CHAPTER - III
CHAPTER - III

DESIGN AND METHODOLOGY OF THE STUDY

Every research problem is unique in itself but to discover the facts and establish relationship between them and to explain the situations in which they occurred is the task of any scientific process. Unraveling the above ingredients is essential to finally reach to retional generalizations. All these process in a sequence constitute the design of the study.

"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".

If 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.

The design of the study is needed because it facilitates the smooth sailing of the various, research operations, there by making research as efficient as possible, yielding maximal information with minimal one expenditure of effort, time and money.

Before conducting any research the researcher has to decide the methodology of his research. The steps that he has adopted from observation to generalization are included in the research methodology.

Research methodology is a way to systematically solve the research problem. It may be understood as a science of studying how research is done scientifically. In it we study the various steps that are generally adopted by a researcher in studying his research problem along with the logic behind them. It is necessary for the research worker not only to know how to develop certain indices or tests, how to calculate the statistics, how to
apply particular research techniques, but to know which of these methods or techniques, are relevant and which are not, and what would they mean and indicate and why. For all this it is necessary for the research worker to design his methodology for his problem as the same may differ from problem to problem.

This chapter deals with the design and methodology of the present study which is divided in following parts.

1. Hypothesis.
2. Sample.
3. Tools and techniques.
4. Collection of data.
5. Statistics used.

The present study is a comparative study of creativity, achievement and level of aspiration of students of Higher secondary level of central school and Govt. Aided School of Kanpur Urban.

The present study involves three variables.

1. Creativity
2. Achievement
3. Level of aspiration.
HYPOTHESIS

When we have to proceed towards some destination the path of which is not known to us, what we generally do is to form an idea, however vague, about the direction in which the place is likely to be located then taken we start on some possible way that is expected to lead us to our destined place. We may make mistakes, change our routes at times but it we proceed cautiously and in right direction we are bound to reach our destination. If we have absolutely no idea of even the direction in which our desired place is located, nor any idea about the possible roads that might lead towards it, we are bound to be caught in wilderness and shall never be able to reach anywhere.

The above illustration is a typical example of any research work. In a scientific research we have to make new discoveries but we cannot proceed in a complete ignorance we must have some idea as to new aspect that are likely to be discovered or new deductions likely to be arrived at. Then, of course we proceed to find out whether the idea conceived were true. They may be totally correct, or only partially or may be altogether false, but they do help us to get going. These primary ideas, which guide us in our study, may be termed as hypothesis.

According to George A. Lundberg - "A hypothesis is a tentative generalization, the validity of which remains to be tested. In its most elementary stage the hypothesis may be any hunch, guess, imaginative idea which becomes the basis of action or investigation".

Goode and Hatt defined it as "A proposition which can be put to test to determine validity."

Quite often a research hypothesis is a predictive statement, capable of being tested by scientific methods, that relates an independent variable
to some dependent variable.

According to James E. Creighton:

"It is a tentative supputation or provisional guess which seems to explain situation under observation."

A scientific research needs a planned line of action which is based on the hypothesis of investigation.

"At the start of an investigation the hypothesis is a stimulus to critical thought and offers insight into the confusion of phenomenon. At the end it comes to prominence as the proposition to be accepted or rejected in the light of findings. In between these stages it furnishes the worker with the sign parts for the progress of the investigation". Thus it can be said that a hypothesis states what we are looking for and it is a proposition which can be put to a test to determine its validity.

Hypothesis in their broadest sense, offer more than mere declarative statements suggesting an answer to a problem. As a problem is reduced from its original, unclear and ambiguous form to a specific question, phrased in terms of a set of operations, the formation of a hypothesis is taking place. By the time the problem is reduced to an acceptable form and meaning, it could easily be converted into a hypothesis by making the question into a declarative statement.

A hypothesis is a proposition, condition or principle which is assumed perhaps without belief in order to draw out its logical consequences and by this method to test its accord with facts which are known or may be determined.

Barr and Scates define a hypothesis as "A hypothesis is a statement temporarily accepted as true in the light of what is, at the time, known about a phenomena, is fully established, it may take the form of facts, principles or theories."
The role of the hypothesis is to suggest explanation for certain facts and to guide in the investigation of others. The importance of hypothesis in research has been emphasized by Cohen and Nagal by stating "We cannot take a single step forward in any enquiry unless we begin with a suggested explanation or solution of the difficulty which originated it. Such tentative explanations are suggested to us by something in the subject matter and by our previous knowledge when they are formulated as propositions they are called hypothesis.

