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Concept Map in Photosynthesis and its Effects on Achievement and Self-Classroom Management

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Abstract

The study assessed the effect of concept map on achievement and classroom management of 7th grade students. Three elementary schools were purposively selected in Silchar town of Assam, India. The 7th grade students (n = 36), of 'School I' was assigned to lecture cum discussion approach, 34, students (n = 34) of 'School II' was assigned to Spider Concept Map Approach (SCMA) and the 30 participants (n=30) of 'School III' was assigned to Hierarchical Concept Map Approach (HCMA). Pretest-posttest quasi-experimental design used to assess the effect of concept map on the achievement and classroom management of students. Pre-map test was assigned to both the experimental and comparison group and after three weeks instruction post map test was administered. In addition to these, Concept Map Classroom Management Scale was assigned among all the participants of both experimental and comparison groups to response. The individual pre and post spider concept map and hierarchical concept map, and Concept Map Classroom Management Scale (CMCMS) scores were analyzed through ANCOVA and post hoc Tukey-Kramer Multiple Comparisons. It was resulted that both spider concept map & hierarchical concept map training students in association with those in the comparison group demonstrated significantly better in the performance of photosynthesis and respiration concepts as well as self-classroom management.

Keywords: classroom management; collaborative concept map; hierarchical concept map; individual concept map; photosynthesis; respiration; spider concept map

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Introduction

Now teachers are using technology in teaching to link, interlink the existing concepts with previous concepts (Author, 2011a, 2012). It does not mean teachers are ignoring the content without applying the facts, principles, theories, and examples during the instruction (Adult, 1985; Novak, 1990). However, teachers don't ignore the students' past experience rather they encourage the students to utilize the previous experience during discussing, questioning, and thinking to understand or express the concepts of science. Concepts are the mental notion of things or events process in the mind by the perceptual classification and discrimination of idea. Crandell & Soderston (1996) found that concept map is a pictorial representation of nodes connected to each other by arcs or links. Trowbridge and Wandersee (1994) concluded that concepts maps are the two-dimensional map arranged in a hierarchy where the super concepts lie at the top and subordinate concepts, micro concepts, and examples represent below. The related concepts are linked by lines labeled with linking words that form the propositions uniting the concepts; however, the cross-links make the bridge, and branches the map into a meaningful network of concepts. Therefore, teachers allow the students to ask questions among the peers to relate what they are learning in school and things happening outside. Those could encourage children to answer the questions in their own words, using previous experiences rather than simply memorizing. Concept map is a diagrammatical methodology to represent the concepts related to previous knowledge of engineering education (Upadhyay, Gaur, Agrawal & Arora, 2007). Now question rose, whether concept map is an effective tool of life science teaching, or an effective approach of classroom management. In support to the questions, literature found that the integration of strategic management in education could only depends on the teaching strategy while the quality of maps, and the strategic plans help in the classroom management (Kettunen, 2005, 2011). Nevertheless, classroom-management is the part of the instructional strategy and a way to the institutional management like social constructivist classrooms (Brophy, 2006). Not only is that but also a number of factors like; teaching methods, modes of learning, classroom management, attitude of teachers, and learner's cognitive styles also linked with science learning and achievement (Buchan, 2010). Contrast to this, it was found that, the use of maps was associated with problems in the classroom management systems (Stewart, 2007; Venkatesh, Shaw, Dicks, Lowerison, Zhang & Sanjakdar, 2007). However, literature found that concept map offers the opportunity to integrate cooperative and individual modes of learning in the science classroom for developing the knowledge and attitude towards the self classroom management **(**Horton, McConney, Gallo,Woods, Senn, & Hamelin,1993; Stoddart, Abrams, Gasper, & Canaday, 2006; Ruiz-Primo & Shavelson, 1997).

Concept Map is an Effective Approach of Science Teaching

Concept mapping as a constructivist approach promotes meaningful learning, where learning is an active process and learners could acquire knowledge, by using their own previous knowledge and beliefs (Karagiorgi & Symeou, 2005; Katiliute, Stanikuniene & Karenauskaite, 2008; Kwon & Ciflulentes, 2008; Lawrence, 2000; Royer, 2004). Students of nursing, engineering, marine, management, and administration used concept map in learning and found that concept map enhances meaningful learning (Chiu, 2003). Not only was that but also concept map is an effective instructional technique improves the individual learning and organizational knowledge (Okebukola & Jegede, 1988; Song, Chermack,Kim, 2008).In addition, literature found that cooperative concept map exercise could help to perform better in getting the meaningful learning as compared to the individual performance (Keraro, Wachanga, and Orora, 2004), and it could clarify student's misconception and doubt significantly better than individual map practice (Okebukola,1990; Raghaban,1991; Rao, 2004).

Concept Map and Self-Classroom Management

The student teacher's classroom management depends on students' engagement in the learning and teacher's organization of classroom environment (Davis, Summers & Miller, 2011). In fact, students' efficacy has a significant positive relationship with the classroom management styles but teachers' efficacy found insignificant relationship with the classroom management styles (Abu-Tineh, Khasawneh, Khalaileh, 2011). Like that, teaching and classroom management skill needs knowledge base and positive attitude of both students and teachers (Denti, 2012). Moreover, the cooperative and academically engaged students are more socially successful in the classroom (Knoff, 2012) and in addition, a quality concept map instruction could help them more in the classroom management especially in higher education (Fischer & Mandl 2000; Dorough and Rye, 1997). The personal map activities help students to develop interpersonal communication, emotional intelligence and it challenges students to explore visible and invisible aspects of learning, and it helps to create an open and affirming classroom environment (Litvin & Betters-Reed, 2005).

