Effect Of Concept Mapping Strategy On Achievement In Chemistry Of IX Graders In Relation To Study Habits

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Abstract
The Study was undertaken to investigate the effect of teaching through concept mapping on the achievement in Chemistry in relation to study habits. Sample of the study consisted of 302 (151 experimental group and 151 controlled group) IX class students from two Government schools of Ludhiana city of the state of Punjab, India. Experimental group was exposed to concept mapping method and the controlled group was exposed to conventional method (lecture and discussion). Mixed group intelligence test by Mehrotra (2008) (to match the groups), Study Habits Inventory by Mukhopadhyaya and Sansanwal (2011 revised) and achievement test in Chemistry (developed and standardized by the investigator) were used as tools for data collection. Levene’s Test for equality of variances and t-test were used for the analysis of data. The results of the study showed that achievement in Chemistry of the group taught by concept mapping was significantly more as compared to group taught by conventional method in both poor and good Study habit groups.
1. Introduction

Concepts are the basic unit of all types of learning. The concepts are the ways by which facts and experiences can be integrated and remain impressed in the mind much longer than facts. According to Weil and Joycee (1978) “Helping children learn concepts and teaching them how to learn concepts is a fundamental purpose of schooling. Constructivist approaches to teaching and learning science emphasize deep understanding of concepts (as opposed to memorization), discussion, explanation and exploration to students’ implicit knowledge”. So to be successful in learning, students have to take possession of knowledge actively by seeking experts conceptual linkages between new concepts and those they already possess.

Nelson (2007) defined Concept Mapping as a non-linear, graphic representation of unstable domains, depicting major concept nodes and the interrelationship of those nodes. It is a learning strategy identified as having a significant impact on retention and retrieval of information, with continued processing of data over time. Concept maps are frequently employed in the classroom because they offer a "complementary alternative to natural language as a means to communicate knowledge" (Gaines & Shaw, 1995). This visual approach has proven to be of great benefit to diverse student groups. Meaningful learning is promoted by this technique leading to improvement in achievement of students.

According to Dictionary of Education (2008), "Academic achievement is a measure of knowledge gained through formal education usually indicated by test scores, grade point average and degree." According to Dictionary of Education (2008), "Habit is a state of body, natural or acquired, aptitude acquired by practice, custom and manner, whereas study is described as earnest endeavours, application of books and subjects, which one studies. Therefore study habit is the endeavour towards studies acquired through state of body which is natural or acquired."

2. Review Of Related Literature


- **Achievement and Study habits:** Rajyaguru (1997) found other variables as better correlates of achievement than Study habits. Studies of Chaudhary (2001), Lawrence (2014), and Siddiqui and Fatima (2014) found that Study habits of students have no effect on achievement, however, majority of the studies conducted in this field indicated a significant positive relation between Study habits and achievement (Singh, 1984; Kasat, 1991; Stella & Purushothaman, 1993; Gelat, 1999; Alude & Onellemhemhen, 2001; Nancy & Sheeba, 2001; Kumar & Sohi 2013; Adeyemi & Adeyemi, 2014; and Sandhu, 2014).

- **Emergence of the Problem:** Most of the studies had been undertaken in foreign countries. A little work had been done in India covering population of Chandigarh (Kumar, 2009; Sharma, 2010;

- Among the studies conducted on the effect of Concept mapping on subject of Chemistry (Markow & Lonning, 1998; Brandt et al, 2001; BouJaoude & Attieh, 2003; Aggarwal, 2012; Agboola & Oloyede, 2013; Ezeudu, 2013; Jack, 2013; Julius & Wachanga, 2013; Fatokun & Eniayeju, 2014) only one study (Aggarwal, 2012) was found conducted in India. But, no study has been found specifically done on the population of Government school students of the state of Punjab of India in the subject of Chemistry.

The proposed study thus seems fully justified as it checks the effect of teaching through Concept Mapping on achievement in Chemistry of grade IX in relation to Study Habits of Punjab Government school students.

3. Objectives

I. To investigate the significance of difference in Achievement in Chemistry of the groups taught through Concept mapping and Conventional teaching of the students having poor Study habits.

II. To investigate the significance of difference in Achievement in Chemistry of the groups taught through Concept mapping and Conventional teaching of the students having good Study habits.

4. Hypotheses

- $H_01$: There will be no significant difference in Achievement in Chemistry of the groups taught through Concept mapping and Conventional teaching of the students having poor Study habits.

- $H_02$: There will be no significant difference in Achievement in Chemistry of the groups taught through Concept mapping and Conventional teaching of the students having good Study habits.

5. Method and Procedure

To study the effectiveness of Concept mapping strategy on the Achievement in Chemistry in relation to Study habits randomized group pre-test- post-test design was used. Here in the first phase concept maps were constructed and Chemistry achievement test was constructed and standardized also test of intelligence was used to form two groups $A_1$ and $A_2$ experimental and controlled groups respectively. In the second phase Chemistry achievement test was applied as a pre-test, apart from this Study habits inventory was applied. In the third phase controlled and experimental group were exposed to traditional teaching and Concept mapping technique respectively. In the last phase Chemistry achievement test was applied again as a post test. The difference of scores of pre and post-test which is termed as mean gain scores was indexed with which effectiveness of two methods could be compared.

