CHAPTER III

METHODOLOGY

3.0 Introduction

The term methodology refers to the processes and procedures one adopts while carrying out a study in order to achieve the particular objectives specified for one's study. Methodology is concerned with how one goes about actually conducting research.

The procedure adopted to realize the objectives set and to test the hypotheses formulated for the present study is described under the four headings - the design, the sample, the tool and the experimental procedure.

3.1 Design of the study

The present investigation is an intervention study carried out for 4 months and the approach is developmental in nature. The study aims at evaluating changes (if there is any at all) in the same students as a result of intervention strategies employed to enhance critical thinking using the psychology subject as content matter. The design employed for the present study is **`ONE GROUP - PRE-TEST, POST-TEST DESIGN`.**

The subjects for the present study are 12 students - all who have opted for Arts stream at the Higher Secondary and also have Psychology as one of

their subjects. The investigator has ruled out control group for the purpose of study due to the unavailability of an equivalent group.

Describing a research method, Proshansky (1976) said, we not only put aside the laboratory physical-science model for our research, but we have abandoned without regret the conception of simple cause-and-effect relationship in understanding how the built environment and human behavior and experience are related. We worry a less about `experimental` controls in doing research and more about what, when, and how to describe on going events, an approach that is possible. We are not looking for the usual independent- dependent variable relationship between observed and described properties of physical setting and described reaction of people in these setting. For the present study the investigator has based her research methodology in the lines of Prosphansky's point of view.

The present study is carried out in a real condition that is classroom setting, where all related variables function in a natural fashion. There is a complex interplay that operates among these variables that result in new patterns of relationships during the teaching-learning process. In the present study the researcher is more interested in understanding and knowing the description of such on going educational process rather than simply focusing on independent-dependent variable relationship.

3.2 Sample of the study

The sample of this study comprises of English medium students of std. XI, who have opted for Arts stream and have Psychology as one of their subject in the academic year 1997, in Navrachana Higher Secondary School, affiliated to Central Board.

3.3 The tool for the present study

The present study is an intervention study to enhance critical thinking in students. Therefore the study requires a tool that measures critical thinking in students of std. XI. The researcher has prepared the tool for the present study. The detailed preparation of the tool is mentioned in this chapter under the section 3.4.

3.4 The experimental procedure

The present study to enhance critical thinking in students is conducted in 3 phases: the pre-intervention phase, the intervention phase and the post-intervention phase.

I. The Pre-Intervention Phase

The pre-intervention was utilized for the (a) Development of tool for measuring critical thinking in students of std. XI. (b) Selection of techniques and methods for developing critical thinking (c) Transposition of Psychology syllabus of std. XI to facilitate critical thinking in students.

(a) <u>The Development of tool</u>

* The critical thinking tool is given in the appendices I.

The tool to measure critical thinking was constructed in the following stages:

(i) ***Identification of dimensions of critical thinking***

The researcher reviewed available literature to identify various dimension of critical thinking. The literature search was possible because of a wide spread interest that is growing in research on critical thinking as the importance of critical thinking in education is gaining momentum. Many Universities and

schools are undertaking various researches and training for restructuring schools through the teaching of thinking skills. This has paved way in identifying various dimensions of critical thinking. Thinking skills fostered by Philosophy for children (Mathew

Lipman, 1976) has identified 27 dimensions of critical thinking and few of these are: Formulating concepts, Making generalization, Formulating questions, Identifying assumptions, Taking relevant consideration into account, Working with analogies, Constructing hypothesis, Analyzing etc.

The Center For Critical Thinking And Moral Critique, Sonoma State University has identified 35 dimensions of critical thoughts under affective strategies and cognitive strategy and a few of these are- Thinking independently, thinking precisely about thinking, exploring implications and consequences, evaluating evidence, facts, assumptions, comparing and contrasting etc. Besides these there are many more tests measuring critical thinking that insinuate dimensions of critical thinking. A few of these dimensions include hypothesis formation, development of conclusion, recognition of assumptions, evaluation etc.