Significance of the Study

Literature found that concept map is a useful tool of science teaching and learning facilitates cooperative learning and self-discipline among students (Novak 1993). It has been used to organize knowledge in different disciplines like Earth science, chemical science, life science and other allied disciplines. However, concept map is a self-classroom management process directly influences the achievement of middle level students' learning of science content (Paucar-Caceres, 2008). Finding of different studies indicated that concept map motivates learners to manage classroom through a collaborative model of learning while teachers the facilitators (Novak, Gowin & Johansen, 1983; Adult, Novak, & Gowin, 1988; Kinchin, De-Leij & Hay, 2005). Teachers only conceptualize the students on how to reduce the stress and on how to engage themselves in the construction of knowledge in the classroom (Flinchbaugh, Moore, Chang, May, 2012). However, specific management techniques through instruction can cope the classroom in a right direction (Lewis, Roache, Romi, 2011). Based on the literature, concept map learning is an interdisciplinary approach assists quality in instruction among students, and encourages self-classroom management (Novak & Gowin, 1984). Especially, in science learning, concept map has a positive direction towards learners' achievement (Kinchin & Hay, 2000) but more studies to be carried out on the use of concept map in teaching, and learning at local elementary and secondary schools, especially on science education. Evidences showed, cooperative mode of concept map learning has significant effect over individual modes of learning (Khamesan & Hammond, 2004). However, concept map directly influence achievement and self-classroom management (Kilic, 2003, Roth & Roychoudhury, 1993). That is why, it's an effort to investigate the reality of spider concept map and hierarchical concept map instruction and its contribution to the science education.

Research Questions

The following research questions are developed in connection with the research problem and the research gaps.

1. Does the spider concept map and hierarchical concept map training students' performance is better over the comparison group, if so, then how it can be helped the students to manage the classroom environment more effective?

Objectives

In the basis of the theoretical background, the current study has following objectives:

1. To study the performance of students before and after expose to spider concept map and hierarchical concept map training in photosynthesis and respiration over the comparison group.

2. To study the awareness, cooperation and self-classroom management of students during spider concept map and hierarchical concept map training in photosynthesis and respiration over the comparison group.

Hypotheses

In the light of literatures and theoretical background, the current study hypothesizes that:

1. Spider concept map & hierarchical concept map training students in association with those in the comparison group will demonstrate better in the performance of photosynthesis and respiration.

2. Spider concept map & hierarchical concept map training students in association with those in the comparison group will make group, gather information and cooperate in learning.

3. Spider Concept Map & Hierarchical Concept Map training students in association with those in the comparison group will answer the skeletal questions, share information and construct concept map

Methodology

Participants

Three schools were purposively selected in Silchar town of Assam, India. 7th grade students of these schools were the participants assigned for experimental and comparison group where the participants were not randomly selected rather the whole class was undertaken for experimental purpose. The whole 7th grade students (*n = 36, age range 13.2 years – 13.9 years, mean age 13.5 and Standard Deviation 0.21*) of School I was assigned to traditional approach counted as comparison group. In addition, a total of 34 7th grade students (*n = 34 age range 13.2 years – 13.5 years, mean age 13.3 and Standard Deviation 0.32*) of School II was assigned for Spider Concept Map Approach (SCMA) of instruction named as experimental group I and the 30 7th grade students (*n=30 age range 13.0 years – 13.3 years, mean age 13.1 and Standard Deviation 0.32*) of School III was assigned for Hierarchical Concept Map Approach (HCMA) counted as experimental group II. The pretest-posttest map of the participants' belongs to the experimental and comparison group was analyzed through ANCOVA and Tukey-Kramer Multiple Comparisons to draw the inferences.

Design of the Study

Pretest-posttest quasi-experimental design used to study the effect of concept map on the learning performance in photosynthesis, respiration, and classroom management of students. In this study, two experimental groups and a comparative group used. Two experimental groups' participants were trained with hierarchical concept map and spider concept map instruction in photosynthesis and respiration while the comparison group was treated with conventional lecture cum discussion approach. The non-equivalent group design was especially susceptible to the internal validity threat of selection. The result of the study was generalized on the whole population but during instruction, extraneous variables were minimized through randomization, selective manipulation, and statistical techniques like ANCOVA and Turkey-Kramer Multiple Comparisons. In addition, concept map classroom management scale was administered to both the experimental and comparison group to assess the effect of concept map instruction on the self-classroom management.