Walter R. Borg., Chairman Bureau of Educational Research, Utah state University states - "Hypothesis reflects the research worker's guess as to the probable outcome of the experiments".

According to Georgy, G. Mouly "Hypothesis is an assumption or proposition whose tenability is to be tested on the basis of compatibility of its implications with empirical and with previous knowledge".

Forms of Hypothesis :

We can state hypothesis in a number of different forms -
1. The declarative form generally states a relationship between the variable that experimenter expects will emerge. For examples the following hypothesis is stated in declarative form "There will be significant difference in the instructional standards of day schools as compared within shift schools".
2. In question form we may state the hypothesis in a question form the afore mentioned hypothesis on question form may read. "Is there a significant differences in instructional standards of day schools ands shift school"?
3. The null form states that no relationship exist between the variables concerned for example in null form the afore mentioned hypothesis could be stated.

"There will be no significant difference in the standards of day school as compared with shift-schools".

**Hypothesis of the Present Study:**

According to F.J. Mc Guigan - "A hypothesis is a testable statement of a potential relationship between two (or more) variable?". So I have take some essential hypothesis in the present study:

1. There is no relationship between creativity and achievement of the students of higher secondary level of central school and students of higher secondary level of government aided school of Kanpur Urban when the other variables are partialed out in case of (i) Boys (ii) Girls.

2. There is no relationship between creativity and level of aspiration of the students of higher secondary level of central school and creativity of the students of higher secondary level of government aided school of Kanpur Urban when the other variables are partialed out in case of (i) Boys (ii) Girls.

3. There is no relationship between creativity of the students of higher secondary level of central school and the creativity of the students of higher secondary level of government aided school of Kanpur Urban when the other variables are partialed out in case of (i) Boys (ii) Girls.

4. There is no relationship between level of aspiration and achievement of the students of higher secondary level of central school and students of higher secondary level of government aided school of Kanpur Urban when the other variables are partialed out in case of (i) Boys (ii) Girls.
5. There is no relationship between achievement of the students of higher secondary level of central school and the achievement of the students of higher secondary level of government aided school of Kanpur Urban when the other variables are partialed out in case of (i) Boys (ii) Girls.

6. There is no relationship between level of aspiration of the students of higher secondary level of central school and level of aspiration of the students of higher secondary level of government aided school of Kanpur Urban when the other variables are partialed out in case of (i) Boys (ii) Girls.
TOOLS OF DATA COLLECTIONS:

After the formulation of hypothesis and selection of the sample the next important step is select suitable device of tools for the collection of data. Data obtained from many resource direct and indirect. The selection of suitable tools for collecting various kinds of information are various purposes.

The major tools of data collection in a research are:-

1. Questionnaire
2. Check list
3. Rating Scale
4. Observation
5. Interview
6. Standardized test
7. Schedules
8. Sociometry

Collection of Data:

Data is a group of known, given are ascertained facts from which conclusion is drawn.

The subjects for the study where selected from different institution of Kanpur urban. Both the male and female students of higher secondary level of central school and students of higher secondary level of government aided school have selected for study. The students of class IX & X have selected. The sample of 200 boys have taken from Central Schools and 200 boys have taken from Govt. aided schools. The sample of 200 girls have taken from Central Schools and 200 girls have taken from Govt. aided schools.
The information about the student are given by the Principals and the teachers.

**Tools Used in The Present Study:**

For measuring creativity, level of aspiration and achievement, standardized test are available and from these standardized test, I have chosen those test which satisfied the requirement of the present study. To measure the achievement of the students. The researcher have take the annual marks of the students of their previous classes.

To measure creativity there are many tests. There are various tests which are adopted in India conditions and which are able to measure the creativity. From this, I have used the creativity test of Dr. N.S. Chauhan.

To test of level of aspiration "Shah and Bhargava" test is used. This test is made by Dr. Mahesh Bhargava and M.A. Shah.

To test the achievement, I have taken percentage of aggregate marks of annual exam. of class IX & X of the students.

