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CHAPTER VI

SUMMARY, IMPLICATIONS AND RECOMMENDATIONS

6.1 Introduction

In this chapter a summary of the study and implication of the results and recommendations and areas of future study are discussed in detail. The chapter begins with rationale of the study, the statement of the problem, objectives, hypotheses, and delimitations of the study, sample, design, tools, and procedure of data collection, statistical technique, and results. Since the study has far reaching implications, it is dealt in detail with a special reference to the contribution to the Indian educational system. Any research is not complete unless it opens avenues for further research. In tandem to this observation; the researcher in the course of the study has identified areas for further research by interested educationists.

6.2 The Rationale

Achievement is closely interrelated to the aspect of education. Further in primary, secondary and tertiary levels of education achievement and meaningful learning are intertwined. In the present day educational spectrum the educationists are studying various models and strategies to make learning meaningful and help students to become analytical thinkers. The curriculum of Teacher Education in Pune University is revised taking into consideration that models and new methods of teaching strategy needs to be taught to the student teachers so that they will be equipped with various
methods and models before they become teachers in schools. Methods used during classroom teaching are a teaching component and Seidel & Shavelson (2007) have noted that teaching components have an effect on student cognitive growth.

Many have echoed the need of change in the pedagogy through the national news papers (Khattar, Education Times, Feb; 5, 2008, Chengappa & Maheswari, India Today 2006, Patkar, Education Times 2006). The mega research conducted by Educational Initiatives 2006 (India Today 2006) also pointed towards a need for change in the pedagogy so that Indian schools will move away from rote learning to meaningful learning.

One of the strategies that have evolved as a useful simple strategy that lead students towards meaningful learning is ‘Concept Map’. This strategy can be used even in a classroom with no gadgets - by paper and pencil or chalk and black board. The strategy is based on Constructivist Cognitive Model (Glatthorne & Coble, 1993) with strong philosophical underpinnings. Number of studies are conducted outside India using concept map as a strategy but in India the research using Concept Map is very meager (Andal, 1991, Rao 2004, Gopal 2004, Kharmatal & Nagarjuna 2006). To construct a lesson sequence using concept map followed by implementing in the classroom setting, then observing the immediate impact on the improvement of cognitive processes and achievement will provide a defensible mechanism for the researcher to present the viability of the tool in Indian scenario. In the above context the present study was selected to find the effect of concept mapping as a pedagogical tool for achievement and development of cognitive processes (higher mental abilities).
6.3 Statement of the Problem.

The Problem of the present study was stated as follows:

“Effect of Concept mapping on the Cognitive Processes and Scholastic performance in General Science for Standard VII Students within Pune City”

6.4 The Objectives

The objectives of the study were:

1) To study the effect of concept mapping on the development of higher mental abilities of standard VII students in General Science.

2) To study the immediate impact of teaching through Concept Mapping on the achievement of standard VII students in General Science. (Chemistry, Biology).

3) To investigate the opinion of the students on concept mapping as pedagogical tool in the learning process.

6.5 Hypotheses

The hypotheses of the study were:

6.5.1 Hypothesis: I. There is no statistically significant difference in the Cognitive Processes, between the experimental group and control group.

Sub Hypothesis:

1. There is no statistically significant difference in the Cognitive Processes (mental abilities), between experimental group and control group.
2. There is no statistically significant difference in the Cognitive Processes (mental abilities), between the experimental group and control group, in the selected units of General Science (Chemistry & Biology).

3. There is no statistically significant difference in the Cognitive Processes (mental abilities), between the experimental group and control group in the selected units of Chemistry.

4. There is no statistically significant difference in the Cognitive Processes (mental abilities), between the experimental group and control group in the selected units of Biology.

6.5.2 Hypothesis: II. There is no statistically significant difference in the achievement, between the experimental group and control group.

Sub Hypothesis:

1. There is no statistically significant difference in the achievement, between the experimental group and control group in selected units of General Science.