Instrumentation

a) Concept map Test

Spider Concept Map Approach and Hierarchical Concept Map instructional strategies used to learn photosynthesis and respiration. Before instruction, the standard concept map in photosynthesis and respiration was developed to evaluate the participants' concept maps in open-ended task or response format (Liu, 2004; Liu, & Hichey,2008) while 1-point weigh assigned to the meaningful proposition, 3 points to each hierarchy, 2 points for each crosslink &1 point for each example (e.g Author et al 2012). The test retest reliability and chronbach alpha was .86 and .81 respectively. The content validity ratio was established and found .80.

b) Classroom Management Scale (CMS)

Classroom Management Scale (CMS) has four subscales having both positive and negative items and each item has three point options (e.g. strongly agree, agree and disagree). Subscale -I *Students make group and cooperate in learning* has 5 positive items (e.g.1, 23, 8, 14 & 28) and five negative items (e.g. 9, 6, 31, 39 & 34), Subscale -II *Students gather information in classroom* has 5 positive items (e.g.2,5,7,11&15) and five negative items (e.g.24,32,36,40& 3), Subscale -III *Students answered and construct concept map in classroom* has 5 positive items (e.g. 4,10,12,25 & 27) and five negative items (e.g.18, 30, 22, 33 & 35)and Subscale -IV *Students share information classroom* has 5 positive items (e.g. 13,16,19,21& 26) and five negative items (e.g.17, 20, 38, 29 & 37). As a whole, the Classroom Management Scale (CMS) has 40 items having both positive and negative items. The overall Chronbach α reliability was .86 and the convergent validity was .81. The positive responses were scored by 2, 1 and 0, that was maximum 10 and minimum 0, and in negative responses were scored by 0, 1 and 2, and the maximum score was 10 and minimum was 0 (zero, e.g. Author, 2011b). The details of the classroom management scale (CMS) were given in box 2.

Box 2 subscales of classroom management scale

Subscale -I Students make group and cooperate in learning

Positive and negative items	Item No.					Total
Positive items	1	23	8	14	28	5
Negative items	9	6	31	39	34	5
Total	2	2	2	2	2	10

Subscale -II Students gather information in classroom

Positive and negative items	Item No.					Total
Positive items	2	5	7	11	15	5
Negative items	24	32	36	40	3	5
Total	2	2	2	2	2	10

Subscale -III Students answered and construct concept map in classroom

Positive and negative items	Item No.					Total
Positive items	4	10	12	25	27	5
Negative items	18	30	22	33	35	5
Total	2	2	2	2	2	10

Subscale -IV Students share information classroom

Positive and negative items	Item No.					Total
Positive items	13	16	19	21	26	5
Negative items	17	20	38	29	37	5
Total	2	2	2	2	2	10

Procedure of experiment and data collection

Before instruction, a concept map training class was organized to familiarize the students with the concept map learning. Followed by that, both the experimental classes were divided into four groups and the skeletal questions were asked in photosynthesis and later respiration. Students were advised to see the textbook to collect the meaningful concepts, sub concepts, words, nodes, and internodes on photosynthesis and respiration. At the same time, students were advised to select the super concept first, which was the answer to the skeletal question. The researchers facilitated the learners to arrange the concepts starting from super concept at the top or in the middle and advised to link, connect, and interlink all the concepts with arrows and linking words to make hierarchical or spiderical proposition. This process was continued upto three weeks to prepare the spider and hierarchical concept maps on related concepts such as factors affecting photosynthesis and respiration, biochemistry of photosynthesis and respiration, ATP generation, carbohydrate production, electron transport system, dark reaction, and photolysis I &II. During the classroom instruction, students prepared their own map by taking the skeletal questions and after construction of the maps, they shared among peers to change, edit and link or interlink the concepts, and examples of the concept maps. Before instruction, the participants of both the experimental groups were constructed their concept maps on *photosynthesis* and *respiration* those were counted as the pre concept map (see fig 1 & 2). After three weeks instruction, again, participants were assigned to construct the photosynthesis and respiration maps those were counted as the post map test. No, such treatment was given to the comparison group, but participants were advised to answer the skeletal questions on their own effort. Concept Map Classroom Management Scale (CMCMS) was administered among the participants. The details of three weeks instruction with steps for the traditional, SCMA and HCMA group were given in the box 3.

Box 3 details of three weeks instruction to the traditional, SCMA and HCMA groups

Groups	Approaches	Week 1 Photosynthesis	Week 2-3 Respiration
Comparison group	Traditional Lecture cum discussion	Concept of photosynthesis, factors, equation, Chloroplast and it's ultra structure, light reaction, split of water molecule and liberation of O_2, carbohydrate and ATP	Concept, factors, equation, respiratory substrates,glycolysis, Krebs cycle, anaerobic respiration, electron transport system
Experimental group I	Spider concept map	Steps : Step-1 Grouping the students Step-2 Asking students the skeletal questions Step-3 Reading assignment to the students *"Concept, factors, equation, Chloroplast ultra structure, light reaction, split of water to liberate O_2,, and ATP generation"* Step-4 Selecting and listing the concepts Steps-5 Selecting the super concept as required by the skeletal questions Step-6 Arranging all concepts radially by concentric to super concept. Step-7 Advising students for connecting, linking concepts by arrows and linking words Step-8 Exchange the map among groups Step-9 Final map become ready to generalize	Steps: Step-1 Grouping the students Step-2 Asking students the skeletal questions Step-3 Reading assignment to the students *"Concept, factors, equation, respiratory substrates, glycolysis, Krebs cycle, anaerobic respiration,electron transport system, anaerobic respiration,electron transport system"* Step-4 Selecting and listing the concepts Steps-5 Selecting the super concept as required by the skeletal questions Step-6 Arranging all concepts radially by concentric to super concept. Step-7 Advising students for connecting, linking concepts by arrows and linking words Step-8 Exchange the map among groups Step-9 Final map become ready to generalize
Experimental group II	Hierarchical concept map	Steps: Step-1 Grouping the students Step-2 Asking students the skeletal questions Step-3 Reading assignment to the students *"Concept, factors, equation, Chloroplast ultra structure ,light reaction, split of water to liberate O_2, and ATP generation"* Step-4 Selecting and listing the concepts Steps-5 Selecting the super concept as required by the skeletal questions Step-6 Arranging all concepts hierarchically to super concept. Step-7 Advising students for connecting, linking concepts by arrows and linking words Step-8 Exchange the map among groups Step-9 Final map become ready to generalize	Steps: Step-1 Grouping the students Step-2 Asking students the skeletal questions Step-3 Reading assignment to the students *"Concept, factors, equation, respiratory substrates, glycolsis, Krebs cycle, anaerobic respiration, electron transport system, anaerobic respiration, electron transport system"* Step-4 Selecting and listing the concepts Steps-5 Selecting the super concept as required by the skeletal questions Step-6 Arranging all concepts hierarchically to super concept. Step-7 Advising students for connecting, linking concepts by arrows and linking words Step-8 Exchange the map among groups Step-9 Final map become ready to generalize