For the present study a few dimensions of critical thinking are selected for the construction of the tool. Only those dimensions are incorporated which the investigator thinks can be easily measurable and can be comprehended by the students who may have not been previously exposed to critical thinking. The dimensions include both cognitive and affective.

The efforts to induct cognitive dimensions of critical thinking would be a deliberate attempt, on the other hand the investigator anticipates that the affective dimensions would be acquired on its own with of development of cognitive dimension. A permissible and censor free classroom climate accompanied by instructional process that facilitates thinking would lead to the

development of affective dimension of critical thinking. The cognitive dimensions of critical thinking incorporated for the present study and glosses are shown in the Table 3.1

Table 3.1 Represents Dimensions of Critical Thinking and Glosses

Cognitive Dimensions	Glosses
D1: Exercising independent thought	Intellectual autonomy to think for one's self, to give one's conception in the context of one's own experience, perspective, point of view.
D2: Intellectual empathy	Having conscious need to imaginatively put oneself to genuinely understand them. Ability to reconstruct accurately the viewpoints and reasoning of others.
D3: Analyzing-arguments, beliefs, themes, interpretation, concept etc.	Analysis –to break up a whole into parts, to examine in detail as to determine the nature of, to look deeply into an issue or situation.
D4: Evaluate-arguments, belief, opinion, themes, propositions etc.	To judge/determine the worth or quality by applying criteria or standards through sufficient information.
D5 Give justification-on one's viewpoint, stand, belief etc.	The act of holding a belief, opinion, action, policy etc in accord with reason and evidence.
D6: Logical reasoning	Correct reasoning, rational consideration that bears upon the facts, justification or explanation. Ability to make one's inferences along with premises, assumptions, upon which those inferences are based.

D7: Comparing and contrasting analogies.	Noting significant differences and similarities based on criteria.
D8: Dialectical thinking	Developing one's own perspective through other points of view. The reasoner puts two or more opposing points of view in competition with each other to test the strength and weakness of opposing points of view.
D9: Questioning	The ability to question and probe deeply to get down to root ideas, ask significant and relevant questions.
D10: Thinking about thinking- getting acquainted with critical vocabulary such as implication, assumption, inference etc. And learning to draw implications, assumptions and inferences from the authors' statements.	Implication: a claim, which follows from other claims. Assumption: a statement accepted or supposed as truth. Inference: act by which one concludes that something is so in light of something else being so.
Affective Dimensions	Glosses
D11: Intellectual autonomy	Having rational control of ones beliefs, values, and inferences. But it does not mean stubbornness or rebellion. It entails a commitment to analyzing and evaluating beliefs on the basis of reason and evidence.
D12: Intellectual humility	Awareness of the limit of one's knowledge. Intellectual humility is based on the recognition that no one should claim more than he or she

	actually knows.
D13: Intellectual courage	To determine for one's self which is which, one must not passively and uncritically "accept" what one learns

b) Designing the test items

The investigator in order to frame the test items had referred to the school library, for inquiring into students` entry behavior and also to find out the kinds of books that were being issued to the students of std. XI in the library period. In addition to it various literature on reasoning were also reviewed.

Randomly a large number of items were framed and those of which could be synchronized with the selected dimension of critical thinking were singled out and others got discarded.

(c) Validation of the tool

Validating of the tool in accordance with the dimensions of critical thinking, through expert opinion was the next step. The basic objective behind validating the tool was to confirm if the selected test items were really measuring the dimensions of critical thinking they were intended for.

The experts' feedback on the tool not only helped in validating the tool but also highlighted the difficulty level. The experts commented on the organization of items, suggested improvement in structuring of items and in addition to it various queries were forwarded which helped the investigator in understanding her tool better. In light of the learned suggestions the investigator redrafted the tool.

(e) Pilot Study

The test was administered to students of std. XI of a particular school. The primary purpose was to check the comprehension level of the students on the test items. In light of their response and feedback the tool was further modified and in the end finalized.

(f) Schematization of scoring procedure

The test items in the tool are framed to measure the specific dimensions of critical thinking. The tool comprises mostly of essay type questions and therefore was a very subjective in nature.

