

Impact of Concept Mapping and Modular Learning Techniques on Pupils' Achievement for the Selected Topics in Mathematics

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Abstract This research emphasizes on an alternate instructional tools called “Concept Map and Modular learning techniques”. The goal of this study was to determine the effectiveness of using concept maps and modular learning techniques in improving the mathematics achievement of higher secondary students and compare it with a traditional approach for a mathematics unit. Both the control and the experimental groups were required to take a pre-test before instruction and a post-test at the end of instruction. The test consisting of 30 questions was used to assess learning gains on a Mathematics Unit about Trigonometry and Differential Calculus. Moreover, results showed that the levels of concept mapping and modular learning techniques ability were associated with the students' learning gains. The study suggests that, when carefully integrated into the normal classroom procedure and when other contributing factors such as student motivation and preparedness, reading ability levels, time and classroom environment are considered, concept mapping and modular learning techniques has a potential to be an effective instructional strategy. To enforce the title of the study, the researcher had determined to verify the results from a different angle using the normative survey method to justify the impact of attitude towards mathematics homework. Based on the findings and discussions, XI standard students are having positive mathematics homework attitude towards concept mapping and modular learning techniques for the topics trigonometry and differential calculus.

Keywords: *concept map, module, homework attitude and academic achievement*

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1. Introduction

In the present scientific and technological age, conventional teaching methods are not sufficient to arouse interest among students, and they do not meet the intellectual, psychological, and emotional needs of the students in the new millennium [1,2]. Our quality of life and economy in future years depends on how well students are capable of utilizing the resources of today's learning. Students need a breeding ground to sharpen their existing skills, acquire new skills, conceive and experiment with new ideas and enhance the curiosity level to attain the perfect state of knowledge; today's children are tomorrow's citizens and hence the beginning should be made from the very basic of education.

To the majority of the people quality education ensures comfortable and secured life. It is expected that education should provide hope and open avenues for a prosperous life. It should create intelligent hard working and productive men and women for our society, education should enable youngsters to become contributing members of the society through knowledge, skills and character development; provide access to first rate training

for people of all ages and backgrounds and make it possible for them to compete in a global economy. To achieve this, our courses and syllabi should emphasize relevance and applications to the real world. In a knowledge based society the content and process of education has to undergo continuous reorganization and up gradation.

Learning has to be appreciated as a participatory process that takes place in a shared social context of the learner's immediate peers as well as the wider social community (NCERT, 2005). Much of our school learning is still individual based (NCERT, 2005) and traditionally trusted tools of learning are inadequate for preparing children for a networked society. New technologies have made the walls of learning space transparent, providing freedom for the learner to explore sources of information outside his institution, even outside his country. The impact of concept mapping and modular learning techniques will enhance the understanding of any abstract concepts in any branch of science especially in mathematics. The researcher has made an attempt to deal with all kinds of approaches and in particular has selected the concept mapping and modular approach as a suitable means to enhance the understanding of the abstract concepts in trigonometry and differential calculus among

the higher secondary students .He finds that selected instructional strategy will be helpful to the students to learn and retain in memory the abstract concepts easily to enable them to score high marks in examinations and also use the same in their day to day life hence the study is necessitated. Hence, the investigator has chosen concept mapping and modular learning techniques in mathematics at higher secondary level the right area for the present study.

2. Review of Related Literature

With regard to concept mapping, it is apparent and clear many investigators such as Sushma, Lakshmi, Baveja.B from India Novak. D. Joseph and others conducted experiments in nineteen eighties for school children for such subjects as science, English and mathematics. Lavie Bar and Zain Ben [3] focuses his attention on environmental education. In 1992 Lambiotte. J. and Danseau D. made use of concept mapping for teaching mathematics for secondary school children. Baroody A. and Bartels B [4] taught general concepts of mathematics to school children. As regards modular learning Shajahan [5], Anita [6] conducted study on basic mathematics for standard VIII. Broome [7] prepared a module on spherical trigonometry for high school students as a 4 – 8 hour topic. John [8] conducted his research on ‘genetics’ for higher secondary students. Sadia Sadiq [9] conducted study at university level. Regarding Homework Velmurugan [10] experiment covering VIII standard students. Shahzad Saqib et.al. [11] devoted their research at elementary level.Holler et.al. [12], Somoski [13]. Hagerty and Smith [14] studied web-based software homework for college

algebra. Taylor [15] dealt with intermediate algebra students. Gutarts and Bains [16] focused their attention in college Calculus course. i.e. the impact of homework when it is made mandatory and optional. Cox and Singer [17] investigated online homework with four sections of college calculus. i.e. paper pencil homework vs online homework. The above mentioned studies are found to be inadequate and confined to certain domains which enabled the investigator to launch the new study. The gap the researcher has found that no investigation has been carried out Trigonometry and Calculus in Mathematics for higher secondary students using concept map and modular learning techniques and also the attitude of students towards homework.