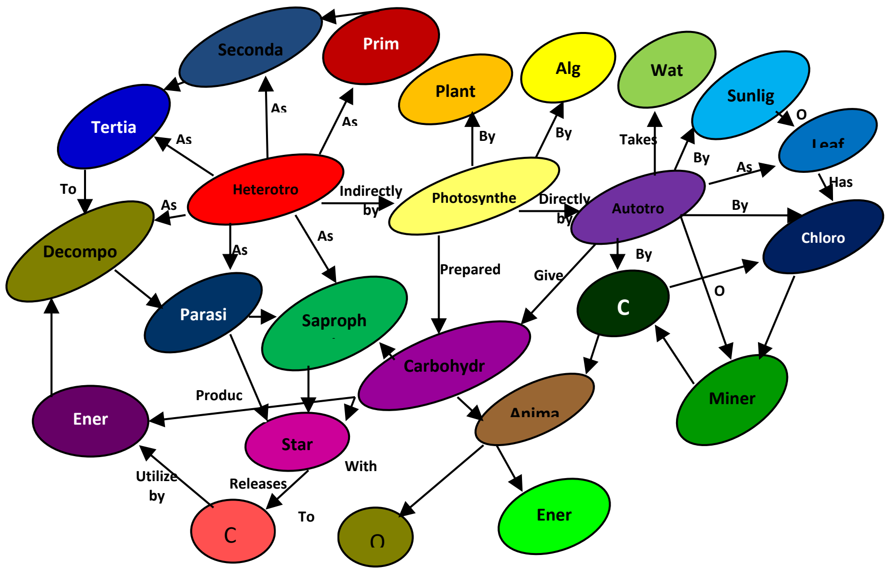

Fig 1. spider concept map on photosynthesis

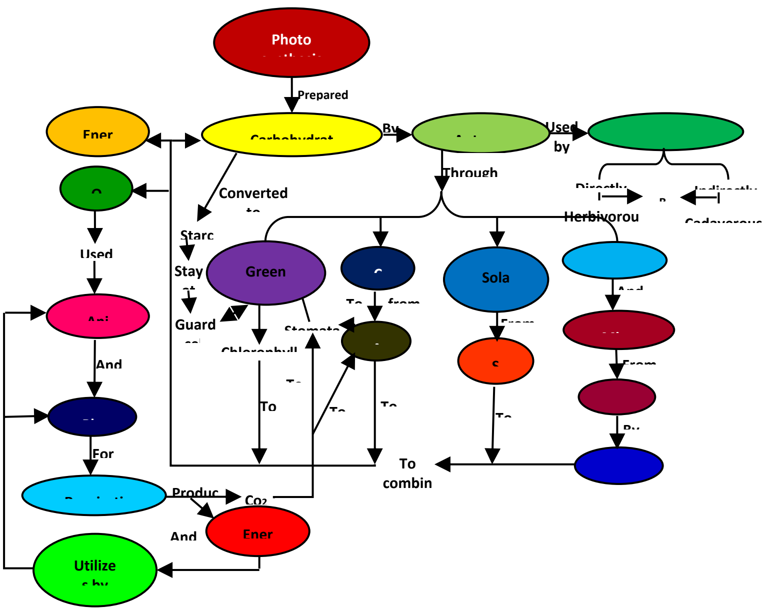

Fig 2. Hierarchical concept map on photosynthesis

Analysis and Results

For hypothesis 1, the pre map and post map test scores were analyzed in ANCOVA is an extended form of ANOVA predicts the outcomes of any continuous variables after the experimental manipulation but the influence of extraneous variables like history, testing, maturation, regression, instrumentation, mortality were minimized by using covariates. Here, pretest of the spider concept map approach & hierarchical concept map approach and traditional group was the covariate. To reduce the within group error variance and eliminating the confounds, ANCOVA used with two important additional considerations: i) Independence of the covariates and treatment effects and it used to look at the overall relationship between the outcomes and covariates. For hypothesis 2 and 3, ANOVA used to know the mean difference among the participants of spider concept map group & hierarchical concept map group and the participants of traditional group with regards to the classroom management of students.

