RESULTS

CHAPTER IV

4.0 RESULTS

The present chapter deals with analysis and interpretation of data which is the main part of the research report .After collection of data the next step is the careful and systematic analysis of it. The data has been carefully analysed quantitatively in the light of the pre fixed objectives for the investigation with the help of different statistical techniques (Fisher,1944) .The data were analysed and interpreted against each objectives in the following way.

Effectiveness of (I) Lecture Cum demonstration method (II) Inquiry and(III) Laboratory method for teaching General Science in Secondary Schools.

4.1. Objective no (1): To find out the effectiveness of the three different methods of teaching General Science at the Secondary level-

(I) Lecture -Cum Demonstration Method

(II) Inquiry Method, and

(III) Laboratory Method.

$\mathbf{H_{01}}$: There exists no significant difference in academic achievement of students if they are taught by using Lecture Cum demonstration method, or by Inquiry method or by Laboratory method of teaching General teaching.

(I) Lecture Cum Demonstration Method

In order to achieve this objective the investigator calculated pre-test scores of sample students. From these scores the table of pre -test scores for lecture demonstration method is prepared. After getting the pre-test scores, the post-test scores of each group are also prepared using same procedure .From these scores means and standard deviations of the pre-test and post-test scores are calculated. For studying significance

of mean difference of pre-test and post-test scores t test is applied and result are shown in the table:3 below

Table:3 t-test for Lecture Cum Demonstration Method

Test	Sample Size	Mean	SD	SE (Mean)	t	d.f	Significance
Pre-Test	1023	7.32	2.253	0.070	18.079	2044	0.000
Post Test	1023	9.95	4.070	0.127			

Interpretation: With t-value 18.079 for 2044 d.f. and significance 0.00 we reject the Null Hypothesis and conclude that there exists significance difference between achievement scores of Pre-test and Post-test when teaching is provided by using Lecture cum Demonstration method. It is found that pre-test means are7.32 and post-test means are 9.95 which are increased and there is difference between the two means. But to test the significance of means of the two tests, t-test is applied. Thus it could be interpreted that Lecture Cum Demonstration method is an effective method for teaching general science.

(II) Inquiry Method

Same statistical procedure was adopted for Inquiry Method. From the pre-test and post-test scores means and standard deviations are calculated. And for studying of mean difference t-test is applied and results are shown in table: 4

Table: 4 t-test for Inquiry Method

Test	Sample Size	Mean	SD	SE (Mean)	t	d.f	Significance
Pre-Test	1023	7.23	2.322	0.073	23.660	2044	0.000
Post Test	1023	10.68	4.036	0.126			

Interpretation: With t-value 23.660 for 2044 d.f. and significance 0.00 we reject the Null Hypothesis and conclude that there exists significance difference between average scores of Pre-test and Post-test when teaching is provided to students of class X using Inquiry method

(III) Laboratory Method

Null Hypothesis: There exists no significant difference between average scores of pre-test and post-test.

In case of Laboratory Method also same procedure was adopted .The calculated means; standard deviations and t-value are shown in the table: 5.

Table: 5 t-test for Laboratory Method

Test	Sample Size	Mean	SD	SE (Mean)	t	d.f	Significance
Pre-Test	1023	7.36	2.25	0.070	34.546	2044	0.000
Post Test	1023	12.35	4.02	0.126			

Interpretation: With t-value 34.546 for 2044 d.f. and significance probability 0.00 we reject the Null Hypothesis and conclude that there exists significance difference between average scores of Pre-test and Post-test when teaching is provided to students of class X using Laboratory method.

Test of significance for the three methods: To study the relative importance of the three methods i.e. significance among the three means, post- test scores of the Lecture Cum Demonstration, Inquiry and Laboratory Methods, ANOVA is applied.

Null Hypothesis: The average scores of post-tests in Lecture Cum Demonstration, Inquiry and Laboratory Methods of Teaching Science do not differ significantly.

For testing the Null Hypothesis the Table: 6.is computed.

Table: 6 Analysis of Variance for Post-Test Scores of Lecture Cum Demonstration, Inquiry and Laboratory Method of Teaching

Sources of variance	Df	Sum of Squares (SS)	Mean Square (Variance)	F	Significance
Between Groups	2	3080.386	1540.193	94.203	0.000
Within Groups	3066	50128.442	16.350		
Total	3068	53208.828			

Interpretation: With F= 94.203 for (2, 3066) d.f significance probability is 0.000. Therefore, we reject the null hypothesis and conclude that mean scores of the three methods of teaching differ significantly.