3. Instructional Design

Since the present study is based on Vygotsky’s approach, the investigator thoroughly studied and analyzed Vygotsky’s theories of learning and development. The instructional approaches, pedagogical attempts and evaluation techniques based on socio-cultural theories were also analyzed. Then some **Topics** were selected and **Assumptions** were formulated in the light of the theories analyzed. **Criteria** of an effective pedagogy for mathematics were fixed and **Annotations** were developed based on the selected aspects and assumptions. **Guidelines for students** were prepared and Instructional Strategies were constructed for teaching the topics ‘Trigonometry’ and ‘Differential Calculus’ response sheet is attached along with each Instructional Strategy to record the student’s reactions about this new Instructional Design i.e. Concept mapping and modular learning techniques.

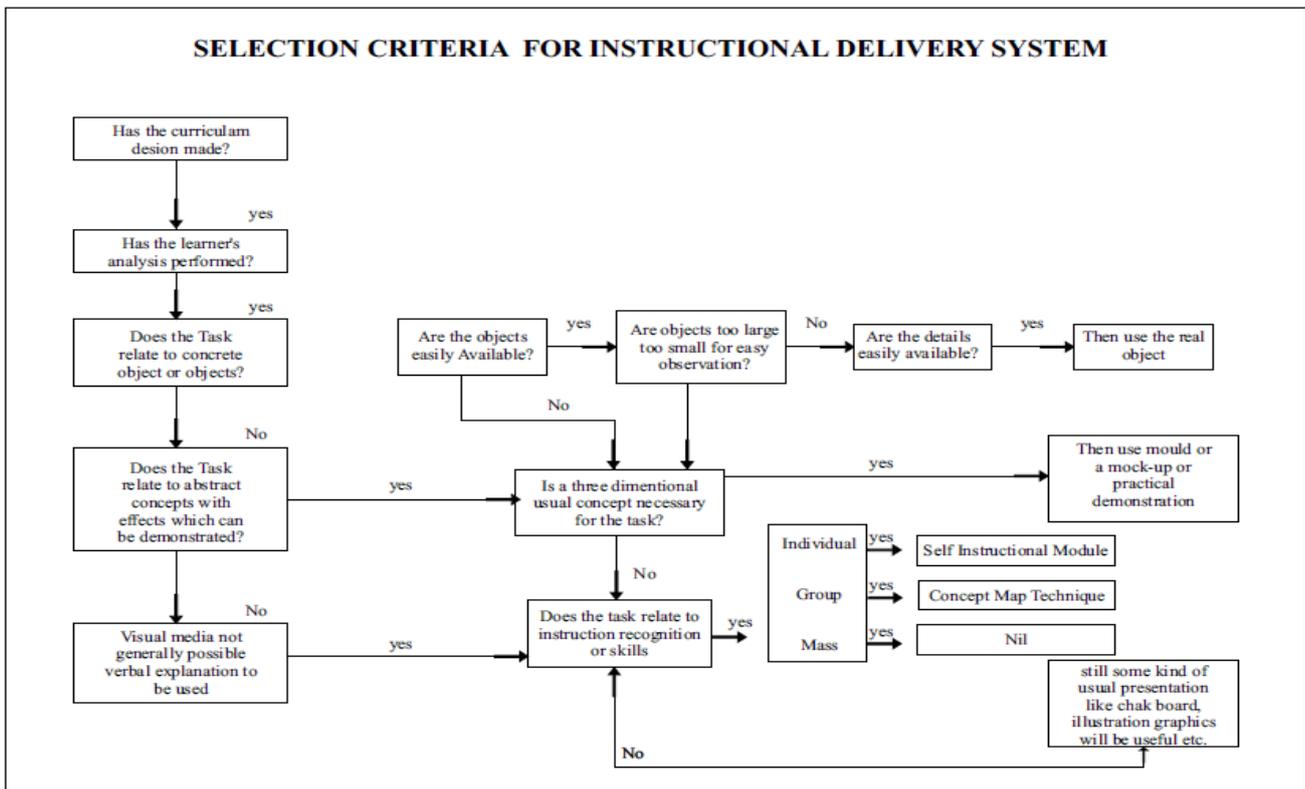


Figure 1. Showing the selection criteria for instructional delivery system

4. Concept Mapping and Modular Learning Techniques

Concept maps is a two dimensional body of knowledge. Construction fosters meaningful learning and positive attitude towards the school & subjects. Concept map is a map showing the interrelationships among concepts. Thus a concept map is a convenient & concise representation of conceptual framework about any type of knowledge & can hence