Testing of Hypothesis 1: Spider concept map & hierarchical concept map training students in association with those in the comparison group will demonstrate better in the performance of photosynthesis and respiration

Table-1. Mean, & SD of TMT, SCMA & HCMA group pre and post map test scores

Methods	Tests	N	M	SD
TMT	Pre test	36	40.47	9.78
	Post test	36	45.11	9.51
SCMA	Pre test	34	41.55	7.15
	Post test	34	68.20	7.90
HCMA	Pre test	30	42.83	6.35
	Post test	30	69.35	5.55

Table-2. ANOVA of TMT, SCMA & HCMA group pre and post map test scores

Test	Source	df	SS	MS	F	p-value
Pre-test result	Between group	2	91.22	45.61	0.71	p>0.05
	Within group(error)	97	6213.52	64.05		
	Total	99	6304.75			
Post-test result	Between group	2	12805.5	6402.7	101.36	p<0.05
	Within group(error)	97	6127.91	63.17		
	Total	99	18933.4			

Table-3. ANCOVA of TMT, SCMA & HCMA group with respect to pre and post map test scores

Sources of variation	df	SSx	SSy	SSyx	MSyx	Fyx	P value
Adjusted mean	2	91.2288	12805.5	11704.93	5852.47	129.46	p<0.05
Adjusted error	96	6213.52	6127.91	4339.84	45.21		
Adjusted total	98	6304.75	18933.4	16044.78			

Table-1 reveals the pre map test mean score of the participants' of TMT (40.47) and SD (9.78) was lower than the post-map test mean (45.11) and SD (9.51).Their pre test and post test score correlation (r=0.81) shown higher and positive. In SCMA pre test mean (41.55) and SD (7.15), were lower than its posttest mean (68.02) and SD (7.90). The F value of control group pre test and experimental group pre test was (df 2/97, 0.71, p>0.05) was not significant. Therefore, it resulted that at the initial stage of treatment no significant variation found between the mean score of all the three groups. The posttest analysis between the comparison group and experimental group resulted that there was significant difference between the posttest results of TMT, SCMA & HCMA group. The F value (df 2/97,101.35, p<0.05) was significant (*see* table 2) and resulted that at the post test level there existed significant variation between the comparison group and experimental groups due to effect of treatment. ANCOVA allowed adjusting or correlating the final posttest scores with the pre test scores. After the adjustment of post test scores with the pre test scores, the F value (Fy.x) found 129.46.This Fy.x value (df 2/96,129.46, p<0.05) was significant (*see* table 3). Hence, the alternative hypothesis was accepted and it was resulted that, SCMA and HCMA has significant effect over TMT of teaching science concepts among 7th grade students.

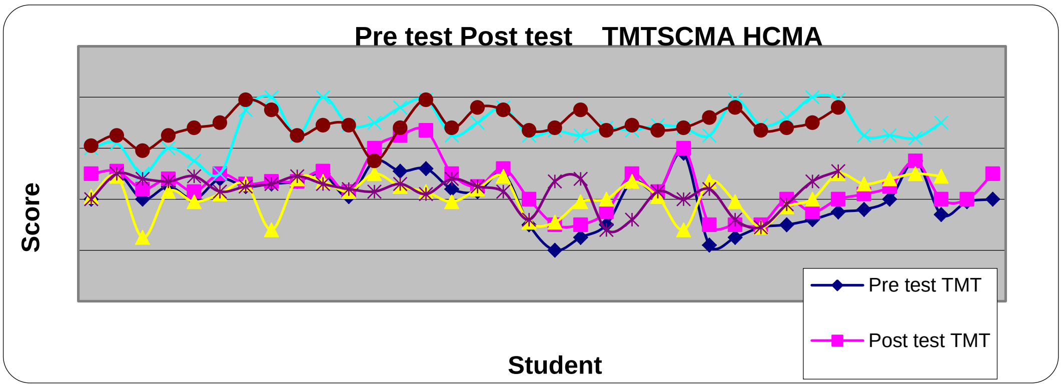

Figure-1. showing pre test & post test science achievement score of TMT, SCMA & HCMA groups

Figure 1 illustrates the pre test & posttest score of TMT, SCMA & HCMA in plotted line graph. Two distributions in the plotted line graph on the same ordinate indicates the posttest scores of SCMA & HCMA, which were better than those of TMT. The vertical line (the Y axis) OY, and the horizontal line (the X axis) OX represents the scores and students numbers respectively. Y axis represents the scores with mean measured from the origin, these are TMT (40.472, 45.111), SCMA (41.55, 48.20) and HCMA (42.83, 69.35) with regards to their pre-test and post test scores.

Testing of Hypothesis 2: Spider concept map & hierarchical concept map training students in association with those in the comparison group will make group, gather information and cooperate in learning.