Independent variables- The investigators had taken two strategies, traditional (Lecture and discussion) method and Concept mapping strategy.

Classifying independent variable: Study habit was taken as classificatory variable. This variable classified the sample of students in two categories i.e. poor Study habits and good Study habits.
Dependent variable- In the present study acquisition of Chemistry concepts (Achievement) was considered as dependent variable. This was evaluated by the mean gain scores of the students (Post-test scores – Pre-test scores of Achievement test in Chemistry).

Control: Steps taken to control the extraneous variables:

a) Selection of sample- Random sampling was done in order to have true representative data. Here cluster random sampling was done.

b) Matching the groups- Matching of groups was done on the basis of intelligence, for this mixed test of intelligence was applied. Apart from this age, socio-economic status, age, gender is the other factors wherein all the relevant variables were controlled.

c) Prior knowledge- The achievement test in Chemistry was administered on all the students of both groups prior to the experiment. The analysis was done on the gain scores (Post-test – pre-test) in order to eliminate the effect of the prior knowledge about the subject.

d) School Environment- Only Government schools were taken for the sampling, so the effect of environmental factor was nullified. These schools have more or less same physical facilities, such as furniture, ventilation, equipment and light etc.

e) Medium of instruction- Investigators made students comfortable with respect to medium. For this purpose Chemistry achievement test was translated and revalidated in all the three languages-English, Hindi and Punjabi.

f) Teacher- Single teacher conducted the whole experiment hence inter teacher variations were eliminated.

6. Sample of the study

For the study, sample of 302 students of 9th class of Government Schools were selected through the multistage randomization technique from Ludhiana district. The poor and good groups in Study habits were framed on the basis of 27% criteria. The upper 27% on the variable were considered as poor Study habits group and low 27% were considered as good Study habits group.

Tools:

(a) Mixed Group Intelligence Test by Mehrotra (2008)
(b) Study Habits Inventory by Mukhopadhyaya and Sansanwal (2011 revised)
(c) Achievement test in Chemistry (developed and standardized by the investigator)

7. Results and discussion

The result is discussed in Part I and Part II given below:

Part I- Matching of the groups: The Controlled and Experimental groups were checked for their homogeneity on the basis of Intelligence and Study habits. The t-ratios were worked out and the values are given in tables 7.1(a) and 7.1(b) given below:

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>t-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controlled Group</td>
<td>151</td>
<td>32.19</td>
<td>9.07</td>
<td>0.58</td>
</tr>
<tr>
<td>Experimental Group</td>
<td>151</td>
<td>32.79</td>
<td>8.81</td>
<td>(N.S.)</td>
</tr>
</tbody>
</table>

N.S. means non-significant
Table 7.1(a) reveals that mean score of the controlled group (group taught through Traditional Method) for intelligence is 32.19 and Standard deviation for the same is 9.07 whereas mean scores of the experimental group (group taught through Concept mapping method) for intelligence is 32.79 and Standard deviation for the same is 8.81. The value of t-ratio came out to be 0.58 which is non-significant (0.56>0.05). Thus there exists no significant difference in both the groups with respect to intelligence.

Table 7.1(b): For Study Habits

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>t-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controlled Group</td>
<td>151</td>
<td>173.57</td>
<td>23.28</td>
<td>0.56</td>
</tr>
<tr>
<td>Experimental Group</td>
<td>151</td>
<td>175.05</td>
<td>22.45</td>
<td>N.S.</td>
</tr>
</tbody>
</table>

N.S. means non-significant

Table 1(b) reveals that mean score of the controlled group (group taught through Traditional method) in Study habits is 173.57 and Standard deviation for the same is 23.28 respectively whereas mean score of the experimental group (group taught through Concept mapping method) in Study habits is 175.05 and Standard deviation for the same is 22.45 respectively. The value of t-ratio came out to be 0.56 which is non-significant (0.56>0.05). Thus there exists no significant difference in the Study habits of both the groups.

Part II (a) Significance of difference in Achievement in Chemistry of the groups taught through Concept mapping and conventional teaching (Poor Study habits group): t-test was applied between students of poor Study habits of controlled and experimental group to investigate the significance of difference in Achievement in Chemistry of the groups taught through Concept mapping and conventional teaching. The values are given in 7.2(a) and 7.2(b) below:

Table 7.2(a): t- test between students of Poor Study Habits of Controlled and Experimental group

<table>
<thead>
<tr>
<th>Gain Scores</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Standard Error of Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controlled Group</td>
<td>41</td>
<td>8.93</td>
<td>6.48</td>
<td>1.01</td>
</tr>
<tr>
<td>Experimental Group</td>
<td>44</td>
<td>16.11</td>
<td>7.28</td>
<td>1.10</td>
</tr>
</tbody>
</table>