However, the significant value of F does not tell us which of the group means differ significantly. Therefore, we applied Post Hoc test to determine the pair of means for which difference is significant. We reject the null hypothesis at 95% and 99% significance level because significance value 0.000 is < 0.05 and 0.01.

Table: 7 Post Hoc Test: Multiple Comparison

(Dependent Variable: Post test Score of Lecture cum Demonstration, Inquiry and Laboratory method, LSD)

(I) Values of Post test of Lec, inq and lab method	(J) Values of Post test of Lect., Inq. and lab. method	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Lecturecum demo. method	Inquiry method	-.73(*)	.179	.000	-1.08	-.37
	Laboratory method	-2.39(*)	.179	.000	-2.74	-2.04
Inquiry method	Lecturecum demo.method	.73(*)	.179	.000	.37	1.08
	Laboratory method	-1.67(*)	.179	.000	-2.02	-1.32
Laboratory method	Lecturecum demo.method	2.39(*)	.179	.000	2.04	2.74
	Inquiry method	1.67(*)	.179	.000	1.32	2.02

* The mean difference is significant at the .05 level.

From Table: 7 it is observed that mean difference for each pair of means is significant at 0.05 level of significance. It is observed that the mean scores in post tests for Lecture Cum Demonstration, Inquiry and Laboratory methods are 9.93, 10.68 and 12.35 respectively. Therefore, Laboratory Method can be regarded as best method for teaching Science. It is cleared in Figure: 5.

From table 7 it is observed that the mean score difference between Lecture cum demonstration and Inquiry method is 0.73. Therefore both methods can be used in teaching Geneal Science separately or simultaneously.

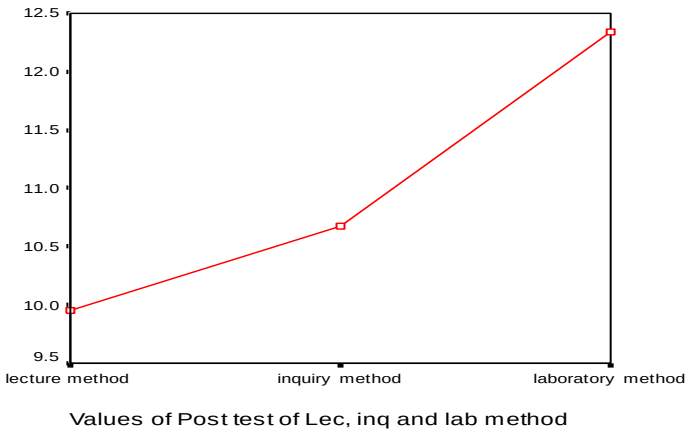

Figure: 5 Mean Plots of Lecture Cum Demonstration, Inquiry and Laboratory Method of Teaching

4.2. Compare the Effectiveness between Lecture Cum Demonstration method and Inquiry method, Lecture Cum Demonstration method and Laboratory method, Inquiry and Laboratory method for teaching General Science in secondary schools.

4.2.1 Objective (2): To make a comparative study of the effectiveness of Lecture Cum Demonstration and Inquiry method in teaching GeneralScience.

H_{02}: There exists no significant difference in academic achievement of students if they are taught by using Lecture Cum Demonstration or by Inquiry method of teaching General Science.

To study the comparative effectiveness between Lecture Cum Demonstration and Inquiry method the pre-test and post-test scores of Lecture Cum Demonstration and Inquiry methods are calculated .From these scores pairs of mean, standard deviation and significance level are analyzed using Post Hoc Test .The comparison between Lecture Cum Demonstration and Inquiry methods are shown in the table 8.

Null Hypothesis: There exists no significant difference in effectiveness of Lecture Cum Demonstration and Inquiry methods in teaching General Science.

Table: 8 - t test for Lecture Cum Demonstration and Inquiry Methods in teaching General Science

Test	Sample Size	Mean	SD	SE (Mean)	t	df	Significance
Lecture cum Demonstration Method	1023	9.95	4.070	0.127	4.047	2044	0.000
Inquiry Method	1023	10.68	4.036	0.126			

Null Hypothesis rejected.

4.2.2 Objective (**3**): To make a comparative study of the effectiveness of Lecture – Cum Demonstration and Laboratory method in teaching General Science.

H_{03}: There exists no significant difference in academic achievement of students if they are taught by using Lecture Cum Demonstration or by Laboratory method of teaching General Science.In order to serve this objective the investigator applied the same statistical procedure. The comparison between pair of means of Lecture Cum Demonstration and Laboratory method are shown in table 9.

Null Hypothesis: There exists no significant difference in effectiveness of Lecture Cum Demonstration and Laboratory Methods in teaching G.Science

Table: 9-t test for Lecture Cum Demonstration Method and Laboratory Method in teaching General Science

Test	Sample Size	Mean	SD	SE(Mean)	t	df	Significance
Lecture cum Demon. Method	1023	9.95	4.070	0.127	13.373	2044	0.000
Laboratory method.	1023	10.35	4.024	0.126			

Null Hypothesis rejected.

4.2.3 Objective (4): To make a comparative study of the effectiveness of Inquiry and Laboratory method in teaching General Science.

H_{04}: There exists no significant difference in academic achievement of students if they are taught by using Inquiry method or by Laboratory method of teaching General Science.

For the achievement of this objective the investigator applied the same procedure. Mean differences between Inquiry method and Laboratory method are significant, and reflected in the table-10

Null Hypothesis: There exists no significant difference in effectiveness of Inquiry and Laboratory Methods in teaching General Science.

Table: 10 t test for Inquiry Method and Laboratory Method

Test	Sample Size	Mean	SD	SE(Mean)	t	df	Significance
Inquiry Method	1023	10.68	4.036	0.126	9.358	2044	o.ooo
Laboratory Method	1023	12.35	4.024	0.126			

Null Hypothesis rejected

4.3. Objective (5):To investigate the relative effectiveness of (I) Lecture Cum Demonstration method (II) Inquiry method and (III) Laboratory method in relation to school:

(i) Type of Management (Government and Private schools)

(ii) Locality (Urban and Rural Schools)

(iii) Board/Certificate (SEBA, CBSE, and ICSE).

H_{05}: There exists no significant difference in academic achievement of students if they are taught by using Lecture Cum Demonstration method or Inquiry method or Laboratory method with respect to-

(i)Management (Government and Private Schools)

(ii) Locality (Urban and Rural Schools) and

(iii) Board/Certificate (SEBA, CBSE and ICSE).

4.3.1 (i) For study the relative effectiveness of Lecture Cum Demonstration, Inquiry and Laboratory method in relation to management of the schools under government the investigator conducted pre-test and post-test . The scores of pre-test and post-test are statistically analyzed and mean, standard deviation are given in the table: 11. Table:12 depicts the analysis of variance results.

Table: 11 Descriptive Statistics for Post Test of Three Methods of Teaching (Government Schools)

Post Test	Sample Size	Mean	SD	SE (Mean)
Lecture cum Demons. Method	760	9.46	4.20	0.152
Inquiry Methods	760	10.13	4.10	0.149
Laboratory method	760	11.78	4.11	0.149

Post test for the three methods for Government Schools (ANOVA)

Null Hypothesis: The mean scores of post tests of three methods in Government schools not differ significantly.

Table: 12 Analysis of Variance for Post-Test Scores of Lecture cum Demonstration, Inquiry and Laboratory Method of Teaching (Govt. Schools)

Sources of variance	df	Sum of Squares (SS)	Mean Square (Variance)	F	Significance
BetweenGroups	2	2166.543	1083.271	63.286	0.000
Within Groups	2277	38975.330	17.117		
Total	2279	41141.873			

Interpretation: With F value 63.286 for degree of freedom (2, 2277) and significance level 0.000 we reject the Null hypothesis and conclude that there exists significance difference among the three methods for government schools.

From Table:11 it is observed that Laboratory Method is seemed to be the best method among the three Methods with mean score 11.78.

Private Schools: Same procedure was used in case of private schools. Means of different methods are shown in the table 13 and analysis of variance results are reflected in table 14.

Table: 13 Descriptive Statistics for Post Test Results of Three Methods of Teaching (Private Schools)

Post Test	Sample Size	Mean	SD	SE (Mean)
Lecture Cum Demons. Method	263	11.37	3.29	0.203
Inquiry Methods	263	12.27	3.37	0.208
Laboratory method	263	13.98	3.26	0.201

Null Hypothesis: The mean scores of post tests of three methods in Private schools not differ significantly.

Table: 14 Analysis of Variance for Post-Test Scores of Lecture cum Demonstration, Inquiry and Laboratory Method of Teaching (Private Schools)

Sources of variance	**df**	**Sum of Squares (SS)**	**Mean Square (Variance)**	**F**	**Significance**
Between Groups	2	922.616	461.308	42.145	0.000
Within Groups	786	8603.376	10.946		
Total	788	9525.992			

Interpretation: With F value 42.145 for degree of freedom (2, 786) and significance level 0.000 we reject the Null hypothesis and conclude that there exists significance

difference among the three methods for private schools. From Table: 13 it is observed that Laboratory Method is seemed to be the best method among the three Methods with mean score 13.98. Figure 6 clearly indicates Comparison of Mean scores Between Government and Private Schools.