In any domain where assessment is taking place, standards are laid down for objective assessment. Making standards/criteria promotes both reliability and validity. For the assessment of the present tool the investigator has incorporated some of the International standards/criteria laid down for higher order thinking by Dr. J.L. Williamsan (1991) . The standards are shown in the Box 3.2

Box 3.2 Standards for higher order thinking

♦ Non clarity	vs. Clarity
♦ Irrelevant	vs. Relevant
♦ Biased	vs. Unbiased
♦ Non answerability	vs. Answerability
♦ Superficial	vs. Deep
♦ Incomplete	vs. Incomplete

Each of these standards will be measured on a 'five point' rating scale. The meaning of standards and the scheme of allocation on the five point rating scale are explained in the Table 3.3

Table 3.3 Standards on a 5-point rating scale

1 2 3 4 5

Standard	Point 1 (very low Performance)	Point 3 (mediocre performance	Point 5 (high performance)
Clarity	Vague in defining key concepts, reasoning, questioning, presenting ideas, oscillating between different or contradicting purpose. At tangent.	Implies precision but may not be consistent. Over loaded with sentences, redundant, ideas not clear/vivid fail to convey holistic idea.	Absolute precision in defining concepts, reasoning, presenting ideas, purpose and goals.
Relevance	Ideas, questions, arguments, point of view are absolutely irrelevant with the purpose	Ideas, questions, arguments, point of view may be appropriate but may not be significant, lack depth and appear superficial.	Ideas, questions, arguments, point of view are significant, vital, insightful, and noteworthy.
Unbiased	Argument from a single point of view/ego centered. Single	Argues from different points of view but narrow	Consistently articulate other point of view.

	perspective/ unidimension and narrow.	and superficial. Lacks empathy and objectivity.	Treating all points of view alike without reference to ones vested interest or feelings.
Answerability	Questions that are not relevant or not answerable are asked.	Questions may be answerable, to an extent relevant but may be value loaded and not significant	Only those questions that are relevant, significant, logically constructed and answerable are asked.
Depth	Superficial reasoning, arguments, analysis, evaluation. Brief and transitory.	Reasoning, analysis, arguments may be deep but lack cogency, and be biased.	Deep understanding of concepts and their relation, making significant analysis, argument, reasoning, evaluations through illustrations,

Logical reasoning	Lacking the power analyze, put forth arguments, support ones' point of view, justify ones stand, inappropriate sequencing of ideas etc.	Uncritical reasoned which is biased, lack depth, completeness, significance, clarity, relevance, and good judgment.	Excellent reasoning-that is logical, relevant, deep, significant, well evaluated and consistent.
Completeness	The purpose is not concluded, consists gaps in ideas, lacks integration, assimilation, in short purpose is unaccomplished.	The purpose may be achieved but may lack depth, evidence, illustrations, dialectical thinking etc.	The purpose is accomplished, concluded, well argued, and well supported through evidence.

(g) Scoring Procedure for Critical Thinking Tool

General Instructions

(1) The tool comprises of 3 main sections. Each section measures different dimension of critical thinking. As a result the scoring procedure for each section will differ.

(2) A dimension measuring critical thinking will be evaluated using certain standards. For example, if 'Reasoning' is the dimension being measured, the standards for measuring reasoning would be (1) clarity in reasoning, (2) relevance in reasoning and (3) completion in reasoning.

(3) A student's answer evaluated on a standard taken into consideration will be plotted on a five point rating scale, depending upon the quality of the answer on a particular standard. For example 'Reasoning', dimension of

critical thinking will be measured using standards like 'clarity', 'relevance', and 'completion' on a five point rating scale as shown below:

- Clarity ----------

1	3	5
Vague	in-between	very clear

- Relevance ----------

1	3	5
Irrelevant	in-between	very clear

- Completion ----------

1	3	5
Incomplete	in-between	very complete

(4) Point 1 would indicate a very low level of performance on a particular standard. Point 5 would indicate a very good level of performance and point 3 would indicate mediocre level of performance on the rating scale. Point 2 and 3 would fall in between 1 and 5.

