Abstract
The Study was carried out to investigate the effect of teaching through Concept Mapping on the achievement in Chemistry among girls. Sample of the study consisted of 118 girls (59 experimental groups and 59 controlled groups) of IX class from two Government schools of Ludhiana city. Experimental group was exposed to Concept Mapping method and the controlled group was exposed to conventional method (lecture and discussion) for twenty five days. Mixed group intelligence test (MGIT) by Mehrotra (2008) was used to match the groups. Achievement test in Chemistry (developed and standardized by the investigator) were used as tool for data collection. The results of the t-test analysis of the gain scores showed that achievement in Chemistry of the girls taught by Concept Mapping was significantly more (p<0.05) as compared to girls taught by conventional method.

1. Introduction
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.

Originally the method was developed by Novak at Cornell University in the 1960s. This concept emerges in the field of learning after new school of constructivism, which accepts active participation of the learner in construction of knowledge.

Concept Mapping is the unique way of representing information. There are three features used in creating concept maps: (a) a list of concepts, (b) lines that represent the relational links between these concepts, and (c) labels for these linking relationships. Well prepared concept maps facilitate both teaching and learning process. So teachers can use these to prepare and organize lessons by sequencing topics with in lectures (Novak, 1995). Logical sequencing of topics helps to present instructional materials in a more meaningful way. It is proven that "humans are significantly better able to absorb and retain meaningful learning than rote learning” (Willerman & Mac Harg, 1991). Wang, Cheung, Lee and Kwok (2006) remarked that concept maps have been widely put to educational uses. They possess a number of appealing features which make them a promising tool for teaching, learning, evaluation, and curriculum planning. 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.”

2. Effect Of Concept Mapping As A Tool Of Teaching On Achievement


If we talk about effect of concept mapping on gender, the study investigated by Udeani and Okafor (2012) was conducted on One hundred and twenty four biology slow learners with the motive of comparing effectiveness of the expository and concept mapping instructional strategy of presenting secondary school biology concepts to slow learners. They found that not only students with normal abilities but slow learners were also benefitted with Concept Mapping, specifically, female slow learners taught with the Concept Mapping instructional strategy performed significantly better than their male counterparts taught by the same method while results obtained by Cheema and Mirza (2013) showed that male students taught through Concept Mapping performed significantly better than the female students, on the contrary findings of Bello (1997), Bilesanmi-Awoderu (2006), Simon (2007), Okoye and Okechukwu (2010), revealed that there was no gender influence on students' Concept-Mapping ability and their achievement in the subject.
3. Justification Of The Problem
Most of the studies had been undertaken only in foreign countries. U.S.A. (Novak, 1980; Lawson, 1994; and Nelson, 2007), Australia (Wilkes et al., 1999), Turkey (Asan, 2007; and Aydin et al., 2009), Singapore (Ling & Boo, 2007), Spain (DeWispelaere & Kossack, 1996), Taiwan (Tsai et al., 2001; and Chiou, 2008), Lebanon (BouJaoude & Attieh, 2003), Malaysia (Arias, 2006), and Nigeria (Okoye & Okechukwu, 2010; Fatokun & Eniayeju, 2014; Nwagbo & Okonkwo, 2014; Victoria and Paul, 2014). A little work had been done in India covering population of Chandigarh (Kumar, 2009; Sharma, 2010; Rani, 2011; and Sood, 2012), Amritsar (Aggarwal, 2012), Kapurthala (Jena, 2014) on effectiveness of Concept mapping. No study was found conducted purely on female sample.

4. Objectives Of The Study
1. To investigate the significance of difference in Achievement in Chemistry of the girls taught through Concept mapping and Conventional teaching.

5. Hypotheses
H_0: There will be no significant difference in Achievement in Chemistry of the girls taught through Concept mapping and Conventional teaching.

6. Method and Procedure

6.1 Randomized Groups Pretest- Posttest Design
To study the effectiveness of Concept mapping strategy on the Achievement in Chemistry among girls, randomized groups pretest- posttest design was used. Here in the first phase concept maps were constructed and Chemistry achievement test was constructed and standardized. Test of intelligence was used to match two groups’ experimental and controlled groups respectively. In the second phase Chemistry achievement test was applied as a pre-test. In the third phase students experimental group and controlled were exposed to Concept mapping method and Conventional teaching 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 is index with which effectiveness of two methods could be compared.

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

ii.) Classifying independent variable: Gender was taken as classificatory variable. This variable classified the sample of students in two categories on the basis of gender i.e. boys and girls.

iii.) Dependent variable - In the present study acquisition of Chemistry concepts (Achievement) was considered as dependent variable. This was evaluated by the mean gain scores (Post-test scores – Pre-test scores of Achievement test in Chemistry) of the students.