**List of Colleges:**

**Govt. Aided Schools:**

* Lallu Prasad Inter College, Mall Road, Kanpur.
* Chacha Nehru Inter College, Govind Nagar, Kanpur
* Mohan Vidya Mandir Balika Inter College, Govind Nagar, Kanpur.
* Khalsa Girls Inter College, Govind Nagar, Kanpur

**Central Schools:**

* Kendriya Vidyalaya No.1, Armapore, Kanpur.
* Kendriya Vidyalaya Cantt, Chakeri, Kanpur.
* Kendriya Vidyalaya, IIT, Kalyanpur, Kanpur
DESCRIPTION & ADMINISTRATION OF THE TESTS:

Creativity Test - The creativity test by Dr. Narendra Singh Chauhan and Dr. Govind Tewari is used for measuring creativity of the subjects. This test inspired by the work of Torrance in the field of creativity. In this, verbal and non-verbal both tests are included. Creativity is an important multi-dimensional variable of personality. This test deals with following main factors (based on Torrance factors).

1. Creative Production - It is the ability to produce number of things or ideas out of available sources. This element has 5 units and 7 sub-units.

2. Associative fluency - To test this ability the subjects have to think-up as many synonyms for each given word. For testing this, there are 7 units and 4 sub-units in this test.

3. Idea Fluency - This element deals with writing as many ideas as possible about a given topic. There are 3 unit to test this capability.

4. Word Fluency - This capacity to write maximum words beginning and ending with a specific letter. The check this capacity, there is 1 unit and 10 sub-units in this test.

5. Originality - It is the test to find out the ability of the person to give clever of original titles for story plots and the ability to produce or to give new, unusual ideas to any problem. In this there are 5 units of different problem having more unusual option to choose from.

6. Adjustive - flexibility - It is the ability to think-up different appropriate and suitable approaches to the problem. This measurement has 4 units.
Reliability:

The reliability of the test is estimated by split-half method. This method is regarded as one of the best methods. In this method, the test is first divided into two equivalent halves and correlation is found for these half tests. From reliability of the half-test, the self-correlation of the whole test is them estimated by the Spartan - Brown prophecy formula.

Sample: 100 Class 9th and 10th (41 and 49 students respectively)

<table>
<thead>
<tr>
<th>Sex-Male</th>
<th>Rural and Urban</th>
<th>Some Socio Economic Status</th>
</tr>
</thead>
</table>

**Factors**

1. Creative Production
2. Fluency
   (a) Associative Fluency
   (b) Expressive Fluency
   (c) Word Fluency
   (d) Idea Fluency
3. Original Power
4. Flexibility
   (a) Adjutative Flexibility
   (b) Spontaneous Flexibility
5. Ingenious Solution of Problems

**Correlation Coefficient**

- 0.762
- 0.831
- 0.903
- 0.483
- 0.689
- 0.731
- 0.597
- 0.673
- 0.438
- 0.640

Validity - Baquer Mehrdi - Verbal test of creative thinking.

<table>
<thead>
<tr>
<th>N = 100</th>
<th>r - Product - Movement Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factors</td>
<td>Correlation coefficient</td>
</tr>
<tr>
<td>Fluency</td>
<td>0.481</td>
</tr>
<tr>
<td>Flexibility</td>
<td>0.393</td>
</tr>
<tr>
<td>Originality</td>
<td>0.403</td>
</tr>
<tr>
<td>Total Creativity score</td>
<td>0.364</td>
</tr>
</tbody>
</table>
7. **Spontaneous Flexibility** - In this test, students are persuaded to think up different peculiar users for given common objects. This section has only 5 units.

8. **Ingenious Solutions** - This is the test to check the person's ability to think-up clever solution rather than recognize the applicability or superior quality from a list of possible choices. There are total 60 units in which 47 units are time bound while 13 units are without time limit. A total of three hours are needed to complete this test. In the questions of productive thinking and ingenious solution, marks have been given upon their quality. In these questions there is no time limit. In the questions of idea fluency, word fluency, associative fluency, the marks have been given upon the number of reactions, that is why they are time-bound. The numbers of reactions are counted in adjutivene flexibility and spontaneous flexibility.

**Scoring of the test:**

Different marks are allocated for different units of the creativity test. Allocation of the marks is as follows:

**Creative Production** - has 10 sub-units and marks allotted to 5 for each subunit and the total aggregate marks are 50 for this area.

**Fluency** - has total 70 sub-units which are divided into different categories like associative fluency, word fluency and idea fluency. A total 70 marks are allotted to this unit.

**Originality** - 25 marks are allotted to 5 subunits.

**Flexibility** - This property is divided into two categories - Adjutive flexibility and spontaneous flexibility. 20 marks are allotted to this unit.

**Ingenious Solutions** - 15 marks are allotted to 3 sub-units.
ACHIEVEMENT:

Scholastic achievement is generally assumed as the product of intelligence. But it has been seen that inspite of high intelligence sometime students do not achieve the expected outcome, due to lack of proper study habits. Studying has long been the primary means by which school learning takes place outside the classroom. Wide variation has been universally noted in the method of study typically practiced by students. The time of the day preferred the time laps between the study session, the degree of noise or music tolerated or invited as background, the physical condition of the study, the extent to which extra curricular activities interfere and the particular study mechanics employed are few of many factors that vary in every conceivable way among individuals. Many study habits appear detrimental to efficient learning, whereas other would seem to facilitate it. This observation has led numerous educators to feel that providing proper instruction in study skills and reading techniques, the learning task can be made easier.

Although student usually dignity - mere reading by the name of study, the two should be differentiated. It is needless to point that it is always very necessary to understand that what one is reading. But even more understanding, is not enough. A student must be able to reproduce and apply to the problem possessed, the substance of what he has studied. In short application of knowledge should be the outcome of the study.

SCORE:

Score are consider from the total aggregate marks converted into their percentage of the results of annual exam of Xth class of students of Central School and the Govt. Aided Higher Secondary School of Kanpur Urban.
Level of Aspiration Test  By Bhargava and Shah

The test level of aspiration is in a form of test booklet. The first page of the level of aspiration booklet contains general information of the testee, instructions to the respondent and the scoring table, while remaining eleven pages contains the performance sheet of this measure which are arranged in order of trial numbers.

The performance sheet has 50 circles. (Each of 1cm in diameter which is arranged in five rows-ten in each row. Above and below of these rows, there are two boxes on the right side-the upper box for writing the number of expected score (except in practice trial) where as lower box is for putting the number of actual score or completed performance. Thus ten trials are needed for each subject except practice trial. Stop watch or stop clock is also required for the test.

The subjects may be instructed that they have to draw four lines in these circles, so that they may appears like a human face. The lines must be drawn in a sequence - right eye, left eye, nose and mouth. The subject should work from left to right across the rows and then proceeds to the next line. For each trial 30 seconds are allotted for work at the end of this time the subject is asked to stop the marking and the count the number of completed faces and enter in lower box.

SCORING:

The procedure of scoring is simple. It provides three types of scores:

* Goal Discrepancy Score (G.D.S.)
* Attainment Discrepancy Score (A.D.S.)
* The Number of Times the Goal Reach Score (N.T.R.S.)
**Goal Discrepancy Score (G.D.S.) :-**

The extent and direction of the difference between actual score on the previous trial and goal set up of the next trial is known as goal discrepancy score (GDS) which is obtained by subtracting the actual score on the trial from the aspiration score (goal set up score) for the next trial.

A positive goal discrepancy suggests that one's goal is higher in relation to one's previous performance and a negative goal discrepancy score indicates that one's goal is lower than one's previous performance.

**Attainment Discrepancy Score (ADS) :-**

Related to the concept of goal discrepancy in this attainment discrepancy. It is the difference between aspiration (expected score) and the achievement (actual score) on the same trial. Thus in order to obtain ADS expected performance is subtracted from the actual performance. Therefore ADS is positive when actual performance is more than expected performance and negative when expected performance is higher than the actual performance.
SAMPLE

Sampling may be defined as the selection of some part of an aggregate or totality on the basis of which a judgement or inference about the aggregate or totality is made. In most of the research work the usual approach happens to be make generalization or to draw inferences based on samples about the parameters of population from which the sample is taken.

The researcher often selects only a few items form the universe for his study purposes. All this is done on the assumption that the sample date will enable him to estimate the population parameters. The items so selected constitute what is technically called a sample. A sample should be truly representative of population characteristics without bias so that it may result in valid and reliable conclusion.

According to Borg - "Perhaps the most important factor in determining the generability of research results in the selection of the sample used in collecting the research date".

There will be wastage of time, money and energy if the research data are not generalizable to some degree beyond the sample used in research. By studying the samples of a defined population educational research aims at making generalizations which can be applied to the population. Different approaches have been made to explain the meaning and contents of sampling. A few of them are under review.

"A sample as name implies is a smaller representation of a large whole".

Goode and Hatt

Prof. Colvin F. Shumid expresses his idea about the sampling method.
"A Statistical population or universe may consist of attributes, qualities or behaviour of people, the behaviour of inanimate objects such as city or city block house. Hold or dwelling structures, the day's out part of a factory or opinion of an electorate of our entire nation".

Goode and Hatt define samples as below.

"Thus the use of sampling allows for more adequate scientific work by marking the time of the scientific work count. Instead of spending many hours over the analysis of a mass material from one point of view, he may use that time to examine a smaller amount of material from many points of view, or in other words, to do a more intensive analysis of fewer cases".

"The primary objective of statistical inference is to enable us to generate from a sample to some larger population of which the sample is a part". - Garret.

Sample is a representation of the population by a smaller group but having the same characteristics as the population. It can also be said that a sample is a representative cross section of a given population.

According to Pauline, V. Young - "A statistical sample is a miniature picture of cross section of the entire group or aggregate from which the sample is taken".

It would be better to discuss briefly the main objects of sampling method. It is obvious that the most important object of sampling studies is to obtain maximum information about the problems under the study with the least sacrifice of money, time and energy. It is clear that if a sample fails to reveal the main characteristics of the population it does not serve the purpose for which it is meant. So we can say that fundamental object of the sampling method is to get as accurately as possible a picture of the whole universe by examining only a part of it.
The observation of some phenomenon in complete detail would involve such a mass of data and the analysis would be slow and tedious. Moreover to analysis large quantities of material is wasteful, when a smaller amount would be sufficient. It is generally much more economical in time effort and money to get the desired information for only some of the elements than for all of them.

The basic requirement of any sample is that it should be of representative character as far as possible of the population or universe form which is taken.

The best way to make a sample representative is to adopt such a procedure that the probability of the individuals of the universe is one.

**Advantages of sampling method**:

1. As previously explained sampling saves time and money. Survey of smaller number of cases not only requires less time but also require less money and energy.
2. Smaller number of cases in the sample permits a more minute observation.
3. Sample method is more scientific.
4. Administrative convenience is also there. A sample is manageable in social researches.

**TYPES OF SAMPLING**

The sample designs are basically of two types that is non probability sampling and probability sampling.

**(A) Non Probability sampling**

Non probability sampling is that sampling procedure which does not afford any basis for estimating the probability that each item in the population
has of been included in the sample however in such a sampling method there is no assurance that every element has some specific chance of being included. Non probability sampling is of following types.

1. **Accidental Sampling**
   
   In this method one simply reaches out and takes the cases that fall to hand, continuing the process until the sample reaches a designated size.

2. **Purposive Sampling**
   
   In this type of sampling items for the sample are selected deliberately by the researcher, his choice concerning the items remain supreme. The basic assumption behind purposive sampling is that with good judgement and an appropriate strategy one can hand kick the cases to be included in the sample and thus develop samples that are satisfactory in relation to one's need.

3. **Quota Sampling**
   
   Under quota sampling the interviewers are simply given quotas to be filled from the different strata with some restrictions on how they are filled.

(B) **Probability Sampling**

Under probability sampling, every item of the universe has an equal chance of inclusion in the sample. The characteristic of probability sampling is that one can specify for each element of the population, the probability that it will be included in the sample.
1. **Random Sampling**

This sampling method ensures the law of statistical regularity which states that if on an average the sample chosen is a random one, the sample will have the same composition and characteristics as the universe.

2. **Complex Random Sampling**

Probability sampling under restricted sampling technique may result in complex random sample designs. Some of the complex random sampling methods are.

(a) **Stratified Sampling**

If a population from which a sample is to be drawn does not constitute a homogenous group, stratified sampling technique is generally applied in order to obtain a representative sample. Under stratified sample the population is divided into several step population that are individually more homogenous than the total population.

These different sub-populations are called strata. Then we select items from each stratum to constitute a sample. Since each stratum is more homogenous than the total population. It results in more reliable and detailed information.

(b) **Systematic Sampling**

In some instances, the most practical way of sampling is to select every item on a list. Sampling of this type is known as systematic sampling. An element of randomness in introduced into this type of sampling by using random numbers to pick up the unit with which to start. In systematic sampling only the first unit is selected randomly and the remaining units of the sample are selected at fixed intervals.
(c) **Cluster Sampling**

If the total area of interest happens to be a big one, a convenient way in which a sample can be taken is to divide the area into a number of smaller non-overlapping areas and then to randomly select a number of these smaller areas usually called as clusters, with the ultimate sample consisting of all units in these clusters.