2. There is no statistically significant difference in the achievement, between the experimental group and control group in selected units of Chemistry.

3. There is no statistically significant difference in the achievement, between the experimental group and control group in selected units of Biology.

6.5.3 Hypothesis III More than 50% of the students subjected to the treatment indicate improvement in their learning process due to the use of concept map as a pedagogical tool as measured by the Trifone (2006)
6.6 Delimitations of the Study

The study is delimited to:

1. The use of Concept Maps in the teaching – learning situation
2. Chemistry and Biology, the branches of General Science. The third branch
   Physics is omitted from the study.
3. Selected units of Chemistry, Biology, (General Science) of standard Seven.
4. Dependant variables such as achievement, and higher mental abilities such as
   application, analysis, synthesis, evaluation.
5. One school from the 10 Indian Certificate Secondary Education (ICSE)
   schools in Pune.
6. From the enrolled group of students, only students who have equivalent
   mental abilities based on PGTI score were selected for the study.

6.7 Limitations of the Study

The limitations of the study were:

1. The validity of the study is greatly influenced by the accuracy of the responses
   given by the students concerned.
2. The number of subjects in the study depends on the equivalent group selected
   from the standard seven of the school.
3. Randomization of the whole population by the researcher is not possible
   because the students are enrolled in various schools and within the school they
   are put in different sections at random. Hence it is a quasi – experimental
   study.
6.8 Sample

The sample consisted of 60 students of Standard seven of Spicer Higher Secondary School, Aundh Road, Pune 411007. The sample was selected on the basis of matched group sample. The group was matched based on the Pramila Group Test of Intelligence (PGTI) scores.

6.9 Design

The test design selected for the study was Quasi – Experimental Design. Group Matching was used to balance the experimental and control groups (Best & Kahn 2003). The threat to internal validity is controlled using matching – only Design (Best & Kahn 1996. p.139, Fraenkel&Wallen 1996. p.275, Borg &Gall 1974.p 394)

The Matching- Only Pretest – Post test Control Group Design

<table>
<thead>
<tr>
<th>Treatment group</th>
<th>O</th>
<th>M</th>
<th>X₁</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>O</td>
<td>M</td>
<td>X₂</td>
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The M in this design refers to the fact that the subjects in each group have been matched (on certain variables) but not randomly assigned to the groups. O refers to dependant variable at the beginning and end of the treatment. X₁ is treatment (concept mapping) X₂ is no treatment.(Fraenkel & Wallen 1996 p.275)
6.10 Tools
The following tools were used in the study:
1.) A test for assessing the intelligence
2.) A test for measuring higher mental ability in General science (THAMGS)
3.) Two-achievement tests in the area of Chemistry, and Biology on specific units selected for the study.
4) An Opinionnaire formulated by Trifone (2006)

6.11 Data Collection
The test for assessing intelligence (PGTI) was administered and matched group was selected. Pre test for THMAGS was given to ascertain the level of the knowledge of concepts by the two groups and after the treatment post scores were collected using the same test instrument. Two Achievement tests were given in Chemistry and Biology and the scores were computed.

6.12 Statistical Techniques Used for Analysis of Data
Mean, Standard deviation, variance, ‘t’ – test and effect sizes were used for the analysis of the data.

6.13 Findings
On the basis of the results and their interpretation, the following conclusions were found:
- There is a significant difference between the experimental and control group for the post scores of THMAGS test when taught using concept mapping strategy.
There is a significant difference between the experimental and control group for the Achievement test scores (Unit test I) in General science when taught using concept mapping strategy.

There is a significant difference between the experimental and control group for the test scores (Unit test I) for Chemistry, when taught through concept mapping strategy.

There is a significant difference between the experimental and control group for the test scores (Unit test I) for Biology, when taught through concept mapping strategy.

There is a significant difference between the experimental and control group for the test scores (Unit test II) for General Science when taught through concept mapping strategy.

There is a significant difference between the experimental and control group for the test scores (Unit test II) for Chemistry when taught through concept mapping strategy.