be defined as an ‘interlocking’ network of “newly & previously acquired knowledge” of the learners. Modular approach is a self contained package dealing with one specific subject in convenient form, so that the learner can complete it at his own pace independently or small groups. It is so structured that the learner can identify the objectives, select material and method and evaluate his own accomplishment. The modular approach in mathematics learning has been proven to be an effective and efficient tool to help students to learn mathematics themselves. Most subjects can be target with this approach. The production of instructional material is time consuming but the modular effectiveness can be evaluated and thus can be done in a positive way. Mathematics module is a single independent unit of instruction, complete in itself with the primary focus on a few well defined objectives. Modules may be added to further units towards the achievement of long-term goal in mathematics. Module carry a wide variety of lables, including unipack, individualized learning package, and learning activity package.

5. The Development and Structure of Concept Mapping Techniques

1. Tutor Initiation, 2. Individual Work, 3. Group Work,
- 4.Evaluation, 5. Reinforcement, 6. Post – Test

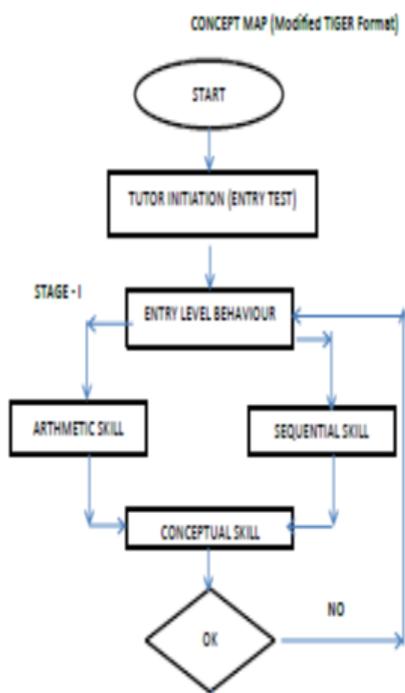


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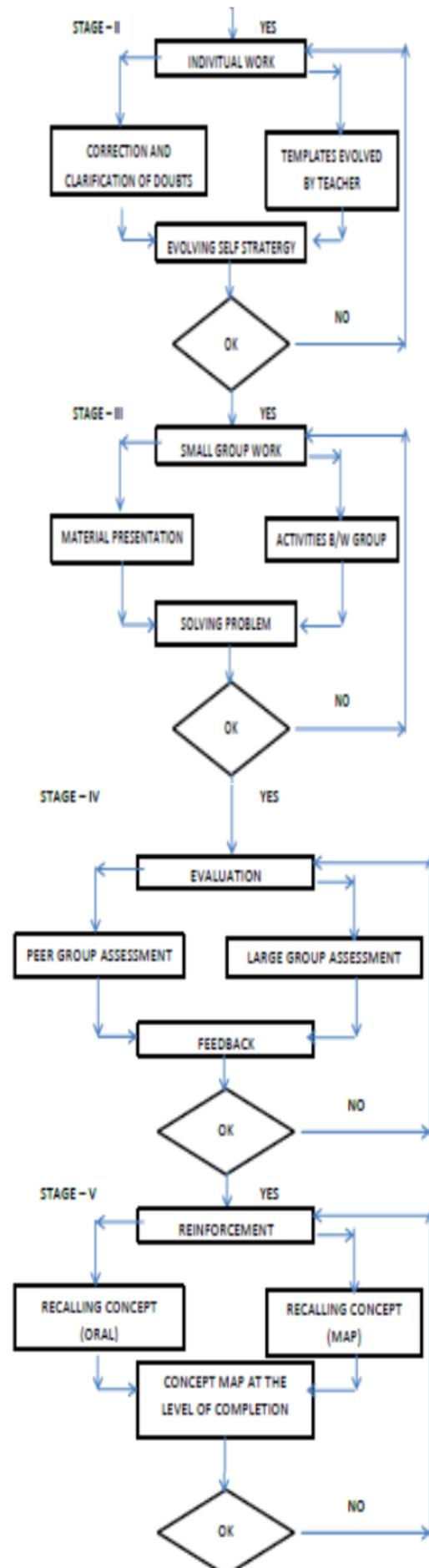