Table-4. ANOVA of pretest & posttest score of TMT, SCMA & HCMA subscale I

Source of variation	df	SoS	MS	F	p
Treatments (between columns)	5	1032.9	206.58	84.00	<.05
Residuals (within columns)	194	477.06	2.459		
Total	199	1510.0			

Table-5. ANOVA of TMT, SCMA & HCMA in subscale II

Sources of variation	df	SoS	MS	F	p
Treatments (between columns)	5	1034.2	206.85	97.97	p<.05
Residuals (within columns)	194	409.56	2.111		
Total	199	1443.8			

Table-4 & 5 depicted the One-way Analysis of Variance (ANOVA) of pre test and posttest score of subscale I among the students TMT, SCMA & HCMA. The F-value (5/194, 84.00 $p<0.05$) and the F-value (5/194, 97.97 $p<0.05$) was significant. Hence, it resulted that spider concept map & hierarchical concept map training students in association with those in the comparison group demonstrated better in classroom management where they made group, gather information and cooperate in learning.

Table-6. Tukey-Kramer Multiple Comparisons for pretest and posttest of TMT, SCMA & HCMA

	Students make group and cooperate in learning			*Students gather information in classroom*		
Comparison of groups	Mean difference	q	p value	Mean difference	q	P value
Pre test TMT vs. Pre test SCMA	-0.69	2.63	P>0.05	0.92	3.78	P>0.05
Pre test TMT vs. Pre test HCMA	0.094	0.34	P>0.05	0.30	1.20	P>0.05
Pre test SCMA vs. Pre test HCMA	0.79	2.85	P>0.05	1.23	4.80	*P<0.05
post test TMT vs.post test SCMA	-5.30	20.00	*P<0.05	4.65	18.95	*P<0.05
post test TMT vs.post test HCMA	-4.87	17.77	*P<0.05	4.76	18.76	*P<0.05
post test SCMA vs. post test HCMA	0.43	1.56	P>0.05	0.10	0.42	P>0.05
Pre test TMT vs. post test TMT	0.16	0.63	P>0.05	-0.36	1.49	P>0.05
Pre test SCMA vs. post test SCMA	-4.44	16.51	*P<0.05	4.08	16.40	*P<0.05
Pre test HCMA vs. post test HCMA	-4.80	16.76	*P<0.05	5.43	20.48	*P<0.05
Pre test TMT vs.post test SCMA	-5.13	19.92	*P<0.05	5.01	20.42	*P<0.05
Pre test TMT vs. post test HCMA	-4.70	17.16	*P<0.05	5.12	20.18	*P<0.05
Pre test SCMA vs. post test HCMA	-4.00	14.42	*P<0.05	4.19	16.31	*P<0.05
post test TMT vs. Pre test SCMA	-0.86	3.26	P>0.05	-0.56	2.31	P>0.05
post test TMT vs. Pre test HCMA	-0.07	0.26	P>0.05	0.66	2.62	P>0.05
post test SCMA vs. Pre test HCMA	5.23	18.84	*P<0.05	5.32	20.68	*P<0.05

Table-6 interprets Turkey-Kramer multiple comparisons of the posttest level of analysis between TMT & SCMA, TMT & HCMA and SCMA & HCMA having mean difference-5.306,-4.872 &0.433 and their q- value (20.00 and 17.77 p<0.05) between TMT & SCMA, TMT & HCMA were significant. The comparisons between TMT& SCMA and TMT& HCMA, both SCMA and HCMA group's posttest scores were better than TMT posttest score. The pre test post test level of analysis of TMT have mean differences 0.166 and q-value (0.367) was not significant, but in pre test post test of SCMA & pre test post test of HCMA have mean differences were (-4.44 &-4.80) and their q-value(16.514&16.76 p<0.05) were significant due to treatment effect. Pre test of TMT vs. post test of SCMA, Pre test of TMT vs. post test of HCMA and Pre test of SCMA vs. post test of HCMA have mean differences are (-5.13, -4.70 & -4.008) and their respective q- value (19.92, 17.16 &14.42 p<0.05) were significant. In all the cases, the posttest of SCMA and HCMA were better than TMT posttest score in Students make group and cooperate in learning Subscale. It was resulted that concept map approach was more effective on cooperative learning and self-classroom management over traditional method of teaching (table- 6 left).

Table-6(right) depicts the Tukey-Kramer Multiple Comparisons on pretest and posttest of students gather information in classroom subscale score of TMT, SCMA & HCMA group of students. The pretest level of analysis, between SCMA& HCMA pretest score comparison, their found the mean difference (1.235) and the respective q-value (4.80 p<0.05) was significant. The posttest level of analysis between TMT & SCMA and TMT & HCMA has mean difference (4.67 & 4.76) and their q- values (18.95 & 18.76 p<0.05) were significant. The comparison between TMT& SCMA and TMT& HCMA, both SCMA and HCMA group's posttest scores are better than TMT posttest score of subscale II with regard to their posttest scores was due to the effects of concept map approach. However, in case of SCMA & HCMA, their pre test & posttest mean differences were (4.08 & 5.43) and their q-value (16.40 & 20.42 p<0.05) was significant at 0.001 levels due to treatment effect. Pretest of TMT vs. posttest of SCMA, Pretest of

TMT vs. posttest of HCMA and Pre test of SCMA vs. post test of HCMA have mean differences were (5.018, 5.128 & 4.198) and their respective q- value (20.42, 20.18 &16.31 $p<0.05$) were significant.