There is a significant difference between the experimental and control group for the test scores (Unit test II) for Biology when taught through concept mapping strategy.

The analysis of the attitude using (1 -5 score) Likert Scale denotes that they show a high positive attitude towards concept mapping as a pedagogical tool.
6.14 Discussion & Implications

6.14.1 Discussion of the results

In this study there is a direct relation between the pedagogy used (concept mapping strategy) on cognitive processes and achievement. Mapping has resulted in meaningful learning for the experimental students. The sample was tested on the prior knowledge of the concepts using THMAGS and found that they both have the same level (mean 4.7) but after the treatment for a period of 12 weeks showed that the experimental group could perform better than the control group (mean gain score 1.3) and the effect size was very high denoting the (effect size = 0.72) experimental group could perform better than the control group.

When the sample was tested on higher mental processes on the unit taught again the experimental group showed a significant difference with the control group. The effect size (ES= 0.92) denoted that the experimental group performed much better than the control group. These two tests consistently show that the new method of teaching had a positive impact on the meaningful learning which reflected in a change in their cognitive processes skills.

The unit test I and II show the achievement levels of the students in the specified units. There is a significant difference in the scores of the experimental groups and the effect size is very high for achievement test (Unit I) (ES= 1.1) and as well as Unit test II (ES = 0.92). The scores show that consistently the new pedagogy had a positive impact on the achievement of the students. This is consistent with the other studies done (Novak 2002, Odum & Kelly 2001, Horton et al 1993, Heinze Fry & Novak 1990, Okebukola & Jegede 1988, Novak & Gowin &Johansen 1983)

The questionnaire used by Trifone (2006) assess students thinking on learning as a direct consequence due to the using of concept mapping. Students have felt that
concept mapping has helped in their *effort in understanding* concepts (Qu 3 mean = 3.3) they also think that concept mapping had an *active role* in their level of achievement (Qu 7 mean = 4.05). Students have maintained that concept mapping affected their *level of achievement* (Qu 2 mean = 4.3) helped in *understanding* the concepts (Qu 1& 8 mean = 4.25,3.85)

Students have beliefs and individual learners construct their own understandings of concepts, principles, phenomena, and situations. Baird, Fensham, Gunstone & White (1991) has noted that “reflection improves knowledge, awareness and control of themselves and their classroom practice” thus constructivism complements meta cognition in effecting personal change.

Concept mapping is a meta cognitive strategy and in the questionnaire given they also felt that concept mapping had helped in their *ability to reflect* on concepts (Qu 4 mean =4,) increased their *interest in science* (Qu 5 mean =4.1) and increased *their confidence* in learning science (Qu 6 mean = 4.). The use of a new pedagogy had influenced their interest in science and encouraged the students to have more confidence in learning science. Germann, (1988) has suggested that children with more positive attitudes towards science show increased attention to classroom instruction and participate more in science activities (cited by Jarvis & Pell 2005) Further Jarvis & Pell (2005) suggest attitudes can also influence attainment. In the present study the achievement is positive and the attitudes are also positive.
6.14.2 Implications of the study

Effective teaching is a reflective process. Analysis and interpretation of the present study indicates that concept mapping strategy is a pedagogical tool which can be implemented in any Indian Classroom. The implications of the present study are as follows:

- The study explicitly demonstrated learner actively constructs meaning and “learning is not fixed and inert” (Cohen, Manion & Morrison, 2004). Hence the goal of teaching should be inculcating the habits of mind such as ‘constructors of knowledge’. This idea is in accordance to the philosophy of constructivism. Constructivism is defined as “learning occurs most effectively when the individual actively processes the information in a way that is meaningful to him/her and not simply and passively incorporates information unchanged from its original form” Carlson,( 2006). Concept mapping is based on constructivism and assist in meaningful learning (Novak & Gowin, 1984; Heinz- Fry, 1990; Horton et al, 1993; Novak, 1998; Trifone, 2006; Novak, 2002; Odum & Kelly, 2001) The present emphasis in the U.S and U.K is for mastering content (Trifone2006) is same in India also, the teacher is mainly concerned with “finishing” the prescribed textbook, and preparing students for government examinations. (Patkar,Education Times, Feb:7, 2006). Concept mapping helps in uncovering the content. The study has shown, students identifies the concept labels and the linking words and arrange them into a hierarchy, linking each other thus building the concept meanings. The cognitive structure formed thus helps to deconstruct and reconstruct ideas and embed in their personal cognitive schemas.
• The researcher used Concept Mapping as a tool to elicit prior knowledge, presentation of the body of knowledge, also for evaluation purpose. In the present study it was an effective tool to elicit prior knowledge and also it helped the students to identify their misconceptions and beliefs. The resistance to change the misconception was reduced since they identified their own misconceptions and with a discussion with the peers and teacher could change their personal beliefs on various phenomena.

• Concept mapping was also used in reviewing the content which was learned in the class room. A weekly concept mapping assignment helped the students to review, recapitulate and reflect on the content learned and make new cross connections and add pictures to enhance their meta cognition in that particular area.. It was found to be an excellent tool for consolidating the lesson completed.

• Concept mapping was found to be excellent tool for active participation of the students, for ensuing discussion on the lesson to be learnt and the intermittent ‘aha’ and ‘I got it’ exclamations were sure remarks that active participation and learning was going on in the classroom along with an enhanced interest in learning science. Reflective thought was prevalent in the period of treatment.

• Feed back to students during the construction process is essential to suggest to them the possible misconceptions which can creep in and also to suggest alternate cross links which can come in. This feed back is very essential because it provides students with meaningful feed back which serve as the necessary scaffolding to facilitate concept and / or task mastery whilst working with their ZPD as suggested by Vygotsky (Trifone 2006)
• Concept maps helped the students and the educator to deconstruct the lessons, make smaller maps according to the focus questions identified and later on can merge many concept maps into a major concept map. This will become the major map for the entire lesson selected to learn. This results in “conceptual bridging” (Hewson & Hewson, 2003) linking important concepts with meaningful common experiences.

• Concept mapping is an effective tool in the hands of the educator in arranging the content in the systematic hierarchy so that no ideas are left or addressed to the students in a haphazard manner. It helps the educator to delimit oneself with scope and depth of the learning material. Also it assists the learner to delimit oneself as well as see the possible cross links which arise from one area of study to the other area of study.

6.15 Contributions to the Knowledge Base

From this study we can state:

1. The testing of the hypothesis had enabled the researcher to develop the capacity in designing and testing concept mapping as a strategy helping in meaningful learning.

2. Testing such standard based strategy with philosophical underpinnings in the complex class room situation has given teacher desire to address such strategy in public venue for the benefit of the teacher community.

3. The study contributes to the professional development and directions in new avenues to critically examine standards based pedagogy.

4. The study will be helpful for teachers to use this defensible strategy for teaching - learning process.
5. It has brought out the need of new pedagogical advances to assist in student achievement and development of cognitive processes.

6. The research will contribute to develop the teaching learning process so that student achievement can be enhanced.

7. The study had uniquely contributed to the literature in the following areas:
   (2.1) The impact of Concept Mapping on the cognitive processes of standard seven students
   (2.2) The impact of Concept Mapping on the achievement in science of standard seven students

8. The study had given a pool of test items analyzed and ready to be used for a test construction in science of standard seven.

9. The study can be implemented in any school since the students in this study only used pencil and paper for the construction of the concept maps.

### 6.16 Recommendations for Future Research

1. A study on rural students teaching learning process using concept mapping should be done.

2. A study on the all the three science subjects simultaneously can be conducted.

3. Concept mapping in non science subjects requires to be studied

4. A comparative study of student made and teacher made concept maps and its effectiveness needs to be assessed.

5. Comparison of technology (Computer) based concept maps and pencil paper concept maps can be studied.

6. How concept map can be used as an evaluation instrument requires to be studied.