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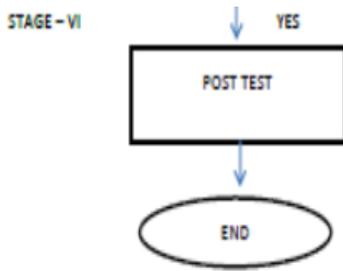


Figure 2. Showing the structure of Concept Mapping Technique

6. The Development and Structure of Modular Learning Techniques

1. Rationale or Overview, 2. Objective, 3. Instruction for Learners, 4. Pre-Test, 5. Learning Materials, 6. Learning Activities, 7. Post-Test

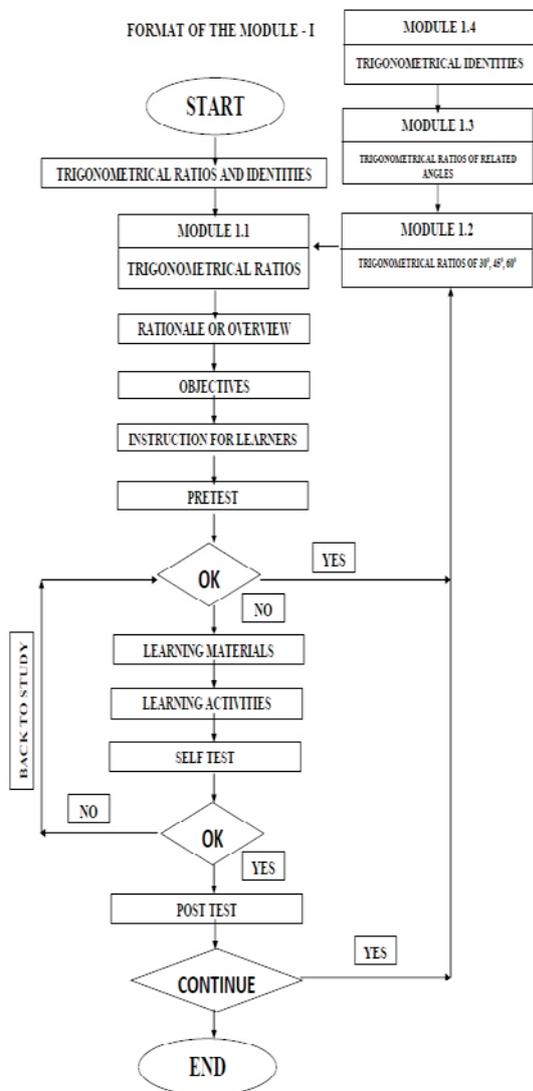


Figure 3. Showing the structure of Modular learning Technique

7. Research Methodology

The main objective of the study is to make the students proficient enough in knowing the basics like “Trigonometry and Differential Calculus” in Mathematics at plus one

level and their level of understanding the problems behind certain concepts.

1. To analyze various dimensions involved for the topic “Trigonometry and Differential Calculus in Mathematics”.
2. To evolve a set of dimension for the topic “Trigonometry and Differential Calculus in Mathematics” at higher secondary level.
3. To develop suitable “Concept mapping” and “Modular learning techniques” for the topic “Trigonometry and Differential Calculus in Mathematics” for the students studying the higher secondary level.
4. To validate the evolved “Concept mapping” and “Modular learning techniques” for the topic “Trigonometry and Differential Calculus in Mathematics” for the students studying in the higher secondary level.
5. To find out the effectiveness of the validated concept mapping and modular learning techniques for the topics “Trigonometry and Differential Calculus in Mathematics” for the students studying in the higher secondary level.
6. To find out the impact of the developed learning techniques on “Mathematics Homework Attitude” of the students studying in the higher secondary level.

The following hypotheses were formulated in this research work

1. There is no significant difference between the means of Experimental group – I which is exposed to the developed concept mapping techniques, Experimental group – II which is exposed to the developed modular learning techniques and the control group which is exposed to the conventional method XI standard students in their pre-test achievement level for the topic Trigonometry and Differential Calculus in Mathematics.
2. There is no significant difference between the means of Experimental group – I, Experimental group – II and the control group XI standard students in their post-test achievement level for the topic Trigonometry and Differential Calculus in Mathematics.
3. There is no significance difference between the means of Experimental group – I, Experimental group – II and the control group XI standard students in their mathematics homework attitude.
4. There is no significant correlation between the post-test achievement level and mathematics homework attitude of Experimental group – I, Experimental group – II and the control group.

To study the impact of concept map and modular approach teaching strategy, the pre-test, Treatment, post-test equivalent group experimental design was adopted in the study. The students studying 11th standard in St. Antony’s Boys Higher Secondary School, Thanjavur was considered as Control group, whereas the students studying 11th standard in Sacred Heart Girls Higher Secondary School, Thanjavur was considered as Experimental group I which is exposed to the developed concept mapping techniques and Kamala Subramaniam Matriculation Higher Secondary School, Thanjavur was

considered as Experimental group II which is exposed to the developed modular learning techniques. Each group consisted of 30 students. They were selected through Purposive sampling technique.

8. Tools for the Study

The following tools were used in the study

1. "Achievement Test in Differential Calculus" constructed and validated by the researcher.
2. "Achievement Test in Trigonometry" constructed and validated by the researcher.
3. "Scale of Mathematics Homework Attitude" constructed and validated by the researcher.

9. Construction of the Tools of Achievement Test in Mathematics

9.1. Planning of the Test

In the first step decisions regarding when to test, what kind of questions to use, total marks and mark for each item etc. were taken. The investigator decided to prepare 30 multiple choice test items, carrying one mark each. The duration of the test was fixed to be one hour. The content of the test is the mathematical topics 'Trigonometry and Differential Calculus'.

9.2. Item Writing

The investigator prepared 45 multiple choice test items for item analysis. Suggestions and valuable opinions of the supervising teacher, mathematics teachers and resource persons were taken into consideration while preparing the test items. Ten items were discarded in the first scrutiny and 35 items were selected for item analysis. The selected items were arranged in the proper order with necessary instruction. Each test item has four alternatives A, B, C and D.

9.3. Method of Answering

Separate answer sheets were prepared. The students were asked to put a 'X' mark against the alphabet of correct answer of each test item. A scoring key was also prepared.

9.4. Item Analysis

Item analysis refers to checking the quality of the test items. It involves estimating the difficulty index and discriminating power of each test item. Identification of upper 25% and lower 25% examinees having highest and lowest scores in rank order respectively on the total test.

9.5. Selection of Items

30 test items were selected from the draft test for the final test. The items having difficulty index between 0.3 and 0.75 and discriminating power more than 0.3 were selected for the final test.

9.6. Validity of the Test

Validity of this Achievement test was estimated by correlating the scores of the test with the marks obtained for the students in mathematics in the half yearly examination. The correlation between two sets of scores was estimated by Pearson's Product Moment Method (Garret, 1979). The obtained value of 'r' is 0.682 and 0.722 for trigonometry and differential calculus indicating that the test is valid.

9.7. Reliability of the Test

The coefficient was estimated using Split Half Method as explained in the case of the previous test. The 30 items were split into two halves, odd numbered items (1, 3, 5 29) and even numbered items (2, 4, 6 30). The scores of these two sets were counted and recorded. The coefficients of correlation between these two sets of scores were calculated. The reliability coefficient of the whole test was 0.749 and 0.771 for trigonometry and differential calculus showing that the test is reliable.

10. Construction of the Tool of Mathematics Homework Attitude

10.1. Experts Opinion

The test items that are suitable to the higher secondary school students in Indian situation were generated. The items generated were subjected to jury's opinion. The panel of jury consisting of research guide, three professors of department of Education, two senior teachers of Mathematics and three specialized in Methods lectures in college of Education. The judges were requested to review each item as to their validity with reference to the objectives, correctness of the structures, phrasing of items and the suitability to the Higher secondary school students. The suggestions given by them were incorporated and suitable modifications were made in the test items.

10.2. Pilot Study

The refined test items were administered to a sample of 25 students. The test item total correlation of each item was computed. The 45 items with significant 'r' values were selected and included in the final test.

10.3. Validity

The content validity and construct validity were established by the investigator. The concurrent validity was established by the investigator and it was 0.83 for Attitude. This establishes the validity of the tool.

10.4. Reliability

The reliability of the test was established by test-retest method. The test was administered after a gap of three weeks to 25 students from St. Joseph's girls Higher secondary school, Thanjavur. The coefficient of correlation between the two sets of scores was found to be 0.812. The

reliability of the test was established by using Split half method also. The coefficient of correlation between the scores of the odd and even items was calculated for 25 students. Split half reliability was found to be 0.74 and using Spearman Brown formula for the full length of the test 'r' was estimated to be 0.85. Thus the Attitude scale for mathematics home work possesses adequate reliability.

10.5. Administration of the Pre-test

Before starting the experiment, the investigator conducted pre-tests for both experimental and control groups. The Achievement test for the topic 'trigonometry' and the Achievement test for the topic 'differential calculus' respectively were used as the pretests in standards XI. The investigator himself conducted the pre-tests for the three groups. The scores obtained by the students in the experimental and control group has been collected and subjected to statistical analysis.

11. Treatment

11.1. Conventional Method of Teaching to the Control Groups

Control groups have been taught by the Conventional Method of teaching mathematics for the selected topics. The control group students of standard XI were taught by Conventional Method of teaching the topic 'trigonometry and differential calculus'. The investigator prepared the Teaching Manuals for teaching the topic 'trigonometry and differential calculus'. The investigator taught the control group with the help of text book. It took eight periods each having 45 minutes duration to complete the teaching of the topics.

11.2. Concept Mapping Method of Teaching to the Experimental Group – I

The experimental group - I of the standard XI were taught by the concept mapping for the selected mathematical topics. The investigator taught the experimental groups by the concept map. First the experimental group was taught through individual and then it was divided into six different groups each having five students. Each group has above average, average and below average students. This division of students into different groups was based on the average marks obtained in mathematics in the quarterly, half yearly and annual examinations in the previous academic year. Fourteen periods each has 45 minutes duration were taken for completing the topics through concept map.

11.3. Modular Approach Method of Teaching to the Experimental Group – II

The experimental group - II of the standard XI were taught by the modular approach for the selected mathematical topics. The investigator taught the experimental groups by the modular approach. First the investigator provides the learning materials and evaluating the learning activities through the self-test of the students. Fourteen periods each

has 45 minutes duration were taken for completing the topics through modular approach.

11.4. Administration of the Post-test

After completing the teaching of the concept mapping and modular learning techniques for the selected topics in mathematics to the experimental group – I and experimental group – II, and teaching the control groups by conventional method, the same achievement tests were again administered to all the three groups in standard XI. The investigator himself conducted the post-test to all three groups. The scores obtained by the students in the experimental group – I, experimental – II and control group in XI standard students were used for statistical analysis.

12. Scoring

12.1. Achievement Test

The answer sheets of the students for the Achievement test were collected. One mark was given to each objective type questions, and thus given the maximum scores as thirty marks. The range of the scores secured by the students in the pre-tests and post-tests were zero to thirty.

12.2. Procedure for the Formative Evaluation for the Constructed Attitude Scale

There were 45 statements in the Mathematics Homework Attitude scale with five points. Each statement was assigned a Weight age ranging as 5(Strongly Agree), 4(Agree), 3(Undecided), 2(Disagree) and 1(Strongly Disagree). For each student a total score on the scale can be attained by summing the scores for the individual items. Thus a maximum of 45 to 225 scores can be obtained. The formative evaluation could help researcher to gauge the initial attitude of the students in the right perspective.

12.3. Statistical Techniques Applied in the Study

The following statistical techniques were used to analyze the data

1. Differential analysis-'t'-test
2. Gain score analysis
3. Correlation analysis-product moment method 'r'

13. Results

Hypothesis 1:

The calculated value of 't' 0.461, 0.506, 0.162, 1.043, 0.048 and 1.008 is not significant at 0.05 level of significance. This makes it obligatory to accept the null hypothesis. It is concluded that there is no significant difference between the Experimental group – I which is exposed to the developed concept mapping techniques, Experimental group – II which is exposed to the developed modular learning techniques and the control group which is exposed to the conventional method XI

standard students in their pre-test achievement level for the topic Trigonometry and Differential Calculus in Mathematics. The table also indicates that the performance of the three groups is almost in same level in the pre-test.

Table 1. Showing the mean, SD and ‘t’ value of Experimental group – I, Experimental group – II and the control group XI standard students in their pre-test achievement level for the topic Trigonometry and Differential Calculus in Mathematics

Variable	Group	N	Mean	SD	‘t’
Pre-Test Achievement in Trigonometry	Control Group	30	10.50	3.95	0.461**
	Exp. Group - I	30	10.07	3.47	
	Control Group	30	10.50	3.95	0.506**
	Exp.Group - II	30	9.93	3.32	
	Exp. Group - I	30	10.07	3.47	0.162**
	Exp.Group - II	30	9.93	3.32	
Pre-Test Achievement in Differential Calculus	Control Group	30	9.90	2.51	1.043**
	Exp. Group - I	30	10.87	4.43	
	Control Group	30	9.90	2.51	0.048**
	Exp.Group - II	30	9.93	2.27	
	Exp. Group - I	30	10.87	4.43	1.008**
	Exp.Group - II	30	9.93	2.27	

**Not Significant at 0.05level.

Hypothesis 2:

The calculated value of ‘t’ 12.682 and 18.537 is significant at 0.05 level of significance. This makes it obligatory to reject the null hypothesis. It is concluded that there is significant difference between the Experimental group – I which is exposed to the developed concept mapping techniques and the control group which is exposed to the conventional method XI standard students in their post-test achievement level for the topic Trigonometry and Differential Calculus in Mathematics.