Table 7.2(a) reveals that values of mean of gain scores in Chemistry of the poor Study Habits controlled and experimental groups are 8.93 and 16.11 respectively.
Table 2(b): Independent Samples Test

<table>
<thead>
<tr>
<th>Gain Scores</th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>0.45</td>
<td>0.50</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>4.82</td>
<td>82</td>
</tr>
</tbody>
</table>

On application of F–test through SPSS Table 7.2(b) table of independent sample test is obtained, this table reveals results of two tests-Levene’s Test for equality of variances and t-test for equality of means. The table contains two sets of analysis, the first one assuming equal variances in the two groups and the second one assuming unequal variances. The Levene’s test tells which statistics to be considered to analyze the equality of the means. It tests the equality of variance; a large value of significance associated with Levene’s Test indicates that the two groups have equal variances. In the above table, F value is 0.45 which is non-significant (0.45>0.05). It indicates that the two groups have equal variances. Therefore, the statistics associated with equal variances assumed should be used for the t-test for equality of means.

The t-test results (with equal variances assumed) show t statistic of 4.80 with 83 degrees of freedom the corresponding two tailed p-value is 0.00, which is less than 0.01. Therefore the null hypothesis (H₀: There will be no significant difference in Achievement in Chemistry of the groups taught through Concept mapping and Conventional teaching of the students having poor Study habits) is rejected at 1% level of significance, which means that the students having poor Study habits of controlled and experimental groups significantly differ in their Achievement in Chemistry i.e. Students with poor Study habits of experimental group (Mean=16.11) are significantly better in Achievement in Chemistry than the students with poor Study habits of controlled group (Mean=8.93). Similarly t-test was applied between students of good Study habits of Controlled and Experimental group in order to check the cause. The values are given in tables 7.3(a) and 7.3(b) below:

Table 7.3(a): t-test between students of Good Study habits of Controlled and Experimental group

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Standard Error of Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controlled Group</td>
<td>45</td>
<td>11.64</td>
<td>6.51</td>
<td>0.97</td>
</tr>
<tr>
<td>Experimental Group</td>
<td>42</td>
<td>20.67</td>
<td>6.22</td>
<td>0.96</td>
</tr>
</tbody>
</table>
Table 7.3(a) reveals that values of mean of gain scores in Chemistry of the good Study Habits controlled and experimental groups are 8.93 and 16.11 respectively.

Table 7.3(b): Independent Samples Test

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>0.20</td>
<td>0.65</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>6.61</td>
<td>0.00</td>
</tr>
</tbody>
</table>

On application of F–test through SPSS Table 7.3(b) table of independent sample test is obtained, this table reveals results of two tests-Levene’s Test for equality of variances and t-test for equality of means. The table contains two sets of analysis, the first one assuming equal variances in the two groups and the second one assuming unequal variances. The Levene’s test tells which statistics to be considered to analyze the equality of the means. It tests the equality of variance; a large value of significance associated with Levene’s Test indicates that the two groups have equal variances. In the above table, F value is 0.20 which is non-significant (0.20>0.05). It indicates that the two groups have equal variances. Therefore, the statistics associated with equal variances assumed should be used for the t-test for equality of means.

The t-test results (with equal variances assumed) show t statistic of 6.60 with 85 degrees of freedom the corresponding two tailed p-value is 0.00, which is less than 0.01. Therefore the null hypothesis ($H_0$) of no significant difference in Achievement in Chemistry of the groups taught through Concept mapping and Conventional teaching of the students having good Study habits (is rejected at 1% level of significance, which means that the students having good Study habits of controlled and experimental groups significantly differ in their Achievement in Chemistry i.e. Students with good Study habits of experimental group (Mean=20.67) are significantly better in Achievement in Chemistry than the students with good Study Habits of controlled group (Mean=11.64).

8. Conclusion
The findings of the present study clearly reveal that Concept mapping is the strategy leading to higher achievement of students. This finding is well supported by the studies of Montiel (1980), Cohn (1987), Jegede and Okebukola (1990), Stensvold and Wilson (1992), Horton et al. (1993), Wilkes et al. (1999), Sungur et al. (2001), Chang and Chen (2002), Novak (2002), Preszler (2004), Snead and Snead (2004), Wang and Dwyer (2004), Novak and Canas (2006), Saquma and May
There is empirical support for the use of mapping in enhancing, retaining and improving knowledge (Davis, 2010). Cognitive Science shows that visual display enhances learning (Winn, 1991; Vekiri, 2002). For many people maps are much easier to follow, it promotes deep and not surface approaches to learning (Biggs, 1987; Ramsden, 1992). The work involved in mapping requires more active engagement on part of the learner which leads to greater learning (Twardy, 2004).

Educational implications of the study: Results of present study supported that Concept mapping is useful for all categories whether poor or good Study habits for teaching Chemistry concepts. This technique is thus strongly recommended for teaching Chemistry in Government Schools of Punjab.

References:


