for categorizing discriminating indices is a widely quoted set of guidelines given in Table 3.4 was used in this test analysis.

Table 3.4
Ebel’s Guidelines (Discriminating Powers)

<table>
<thead>
<tr>
<th>Discriminating powers</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>.40 and above</td>
<td>The item is functioning quite satisfactorily</td>
</tr>
<tr>
<td>Between 0.30-0.39</td>
<td>Little or no revision is required</td>
</tr>
<tr>
<td>.Between .20-0.29</td>
<td>The item is marginal and needs revision</td>
</tr>
<tr>
<td>&lt;.19</td>
<td>The item should be eliminated or completely revised</td>
</tr>
</tbody>
</table>

Based on the Ebel’s guidelines in the above table, the 60 test items were categorized as shown in the Table 3.5 and Table 3.6:
Table 3.5
Distribution of Discrimination Powers of the all Items of Achievement Test

<table>
<thead>
<tr>
<th>Discriminating Power</th>
<th>Frequency</th>
<th>Item Numbers</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>.40 and above</td>
<td>21</td>
<td>5,6,8,9,10,13,14,15,20,21,22,23,24,25,26,27,29,31,38,40,46,48,55,60</td>
<td>Very Good Items</td>
</tr>
<tr>
<td>.30-.39</td>
<td>12</td>
<td>16,17,18,19,28,33,34,36,39,41,45,49,52,59</td>
<td>Reasonably Good</td>
</tr>
<tr>
<td>.20-.29</td>
<td>7</td>
<td>2,3,4,11,32,43,54,56,58</td>
<td>Needs Improvement</td>
</tr>
<tr>
<td>&lt; .19</td>
<td>10</td>
<td>1,7,12,30,35,37,42,44,47,50,51,53,57,</td>
<td>Very Poor Items</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3.6
Bi-variate Scatter Diagram for Achievement Test in Science between Difficulty Value (dv) and Discrimination Index (rb)

<table>
<thead>
<tr>
<th>Dv (rb)</th>
<th>.00-.09</th>
<th>.10-.19</th>
<th>.20-.29</th>
<th>.30-.39</th>
<th>.40-.49</th>
<th>.50-.59</th>
<th>.60-.69</th>
<th>.70-.79</th>
<th>.80-.89</th>
<th>.90-.99</th>
</tr>
</thead>
<tbody>
<tr>
<td>.00-.09</td>
<td>50</td>
<td>44</td>
<td>12</td>
<td>42, 1,</td>
<td>35</td>
<td>31,37</td>
<td>47</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>.10-.19</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.20-.29</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4,11</td>
</tr>
<tr>
<td>.30-.39</td>
<td>18,39</td>
<td>33,36</td>
<td>17,19</td>
<td>34</td>
<td>16</td>
<td>28,41</td>
<td>49,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.40-.49</td>
<td>20,23</td>
<td>8,21,29</td>
<td>14,15,38</td>
<td>10,</td>
<td>5,6</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>.50-.59</td>
<td>24,46</td>
<td>22,40</td>
<td>26,30</td>
<td>13,27</td>
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<td>48,</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.80-.89</td>
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<td>.90-.99</td>
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It is revealed from Table 3.5 and 3.6 that 24 items have discriminating power .40 or above, hence these were selected in the final draft, 14 items have D.P. range from .30 to .39 and 09 items have D.P. range from .20 to .29. The remaining 13 items having
discriminating power below .19 were rejected. The test items having difficulty value between .30 - .79 and discriminating power between .30 and above were selected for final draft of the achievement test in science.

**Reliability**

Reliability is the consistency of our measurement, or the degree to which an instrument measures the same way each time it is used under the same condition with the same subjects. In short, it is the repeatability of our measurement. There are many ways for reliability estimation. The researcher has used Split-Half Methodology for estimation of reliability. The items in a test are split into two tests that are equivalent in content and difficulty. Researcher has done this by splitting among odd and even numbered items. This assures that the assessment is homogeneous in content. Once the test is split, reliability estimated as the correlation of two separate tests with an adjustment for the test length.

**Interpretation of Reliability**

The reliability of a test is indicated by the *reliability coefficient*. It is denoted by the letter "r," and is expressed as a number ranging between 0 and 1.00, with r = 0 indicating no reliability, and r = 1.00 indicating perfect reliability. The larger the reliability coefficient, the more reliable is the test scores. Table 3.7 given below serves as a general guideline for interpreting test reliability:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Reliability coefficient value</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>0.90 and up</td>
<td>Excellent</td>
</tr>
<tr>
<td>2.</td>
<td>0.80 – 0.89</td>
<td>Good</td>
</tr>
<tr>
<td>3.</td>
<td>0.70 – 0.79</td>
<td>Adequate</td>
</tr>
<tr>
<td>4.</td>
<td>below 0.70</td>
<td>May have limited applicability</td>
</tr>
</tbody>
</table>
Researcher has found 0.87 as the calculated value of Reliability coefficient, which means 87% of the variance of test scores is true-score variance, and only 13% error variance. So, we can say that achievement test is fairly reliable.

**Validity**

The purpose of the present investigation and the nature of the test items restricted the use of very exhaustive statistical techniques to validate the test. The test was validated against the criterion of **Content Validity**. The Content Validity is concerned with the adequacy of sampling of a specified universe of content. To determine Content Validity the test items and a list of outcomes were given to the panel consisting of five experts in subject matter and three experts in test items. The panel was asked to identify which test item corresponded to which outcomes. The experts agreed with the researcher on the assignment of test items to objectives 95% of time. The percentage was taken as evidence of Content Validity.

**Final Form of Test**

After the selection of items for final test, items were rearranged. On the cover page of the test, directions were printed. The scoring key for the final test was also prepared and has been given along with the final form of the Science Achievement Test, which contained 30 items (**Appendix C-4 and C-5**). The time limit for the final test was 45 minutes.

**3.5 Procedure for Data Collection**

In any type of research, exercise data are gathered so that hypotheses formulated at the planning stage may be tested. Collection of factual information or data required adaptation of a systematic procedure, because as per Whittery (1950) ‘Data are the things we think with. They are the raw material of reflection until by comparison, combination and evaluation they are stepped up to higher levels of generalization, where again they serve as basic material for further and higher thinking’. It also requires collection of relevant data adequate in quality and quantity and as reliable and valid as possible.

In the beginning, all the 320 students studying in 9th class, selected for the present study were administered Emotional Intelligence Inventory (EII) as per standardized instructions given in the manual. There are 100 questions in the test that require verbal
ability for answering. The students were told to read and respond to each item solely on
the basis of how the item applies to his or her own feelings about the world of work. The
time limit for the completion of total test was 2 hours. After establishing rapport with the
students, they were asked to fill the top columns of personal particulars before the test
started. They were told to mark the responses on the prescribed answer sheets.

As the second one, Meta-cognitive Skills Scale (MCSS) by Dr. A Gupta was
administered on the same students. The test consists of 35 items of incomplete
sentences/items which are to be completed by the subjects by putting a check-mark on
any one of the five alternative responses given against each item. The students were
required to respond according to what he / she feels about himself/herself with reference
to that statement. They were told that the answers will be kept confidential. The
investigator explained to all the students the instructions and way of answering the
questions. There was no time limit for answering the SCQ but they were asked to
complete the test within 30 minutes as possible. The investigator assured the students that
their answers and scores would be treated with strict confidence. After giving these
instructions and distributing the Meta-cognitive Skills Scale among all the 320 students,
the researcher explained one example given in the questionnaire. Then the students were
asked to start the Meta-cognitive Skills Scale.

After the above two tests, the third one Science Achievement Test was
administered on the same students. The final test contains 30 items and each item is
provided with four alternatives. The test was distributed to the same 320 students of 9th
class. The students were asked to read each item carefully and respond it by marking a
tick on any one of the five responses against each item which described them well. It was
told that there is no right or wrong answer. There was a time limit of 45 minutes for
answering the questions of achievement test. While administering all tests, the time limit
was strictly followed as per the instructions given by the authors. The investigator gave
his sincere attention via supervision for the time while administering the tests.

After the administration of tools, the next step was scoring the answer sheets.
Scoring of the answer sheets was done strictly according to the instructions given in the
concerned manual.
3.6 STATISTICAL TECHNIQUES USED

Statistical techniques are employed on the raw score to make it meaningful and to test the significance of the scores. Without use of statistical techniques raw scores do not have their own meaning and weight. Therefore after sorting the data for final scores, Means, SD’s, t-test and ANOVA were employed as statistical techniques in the present study. Means, SD’s and t-test were used to compare the academic achievement of students with high and low emotional intelligence and high and low meta-cognitive skills.

ANOVA was used to find out the interaction effect of the emotional intelligence and meta-cognitive skills of students on their academic achievement.

On the basis of these tools, procedures, methods, and statistical calculations, the analysis of the results has been given in the next chapter.