Table 2. Showing the mean, SD and ‘t’ value of Experimental group – I, Experimental group – II and the control group XI standard students in their post-test achievement level for the topic Trigonometry and Differential Calculus in Mathematics

Variable	Group	N	Mean	SD	‘t’
Post-Test Achievement in Trigonometry	Control Group	30	17.20	3.93	12.682*
	Exp. Group - I	30	26.63	1.59	
	Control Group	30	17.20	3.93	10.874*
	Exp.Group - II	30	26.40	1.98	
	Exp. Group - I	30	26.63	1.59	0.514**
	Exp.Group - II	30	26.40	1.98	
Post-Test Achievement in Differential Calculus	Control Group	30	13.83	1.90	18.537*
	Exp. Group - I	30	25.93	2.49	
	Control Group	30	13.83	1.90	22.274*
	Exp.Group - II	30	26.10	2.78	
	Exp. Group - I	30	25.93	2.49	0.253**
	Exp.Group - II	30	26.10	2.78	

*Significant at 0.05 level.

** Not Significant at 0.05 level.

The calculated value of ‘t’ 10.874 and 22.274 is significant at 0.05 level of significance. This makes it obligatory to reject the null hypothesis. It is concluded that there is significant difference between the Experimental group – II which is exposed to the developed modular learning techniques and the control group which is exposed to the conventional method XI standard students in their post-test achievement level for the topic Trigonometry and Differential Calculus in Mathematics.

The calculated value of ‘t’ 0.514 and 0.253 is not significant at 0.05 level of significance. This makes it obligatory to accept the null hypothesis. It is concluded that there is no significant difference between the Experimental group – I which is exposed to the developed concept mapping techniques and the Experimental group – II which is exposed to the developed modular learning techniques XI standard students in their post-test achievement level for the topic Trigonometry and Differential Calculus in Mathematics. The table also indicates that the performance of the two groups is almost in same level in the post-test.

Table 3. Showing Mean gain and Gain percentage scores of in Achievement Mathematics for the topic Trigonometry and Differential Calculus of the XI standard

	Group	N	Pre-Test M	Post-Test M	Mean Gain (30)	Gain %
Trigonometry	Control Group	30	10.50	17.20	6.70	22.33
	Exp.Group - I	30	10.07	26.63	16.56	55.20
	Exp. Group - II	30	9.93	26.40	16.47	54.90
Differential Calculus	Control Group	30	9.90	13.83	3.93	13.10
	Exp.Group - I	30	10.87	25.63	14.76	49.20
	Exp. Group - II	30	9.93	26.10	16.17	53.90

The Table 3 indicates that the Gain percentages score is more in the experimental group – I and experimental group - II than the control group. Therefore the concept mapping and modular learning techniques is effective in enhancing the Achievement in Mathematics for the topic Trigonometry and Differential Calculus of the XI standard students than the Conventional lecture method.

Hypothesis 3:

Table 4. Showing the mean, SD and ‘t’ value of Experimental group – I, Experimental group – II and the control group XI standard students in their mathematics homework attitude

Variable	Group	N	Mean	SD	‘t’
Mathematics Homework Attitude	Control Group	30	146.27	24.88	2.534*
	Exp. Group - I	30	161.97	23.77	
	Control Group	30	146.27	24.88	3.240*
	Exp.Group -II	30	164.90	26.36	
	Exp. Group - I	30	161.97	23.77	0.962**
	Exp.Group -II	30	164.90	26.36	

*Significant at 0.05 level.

** Not Significant at 0.05 level.

The calculated value of ‘t’ 2.534 and 3.240, is significant at 0.05 level of significance. This makes it

obligatory to reject the null hypothesis for Experimental group – I & Control group and Experimental group – II & Control group of XI standard students in their mathematics homework attitude. The calculated value of 't' 0.962 is not significant at 0.05 level of significance. This makes it obligatory to accept the null hypothesis for Experimental group – I & Experimental group – II of XI standard students in their mathematics homework attitude.

The statistical analysis reveals that concept mapping and modular learning techniques is more effective than the conventional method of teaching mathematics in terms of achievement, development of mathematics homework attitude.

Hypothesis 4:

Glass and Hopkins [18] and Best and Khan [19] have given the following criteria for analyzing the correlation and their magnitude.

Co-Efficient (r)	Relationship
0.00 to 0.20	Negligible
0.20 to 0.40	Low
0.40 to 0.60	Moderate
0.60 to 0.80	Substantial
0.80 to 1.00	High to very high

Table 5. Showing correlation between the post-test achievement level and mathematics homework attitude of Experimental group – I, Experimental group – II and the control group

Group	Variable	N	'r'	p-value
Exp. Group I	Homework	30	0.639*	0.015
	Trigonometry	30		
	Homework	30	0.736*	0.151
	Diff. Calculus	30		
Exp. Group II	Homework	30	0.812*	0.221
	Trigonometry	30		
	Homework	30	0.795*	0.121
	Diff. Calculus	30		

*Significant at 0.05 level.

The calculated value of 'r' 0.639, 0.736, 0.812 and 0.795, is significant at 0.05 level of significance and indicates positive relationship.

14. Educational Implications

1. The Achievement in Mathematics is improved by the concept mapping and modular learning techniques.
2. The habit of drawing concept maps helps the students to grasp the main theme and the connected sub ideas within short time.
3. The habit of making modules helps the students to solve the problems in an easiest manner.
4. The rapport between teachers and students improve the performance of the students in their educational activities.
5. The concept mapping and modular learning techniques has the potential to provide intellectual challenges

for enhancing students' Knowledge, Understanding, Application and Skills in Mathematics.

6. The concept mapping and modular learning techniques raises the students' attitude towards mathematics homework. Mathematics homework attitude is improved by these strategies.

15. Discussion

The results of the present study, "Impact of concept mapping and modular learning techniques on pupils' achievement for the selected topics in mathematics at higher secondary level" were discussed with the related results of others studies.

The study reveals that the concept mapping techniques is effective in enhancing the Achievement in Mathematics of XI standard students than the Conventional lecture method. It is in concurrence with the result of Baroody A. and Bartels B. (2000) who reported that Concept Mapping as a teaching tool in Secondary and Post-secondary mathematics and found remarkable improvement of students after using Concept Mapping.

The study reveals that the modular learning techniques is effective in enhancing the Achievement in Mathematics of XI standard students than the Conventional lecture method. It is in concurrence with the result of Anita (1989) who showed that the modular approach is more effective than traditional approach.

The study reveals that the mathematics homework attitude is effective in enhancing the Achievement in Mathematics of XI standard students than the Conventional lecture method. It is in concurrence with the result of Cox and Singer (2011) they reported students spent more time working independently on calculus problems. Survey results indicate high student satisfaction with online homework.

16. Recommendations

The following are some of the recommendations of the study

- (i) Recommendations to the Mathematics teachers

It is recommended

1. The students should be encouraged to draw Concept maps to various Mathematical problems and concepts of their own.
2. The students should be encouraged to make modular approach to various Mathematical problems and concepts of their own.
3. Week end concept map and modular approach Mathematics Associations can be arranged with some experts from SSA.
4. Students should be given some project work connected with their life situations and ask them to find out various solutions through concept map and modular approach.

- (ii) Recommendations to the Government

1. Concept map and modular approach Training program may be organized to improve teaching quality among teachers.

2. Concept map and modular learning techniques may be implemented in classroom for higher secondary school students in course of time.
3. Concept map and modular learning techniques may be included in the curriculum of Bachelor of Education.

17. Suggestions for Further Study

Further studies may be carried out in the following ways

1. Studies may be conducted by using concept mapping and modular learning techniques to teach other subjects like science, social science etc.
2. Studies may be conducted to teach Language subjects using concept mapping and modular learning techniques.

18. Conclusion

The study reveals that the concept mapping and modular learning techniques is effective in teaching Mathematics for the selected topics over the Conventional lecture method at the Higher secondary school level. The concept map and modular learning techniques provides learning experiences with higher achievement for students. Most learning involves lecture methods and tons of words, which may not work very well for those who tend to retain material better through visual cues. Students who were taught to use concept mapping and modular learning techniques were encouraged to explore the relationship with ideas of their own and relate these and able to form number of branches and sub branches that emanate from a single central idea. This strategy facilitated better revision of learned material and it's an excellent group and individual activity, allowing for a lot of collaboration and enthusiastic discussion. Based on the findings and discussions, XI standard students who are having positive attitude towards concept mapping and modular learning techniques are having better achievement in mathematics for the topics trigonometry and differential calculus.

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