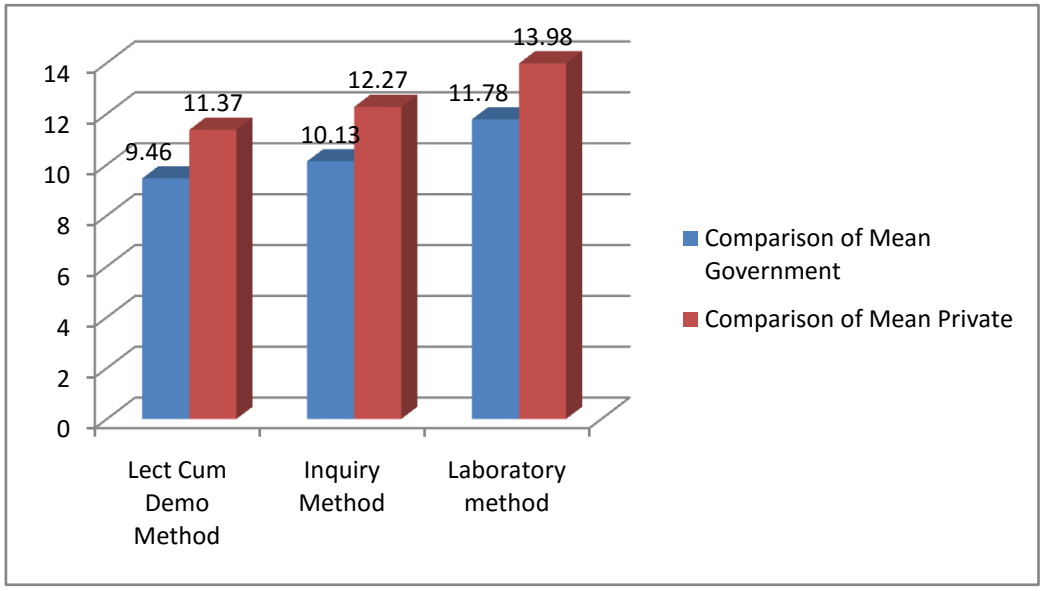

Figure: 6 Comparison of Mean scores Between Government and Private Schools

4.3.2 (ii)For study the relative effectiveness of Lecture Cum Demonstration, Inquiry and Laboratory method in relation to locality of the schools under urban area the investigator conducted pre-test and post-test . The scores of pre-test and post-test are statistically analyzed and mean, standard deviation are given in the table: 15. Table: 16 depict the analysis of variance results.

Table: 15 Descriptive Statistics for Post Test Scores of Three Methods of Teaching (Urban Schools)

Post Test	Sample Size	Mean	SD	SE (Mean)
Lecture Cum Demons. Method	453	10.84	4.09	0.19
Inquiry Methods	453	11.60	4.14	0.19
Laboratory method	453	13.47	3.81	0.18

Table: 16 Analysis of Variance for Post-Test Scores of Lecture cum Demonstration, Inquiry and Laboratory Method of Teaching (Urban Schools)

Sources of variance	df	Sum of Squares (SS)	Mean Square (Variance)	F	Significance
Between Groups	2	1663.263	831.631	51.612	0.000
Within Groups	1356	21849.439	16.113		
Total	1358	23512.702			

Interpretation: With F value 51.612 for degree of freedom (2, 1356) and significance level 0.000 we reject the Null hypothesis and conclude that there exists significance difference among the three methods for urban schools. From Table: 15 it is observed that Laboratory Method is seemed to be the best method among the three Methods with mean score 13.47.

Rural Schools :

Same procedure was used in case of rural schools. Means of different methods are shown in the table 17 and analysis of variance results are reflected in table 18.

Table: 17 Descriptive Statistics for Post Test of Three Methods of Teaching (Rural Schools)

Post Test	Sample Size	Mean	SD	SE (Mean)
Lecture Cum Demons. Method	570	9.25	3.920	0.164
Inquiry Methods	570	9.95	3.801	0.159
Laboratory method	570	11.45	3.969	0.166

Table: 18 Analysis of Variance for Post-Test Scores of Lecture cum Demonstration, Inquiry and Laboratory Method of Teaching (Rural Schools)

Sources of variance	df	Sum of Squares (SS)	MeanSquare (Variance)	F	Significance
Between Groups	2	1444.282	722.141	47.547	0.000
Within Groups	1707	25925.660	15.188		
Total	1709	27369.942			

Interpretation: With F value 47.547 for degree of freedom (2,1707) and significance level 0.000 we reject the Null hypothesis and conclude that there exists significance difference among the three methods for urban schools. From Table: 17 it is observed that Laboratory Method is seemed to be the best method among the three Methods with mean score 11.45. Figure 7 clearly depicts, Comparison of Mean scores Between Urban and Rural Schools.