6.2 Steps Taken To Control The Extraneous Variables
a) Selection of sample - Random sampling was done in order to have true representative data.
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, teachers were the other factors wherein control was applied.

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 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.

### 6.3 Sample Of The Study

For the study, sample of 118 girls of 9th class were selected through the randomization technique from two Government schools of Ludhiana city. Here 59 girls were taken as experimental group and other 59 students were taken as controlled group.

### 6.4 Tools

(a) Mixed group intelligence test by Mehrotra (2008)

(b) Achievement test in Chemistry (developed and standardized by the investigator)

### 7. Results and Analytical Interpretation

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

#### Part I - Matching of the groups: The Experimental and Controlled groups were checked for their homogeneity on the basis of Intelligence. The t-ratios were worked out and the values are given in table 1 below:

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>t-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>59</td>
<td>35.42</td>
<td>9.504</td>
<td>1.84</td>
</tr>
<tr>
<td>Controlled</td>
<td>59</td>
<td>32.41</td>
<td>7.507</td>
<td>N.S.</td>
</tr>
</tbody>
</table>

*N.S. means non-significant (value of t-ratio significant at 0.05 level = 1.96)*

Table 1(a) reveals that mean scores of the experimental group (group taught through Concept mapping method) for intelligence is 32.59 and Standard deviation for the same is 8.481 where as mean scores of the Controlled group (group taught through Traditional Method) for intelligence is 32.29 and Standard deviation for the same is 9.646. The value of t-ratio came out to be 1.84, which is non-significant. Thus there exists no significant difference in both the groups with respect to intelligence.

#### Part II (a) Significance of difference in Achievement in Chemistry of the girls taught through Concept mapping and Conventional teaching of the students: t-test was applied
on gain scores of achievement in chemistry of girls of Experimental group and Controlled group to investigate the significance of difference in Achievement in Chemistry of the girls taught through Concept mapping and conventional teaching. The values are given in 2(a) and 2(b) below:

Table 2(a) Group Statistics

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Standard error of mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental group</td>
<td>59</td>
<td>18.54</td>
<td>6.109</td>
<td>0.795</td>
</tr>
<tr>
<td>Controlled group</td>
<td>59</td>
<td>10.36</td>
<td>5.962</td>
<td>0.776</td>
</tr>
</tbody>
</table>

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>0.036</td>
<td>0.850</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>-7.367</td>
<td>115.931</td>
</tr>
</tbody>
</table>

Table 2(a) reveals that value of mean of gain scores in Chemistry of the experimental group is 18.54 whereas mean of achievement in Chemistry of the girls of controlled group for is 10.36 respectively. On application of F–test through SPSS Table 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. Above table reveals that F value is 0.036 and P=0.850 which is non-significant (P>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 value is 7.367 with 116 degrees of freedom the corresponding two tailed P- value is 0.00, which is less than 0.01. Therefore the null hypothesis H₀₁ is rejected at 1% level of significance, which means that the girls of experimental and controlled groups significantly differ in their Achievement in Chemistry i.e. girls of experimental group (Mean = 18.54) are significantly better in Achievement in Chemistry than the girls of controlled group (Mean = 10.36). The findings of the present study support that concept mapping is the strategy leading to higher achievement of students. This finding is well supported by the studies of Montiel (1980), Jegede and Okebukola (1990), Sungur et al. (2001), Chang and Chen (2002), Novak (2002), Preszler (2004), Snead and Snead (2004), Wang and Dwyer (2004), Bilesanmi-Awoderu (2006), Novak and Canas (2006), Saquma and May (2007), Olgun and Sila (2008), Aydin et al. (2009),
Chiou (2009), Kamble (2012), Agboola and Oloyede (2013), Jack (2013), Julius and Wachanga (2013), Nwagbo and Onkonwuo (2014), Fatokun and Eniayeju (2014) and Chawla and Singh (2015). This technique has positive impact on the achievement in case of Chemistry in fact it was found to be beneficial in other subjects also as in case of Mathematics (Novak, 2002; Novak & Canas, 2006; Awofala, 2011), History (Miandoab, Mostafoei & Ghaderi, 2012) and English course (Tiimen & Taspinar, 2005). Hence we can say Concept Mapping helps in easy understanding of concepts to the students, irrespective of their grades and also affects their improved performance in various aspects. So, Concept Mapping also helped to bring all desired effects in the field of education whether it’s better academic performance, learning and retention ability.

8. Implications

Results of present study also supported that Concept mapping is useful for girls for teaching Chemistry concepts. Concept mapping technique is thus strongly recommended for teaching Chemistry.

9. References