Thus in cluster sampling the population is divided into a number of relatively small subdivisions which are themselves clusters of still smaller units and then some of these clusters are randomly selected for inclusion in the overall sampling.

(d) **Area Sampling**

If clusters happen to be some geographic subdivisions, in that case cluster sampling is better known as area sampling.
SAMPLE OF THE PRESENT STUDY

Present study deals with a comparative study of students of higher secondary level of central school and students of higher secondary level of government aided school of Kanpur urban.

Both the male and female students of high-school of Kanpur urban within the age of 13 of 15 years constitute the element of universe only H.S. School have selected. This help to control the ecological factors of the institutions. The method of sampling used is multistatified and random one multistatified sampling is used when a population from which a sample is to be drawn does not constitute a homogenous group. The technique is used in order to obtain a representative sample.

We select 800 students (400 higher secondary level of central school and 400 students of higher secondary level of government aided school of Kanpur Urban).
STATISTICS USED

Statistics Used is that science which deals with the collection, analysis, organization and generalization of the data. The classification, expansion, and generalization of the data is necessary in the research work and for the filed of investigation.

The formula are detailed below

1. Mean
   \[ M = \frac{\sum fx}{\sum f} \]
   \( \sum f \) = Sum of frequencies
   \( \sum fx \) = Sum of product of score and frequencies

2. S.D. (Standard deviation)
   \[ \sigma = \sqrt{\frac{\sum f(x - M)^2}{\sum f}} \]
   \( \sigma \) = standard deviation
   M = Mean
   \( \sum \) = Sum Total
   \( x \) = scores
   \( \sum f \) = Sum of frequencies

3. C.R. (Critical Ratio)
   \[ C.R. = \frac{M_1 - M_2}{S_{ED}} \]
   \( M_1 \) = mean of first group
   \( M_2 \) = mean of second group

4. \[ S_{ED} = \sqrt{\frac{\sigma_1^2}{\sum f_1} + \frac{\sigma_2^2}{\sum f_2}} \]
   \( S_{ED} \) = Standard error of difference
   \( \sigma_1 \) = Standard deviation of first group
   \( \sigma_2 \) = Standard deviation of second group
   \( \sum f_1 \) = Scores of first group
   \( \sum f_2 \) = Scores of second group
when the value of C.R. is significant at .01 and .05 level it is considered to be highly significant.

4. **Analysis of Variance (ANOVA)** -

A technique for investigation how much of the variability in a set of observation can be ascribed to different causes. Analysis of variance involves separating the sample variance into two components, that within the samples and that between them. These are then compared using F-test. The variance is separated using the sum of squares result. When the value is significant at .05 and .01 level it is considered to be highly significant.

\[
\Sigma X_T^2 = \Sigma X_B^2 + \Sigma X_W^2
\]

\[
\Sigma X_T^2 = \text{Total sum of squares}
\]

\[
\Sigma X_b^2 = \text{Sum of squares of between groups.}
\]

\[
\Sigma X_w^2 = \text{Sum of squares of within groups.}
\]

"t" **Test** -

The t test has been designed to test the difference between the mean \((M_1 \text{ and } M_2)\) of the two lots when their variance are not known but assumed to be same. It is based on the assumption that the observation follows the normal distribution and drawn at random. In case of two tots it is further assumed that their variances are not significantly different. When the value is significant at .05 and .01 level it is considered to be highly significant.

\[
t = \frac{M_1 - M_2}{\sqrt{\frac{\Sigma f_1 d_1^2 + \Sigma f_2 d_2^2}{\Sigma f_1 + \Sigma f_2 - 2}} \cdot \frac{\Sigma f_1 + \Sigma f_2}{\Sigma f_1 \cdot \Sigma f_2}}
\]
\[ M_1 = \text{Mean of first group} \]
\[ M_2 = \text{Mean of second group} \]
\[ \Sigma fd_1^2 = \text{Sum of squares from the mean and product with their respective frequency of first group.} \]
\[ \Sigma fd_2^2 = \text{Sum of squares from the mean and product with their respective frequency of second group.} \]
\[ \Sigma f_1 = \text{Number of items of first group} \]
\[ \Sigma f_2 = \text{Number of items of second group} \]
\[ \text{d.f.} = (\Sigma f_1 - 1) + (\Sigma f_2 - 1) \]