Testing of Hypothesis 3: Spider Concept Map & Hierarchical Concept Map training students in association with those in the comparison group will answer the skeletal questions, share information and construct concept map

Table-7. ANOVA of TMT, SCMA & HCMA in sub-scale III

Source of variation	df	SoS	MS	F	p
Treatments (between columns)	5	1011.9	202.38	64.78	<.05
Residuals (within columns)	194	606.04	3.124		
Total	199	1617.9			

Table-8. ANOVA of TMT, SCMA & HCMA in sub-scale IV

Source of variation	df	SoS	MS	F	p
Treatments (between columns)	5	937.37	187.47	52.87	<.05
Residuals (within columns)	194	687.83	3.546		
Total	199	1625.2			

Table-7 depicts the One-way ANOVA of pre test and posttest score of students belong to TMT, SCMA & HCMA subscale II & IV . The F-value (5/194, 64.78 $p<0.05$) and the F-value (5/194, 52.87 $p<0.05$) was significant. Therefore, the spider Concept Map & Hierarchical Concept Map training students in association with those in the comparison group answered the skeletal questions, shared information and constructed concept map in the classroom without any teachers (Table-8).

Table-9. represents Tukey-Kramer Multiple Comparisons on pre test and posttest of subscale III & IV

Comparison of group	Students answered skeletal questions and construct concept map in classroom			*Students share information in classroom*		
	Mean Difference	q	P value	Mean Difference	q	P value
Pre test TMT vs. Pre test SCMA	0.08	0.30	P>0.05	0.63	1.98	P>0.05
Pre test TMT vs. Pre test HCMA	0.30	0.98	P>0.05	-0.11	0.35	P>0.05
Pre test SCMA vs. Pre test HCMA	0.21	0.68	P>0.05	-0.74	2.24	P>0.05
post test TMT vs. post test SCMA	-4.65	15.58	P<0.05	-4.44	13.94	P<0.05
post test TMT vs. post test HCMA	-4.43	14.36	P<0.05	-4.10	12.45	P<0.05
post test SCMA vs. post test HCMA	0.21	0.70	P>0.05	0.34	1.023	P>0.05
Pre test TMT vs. post test TMT	-0.22	0.75	P>0.05	-0.25	0.79	P>0.05
Pre test SCMA vs. post test SCMA	-4.97	16.39	P<0.05	-5.32	16.48	P<0.05
Pre test HCMA vs. post test HCMA	-4.96	15.39	P<0.05	-4.23	12.31	P<0.05

Pre test TMT vs. post test SCMA	-4.88	16.33	P<0.05	-4.69	14.73	P<0.05
Pre test TMT vs. post test HCMA	-4.66	15.08	P<0.05	-4.35	13.21	P<0.05
Pre test SCMA vs. post test HCMA	-4.75	15.17	P<0.05	-4.98	14.93	P<0.05
post test TMT vs. Pre test SCMA	0.31	1.044	P>0.05	0.88	2.77	P>0.05
post test TMT vs. Pre test HCMA	0.52	1.70	P>0.05	0.13	0.40	P>0.05
post test SCMA vs. Pre test HCMA	5.18	16.56	P<0.05	4.57	13.71	P<0.05

In Table-9 (left) Tukey-Kramer Multiple Comparisons on pre test and posttest score of subscale III & IV among TMT, SCMA & HCMA group. The pretest level of analysis between TMT vs. SCMA and TMT vs. HCMA and SCMA vs. HCMA have found the mean differences (0.089, 0.305 & 0.215) and their respective q- values (0.30, 0.98 & 0.68 p<0.05) were not significant. The posttest levels of analysis between TMT vs. SCMA and TMT vs. HCMA have mean difference (-4.65&-4.43) and the q- values (15.58&14.36 p<0.05) were significant. The comparisons between TMT & SCMA and TMT & HCMA, both SCMA and HCMA group's posttest scores were better over the posttest of TMT with response to subscale III. The pre test- post test level of analysis of TMT have mean differences (-0.222) and q-value (0.754) was not significant, but in case of SCMA & HCMA their pre test- post test mean differences were (-4.97 &-4.96) and their q-value(16.39 & 15.39 p<0.05) were significant due to treatment effect. Pre test of TMT vs. post test of SCMA, Pre test of TMT vs. post test of HCMA and Pre test of SCMA vs. post test of HCMA have mean differences were (-4.88,-4.66&-4.75) and their respective q- value (16.33,15.08&15.17 p<0.05) were significant. In all the cases, the posttest of SCMA and HCMA were better than TMT posttest score in subscale III.