(5) The score on each section will be indicated by the sum total of scores on each question.

(6) The highest possible score obtained in various sections are:

Section		scores
I		30
II		20
III		85
Total	=	135

A Comprehensive Scoring Procedure for Each Section

Section I- Section I has 6 items. All the six items in the section measures students' ability to analyze relationships between the given pair of words.

Logical Reasoning: would be the rational consideration that bears upon the analysis of relationship.

Standards for evaluating good reasoning-

(1) Clarity in reasoning: means free from ambiguity, confusion or vagueness. Definitely stated and precise in expression.
(2) Relevance in reasoning: implies close logical relationship to the matter under consideration, highly appropriate, direct bearing on the matter at hand.
(3) Completeness in reasoning: when the relationship has been completely established, not left incomplete and vague.

The exercise in this section calls for selecting a pair from the other pairs of words that has the same relationship as the original pair and providing reasons for the choice. A student's task is therefore to select and give reason. No marks will be allotted if the student simply selects the pair and provides no reasons for the same. Student's answer will be evaluated using 5 point rating scale qualified on the individual standards. The marks secured for each item in a section would be the sum total of the points allotted on each rating scale for an individual standard divided by the number of standards. Taking the above example into consideration, the score for a particular dimension would be the sum of the points on each rating scale i.e. points on clarity + points on the relevance + points on completion divided by number of standards (in this case divided by 3). The total score on the tool will be indicated by the sum total of scores on the section. For example if a student gets highest score i.e. 5 points on clarity and 5 points on relevance and 5 points on completion. The sum total of the score will

be 15, which will be divided by number of standards that is 3 and is equal to 5. The total scores for the section will be the sum total of scores on each item. If the students scores the highest for all other 6 items then his/her score would be 30 (5 multiplied by 6).

Section II- Section II has 4 items and it measures students' ability to draw/ recognize inferences and implications from the statements and justify their stand. The dimension of critical thinking that is being measured in this section is the ability to justify.

Ability to justify: is the act of holding a belief or thought in accord with reason and evidence.

Standards for evaluating good justifying ability are:

(1) Justification through logical reasoning: Correct line of reasoning, rational consideration that bears upon justification or explanation.
(2) Clarity in justification: implies free from vagueness, ambiguity and confusion.
(3) Relevance in justification: that which is appropriate or suitable and has bearing on the matter at hand.
(4) Accuracy in justification: free from errors, mistakes, and correct selection of the choice from given choices.
(5) Completion: completely justify the stand he/she has taken.

Once again no marks will be allotted merely on the selection of the appropriate statement/statements from the given choices unless followed by an explanation. Student's answer will be evaluated using 5 point rating scale qualified on the individual standards. The marks secured for each item in a section would be the sum total of the points allotted on each rating scale for an individual standard divided by the number of standards (in this case divided by 5). The total score

on the tool will be indicated by the sum total of scores on the section. For example if a student gets highest score i.e. 5 points on reasoning, 5 points on clarity and 5 points on relevance, 5 points on accuracy and 5 points on completion, the sum total of the score will be 25. This will be divided by number of standards that is 5 and is equal to 5. The total scores for the section will be the sum total of scores on each item. If the student scores the highest for all other 4 items then his/her score would be 20 (5 multiplied by 4).

Appropriate choices of answers in the section are as follows:

Item no.	Correct choice
1	a and d
2	b and c
3	Only c
4	a and d are directly suggested b is indirectly suggested and c not suggested

- **SECTION III- The questions 2 in the section III of critical thinking has part 'a' and part 'b'. Part 'b' of the question will only be evaluated as part 'a' of the question is only to facilitate students into critical thinking in the pre-testing**

Under section III there are four questions. Each question measures different dimensions of critical thinking. Therefore the scoring procedure laid down will be question wise.

Question 1. Intends to measures the ability to evaluate. **Ability to evaluate**- is to judge /determine the worth or quality by applying criteria or standards. Standards for gauging this ability to evaluate are:

(1) Logical evaluation: correct reasoning. The set of rational consideration that bears upon the evaluation of any belief.
(2) Clarity in evaluation: free from ambiguity, vagueness, confusion; something that is definitely and precisely evaluated.
(3) Depth in evaluation: connotes not superficial ability to provide evidences and justification for one's evaluation, developing standards for one's evaluation.
(4) Relevance in evaluation: implies close logical relationship to the matter under consideration. Appropriate and has direct bearing on the matter at hand.

Student's answer will be evaluated using 5 point rating scale qualified on the individual standards. The marks secured for this particular question would be the sum total of the points allotted on each rating scale for an individual standard. For example if a student scores highest points (5 point) on the all the 4 standards then the marks acquired for this question would be the sum of all the points (i.e. 5+ 5+5+5=20).

Question 2. Intends to measures independent thinking in students, based on their own analysis. The dimension of critical thinking under consideration is the ability to analyze. **Analysis of one's position/stand**- is to examine the nature of, to look deeply into an issue and to develop perspective point of view and to give one's conception for an issue, policy or situation.

Standards for evaluating students' independent thinking are:
(1) Logical analysis of belief/opinion: correct reasoning, the set of rational consideration that on which the belief/ opinion is based upon.
(2) Clarity in analysis of a belief/opinion: free from ambiguity, vagueness, and confusion. Sharp, certain or precise in thinking.
(3) Depth in analyzing one's opinion/belief: implies not superficial, deepness in analysis by providing evidences, illustrations, and data.

(4)Relevance in evaluation: implies close logical relationship to the matter under consideration. Appropriate and has direct bearing on the matter at hand.

(5)Fair/unbiased: free from weakness within one's point.

Student's answer will be evaluated using 5 point rating scale qualified on the individual standards. The marks secured for this particular question would be the sum total of the points allotted on each rating scale for an individual standard. For example if a student scores highest points (5 point) on the all the 5 standards then the marks acquired for this question would be the sum of all the points (i.e. 5+ 5+5+5=25).

Question 3. Intends to measures questioning ability. **Questioning ability**- is the ability to question and probe deeply, get down to root ideas, questioning as to deeply understand. An attempt to figure something out.

Standards for evaluating questioning ability are:

(1) Logic of questioning: analyzing questions to determine what a question seeks to ask, rational consideration that bear upon asking a question.

(2) Clarity of questions: under clarity about questions one is trying to ask, free from ambiguity, vagueness, confusion.

(3) Answerability: questions that are answerable are only asked. Questions that are not answerable or value loaded questions are not asked.

(4) Relevant questions: Appropriate/fit and direct bearing to the matter at hand.

Student's answer will be evaluated using 5 point rating scale qualified on the individual standards. The marks secured for this particular question would be the sum total of the points allotted on each rating scale for an individual standard. For example if a student scores highest points (5 point) on the all the 4 standards than the marks acquired for this question would sum of all the points (i.e. 5+ 5+5+5=20).

Question 4. Has intended to measure dimension comparing and contrasting analogies. Comparing and contrasting analogies- is noting significant differences and similarities.

Standards for evaluating the ability to compare and contrast are:

(1) Logical reasoning in comparing and contrasting: rational considerations that bear upon in analyzing of relationships.
(2) Clarity in analysis of relationship: Clarity about questions one is trying to ask, free from ambiguity, vagueness, confusion.
(3) Relevance in comparing and contrasting: implies close logical relationship to matter under consideration.
(4) Flexibility in comparing and contrasting: implies that while comparing and contrasting between analogies, is not restricted to a single /particular aspect of the concept. Analogies are defined in a broader perspective for comparing and contrasting.

Student's answer will be evaluated using 5 point rating scale qualified on the individual standards. The marks secured for this particular question would be the sum total of the points allotted on each rating scale for an individual standard. For example if a student scores highest points (5 point) on the all the 4 standards then the marks acquired for this question would be the sum of all the points (i.e. 5+ 5+5+5=20).

Components (b) and (c) of the pre-intervention phase that is the Selection of techniques and method to enhance critical thinking in students and Transposition of lesson plans to facilitate critical thinking in students have been spelt out in detail in chapter IV and V respectively.

II. Intervention Phase

The present study is an intervention study to enhance critical thinking in students of std. XI using Psychology Subject as content. The teaching of thinking skills is potentially one of the most valuable areas of educational research and development. The movement to teach thinking skills stem from the belief that thinking can be learnt and taught. Bereitr (1984) has identified 3 basic approaches to implement the teaching of thinking.

(1) Thinking is taught as `enrichment` - either special classes on thinking are organized or special thinking exercises are developed and added to the curriculum. In either case thinking is seen as something that is `added on` as if it were a curriculum area, being separate from the academic substance.

(2) Teaching thinking as content - in doing it, one proceeds to identify the elements of good thinking and then teaches students what those elements are. Essentially it is a course in logic and problem -solving.

(3) Pervasive approach- teaching of the basic school subjects in such a way that thinking is enhanced. It facilitates teaching thinking as well as increases the learning of subject matter. More over to teach the basic subjects without teaching thinking simultaneously not only neglects thinking but is inefficient.

The researcher decided on the last approach i.e. teaching thinking using psychology subject as a content. Therefore the sample of this study comprises of English medium student of std. XI, all those who have opted for Arts stream and have Psychology as subject in the academic year 1997, in Navrachna Higher Secondary School of Baroda City.

The decision to use psychology subject for the development of critical thinking stems from researcher's own specialization in psychology at Masters level. Since Psychology is being offered only in higher secondary, Arts stream, the researcher has decided on taking students of std. XI as her subjects for the study.

The subjects for the present study are adolescent (15 years and above) and can be considered of an age where thinking can be canalized as they have already entered the `formal operation period`. Formal operations are characterized by scientific reasoning, hypothesis building and testing and they reflect the true understanding of causation.

According to Piaget the child's cognitive structure reaches maturity during the adolescent period when formal operations are achieved. The adolescent with formal operation typically has the cognitive structural equipment to think `as well as` adult but this does not mean that adolescent (formal) thought is necessarily `as good as` adult. The attainment of formal operations means a new potential has been achieved. Taking this into consideration, the present program to facilitate thinking in this age group i.e. 15 years and above is likely to be appropriate.

Navrachana Higher Secondary school was considered the choice for conducting the intervention as it the only school that had adequate students who had opted for psychology in std. XI. More so, the researcher was also looking for a school that would render cooperation and freedom to execute her study. The principal Mrs. Gupta and the concerned teacher Mrs. Annie Jose of Navrachana Higher Secondary School satisfied these requirements.

The intervention study was carried out for the period of 4 months using the psychology subject. In consultation with the psychology teacher four teaching

units were selected out of total eight units from the syllabus of Psychology for std. XI as prescribed by Central Board Of Higher Seconary. The four units are (1) Memory (11) Learning (111) Sensory Attentional And Perceptual Process (1V) Motivational and Emotional Aspects Of Behavior. These units were taught within the regular schedule of the school.

Before commencing the intervention program a pre-test measuring critical thinking was administered to all those students who were the participants in the experiment. The intervention program was carried out using various methods and techniques and the content was transposed to facilitate critical thinking. The manner in which the actual intervention program was carried out has been spelt in the chapter V.

III Post -Intervention Phase

In the post-intervention phase the researcher once again administered the tool measuring critical thinking to the subjects. Students' pre-tested, post-tested scores on the critical thinking collected before and after the intervention program were analyzed. The data collected were both qualitative and quantitative data.

The quantitative data are pre-tested and post-tested scores of critical thinking, which are in form of numbers. The quantitative data were subjected to t-test to find the significance between the initial scores on the pre-test and later scores on the post-test.

The qualitative data are descriptive analysis of each student's pre-test and post-test performance on the Critical thinking tool. Most of the analysis is descriptive in nature, using words, based on observation and classroom interaction. The qualitative data also included student's verbal interaction in the class.