Table-9 (right) illustrates Tukey-Kramer Multiple Comparisons of the pre test and posttest score of TMT, SCMA, & HCMA group in subscale IV. The pretest level of analysis between TMT vs. SCMA and TMT vs. HCMA and SCMA vs. HCMA have found mean differences (0.632,-0.11 &-0.74) and their respective q- values (1.98, 0.35 & 2.24 p<0.05) were not significant. That is why, there was no significance difference found between groups of students on response to subscale IV based on pre test scores. The posttest levels of analysis between TMT vs. SCMA and TMT vs. HCMA have mean differences (-4.44,-4.10 & 0.34) and their q- values (13.94 & 12.45 p<0.05) were significant. In case of SCMA & HCMA comparison with regard to their posttest scores, there found the mean difference (0.34) and their q value (1.02 p>0.05) was not significant. In first two comparisons between TMT& SCMA and TMT& HCMA, both SCMA and HCMA group's posttest scores are better than TMT posttest score due to concept map effect. Hence, there was no significant difference found between SCMA& HCMA groups of students on response to Concept map Classroom Management without the Teacher Subscale (CCMTS) with regard to their posttest scores. The pre test- post test level of analysis of TMT have mean differences (-0.25) and q-value (0.79) is not significant, but in case of SCMA & HCMA their pre test- post test mean differences are (-5.32&-4.23) and their q-value(16.48 & 12.31 p<0.05)were significant due to treatment effect. Pre test of TMT vs. post test of SCMA, Pre test of TMT vs. post test of HCMA and Pre test of SCMA vs. post test of HCMA have mean differences were (-4.69,-4.35&-4.98) and their respective q- value (14.73,13.21 & 14.93 p<0.05) were significant. In all the cases, the posttest of SCMA and HCMA were found better in subscale IV over the post test score of TMT. Post test of TMT vs. Pre test of SCMA, and post test of TMT vs. Pre test of HCMA have mean differences (0.88 & 0.13) and their respective q-value (2.77 & 0.40 $p<0.05$) of first two were not significant and post test of SCMA vs. Pre test of HCMA mean difference (4.57) and q-value (13.71 $p<0.05$) was significant.

Findings and Discussion

The author has discussed the findings of the study adequately considering with the research question(s), and hypotheses those are related to the current and relevant literature. In fact, in Indian context, the researcher claimed that spider concept map & hierarchical concept map training students in association with those in the comparison group demonstrated better in the performance of photosynthesis and respiration and this finding was corroborated to the findings of Kwon & Ciflulentes, 2008. Because concept maps are based upon the previous knowledge of the learners that could help them to find out the answer of the skeletal questions to construct the concept map (Author, 2012). In Indian classroom, students, shared knowledge and understanding among the group members, conceptualized a new proposition, and build hierarchies, facilitated group communication among members, changed individual understanding and misconception, draw together the concept they have learn in a researchful and integral manner, examined changes in cognitive structure and strengthened internal assessment and evaluation. They enjoyed concept map is a colorful activity has the freedom of sharing the information, and it was an opportunity in editing, deleting, and modifying the concept map by the peers that the participants did in this study. Not only was that but also in this study, it was found that the participants of spider concept map group and hierarchical concept map group managed their own classroom by following steps such as grouping the students, asking the skeletal questions, reading assignment, selecting and listing the concepts, selecting the super concept as required by the skeletal questions, arranging all concepts hierarchically or spiderlly to super concept for connecting, linking concepts by arrows and linking words to exchange the map among groups. At last, the final map became ready to generalize among the whole participants of the class. It was found that concept map was a collaborative work and it helps the learners to prepare the map without the assistance of the teacher, so it is a student active classroom instruction. This finding was strengthen by the result of the study conducted by Kettunen, 2005. In addition, it was found that concept map approach was more effective because of peer cooperation and self classroom management policy but these cannot be possible through traditional method of teaching (table-2c right).This result was strongly supported by the result of Denti, 2012. Concept map approach created awareness of self-management over traditional methods of teaching that we have strongly realized in this study that concept map created awareness of self-management (e.g. Abu-Tineh et al 2011). Concept map approach was a student active constructivist process where the learners could accumulate information and construct the map. It is a self-classroom management process where teachers were the passive. This finding was supported by Paucar-Caceres, 2008.

Conclusion

Learning should be shifted from rote to meaningful. Besides that, encouragement, motivation, freedom of thinking, freedom of speaking could help to promote equality education in accessing the knowledge rather than textbook or content centered education. Learning science by constructivist philosophy is an innovative idea, which motivates students to gain direct experience with science. Student thinks and rethink individually as well as cooperatively to link the old concepts with new concepts. Their knowledge structure could be branched through concept map in a meaningful way while concepts, sub concepts, examples, cause and effect relations students link and interlink to make a meaningful proposition. It is also noted that constructivist promotes open ended activities, mostly in science, which helps to branch the knowledge structure of students in a greater latitude and clears students' partial understanding. It helps in conceptual understanding and to achieve higher order of cognition to process the ideas for explaining and planning. Children in upper primary stage (Class VI-VIII) begin to recognize the relationship of science with human enterprises. Not only that but also learners free discussion about the scientific concepts, grouping, sorting, linking, interlinking, concepts, sub concepts could help them to understand the cause and effect relation of science. In addition, students realize physical, chemical, and biological principles, relationships and their operation in nature as well as in daily life. In this regard, concept mapping as a useful constructivist approach for science learning, through which new science information, students can link with their existing knowledge. This study claimed that concept map was a cooperative learning activities require all students to be involved in the classroom management and it is the easiest way to do this by giving each student a role assignment. Concept map classroom management is the student active technique where students are well aware about their self-learning, and thinking about the construction of the map, so, then how students could create disturbance between each other in the classroom. Here, the teacher only the facilitator and his/her accountability is to observe the students' activity and what difficulties are the students facing the during map preparation. As a whole, we could be concluded that concept map learning is a best model or approach to apply in teacher training institutions to train the pre-service and in-service science teachers, science teacher educators, and studentswho are the future service provider.

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