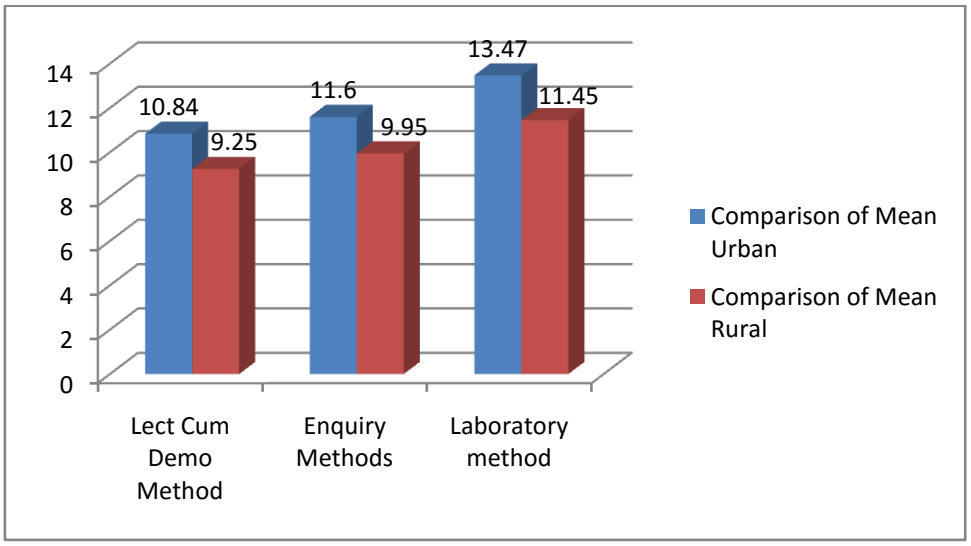

Figure: 7 Comparison of Mean scores Between Urban and Rural Schools

4.3.3 (iii) For study the relative effectiveness of Lecture cum Demonstration, Inquiry and Laboratory method in relation to Board and Certificate of the schools under SEBA,CBSE and ICSE the investigator conducted pre-test and post-test . The scores of pre-test and post-test are statistically analyzed and mean, standard deviation are given in the Table: 19, Table:21 and Table: 23 respectively. Table: 20, Table: 22 and Table: 24 depict the analysis of variance results respectively.

Table: 19 Descriptive Statistics for Post Test Scores of Three Methods of Teaching (SEBA Schools)

Post Test	Sample Size	Mean	SD	SE (Mean)
Lecture Cum Demons. Method	839	9.71	4.154	0.143
Inquiry Methods	839	10.41	4.054	0.140
Laboratory method	839	12.72	4.057	0.140

Table: 20 Analysis of Variance for Post-Test Scores of Lecture cum Demonstration, Inquiry and Laboratory Method of Teaching (SEBA Schools)

Sources of variance	df	Sum of Squares (SS)	MeanSquare (Variance)	F	Significance
Between Groups	2	2424.125	1212.062	72.511	0.000
Within Groups	2514	42022.970	16.716		
Total	25`16	44447.095			

Null hypothesis rejected

Interpretation: With F value 72.511 for degree of freedom (2,2514) and significance level 0.000 we reject the Null hypothesis and conclude that there exist significance difference among the three methods for schools under SEBA.

Table: 21 Descriptive Statistics for post Test of Three Methods of Teaching (CBSE Schools)

Post Test	Sample Size	Mean	SD	SE (Mean)
Lecture Cum Demons. Method	173	10.68	3.20	0.24
Inquiry Methods	173	11.55	3.57	0.27
Laboratory method	173	13.40	3.49	0.27

Table: 22 Analysis of Variance for Post-Test Scores of Lecture cum Demonstration, Inquiry and Laboratory Method of Teaching (CBSE Schools)

Sources of variance	df	Sum of Squares (SS)	MeanSquare (Variance)	F	Significance
Between Groups	2	665.63	332.82	28.38	0.000
Within Groups	516	6051.72	11.73		
Total	518	6717.35			

Null hypothesis rejected

Interpretation: With F value 28.38 for degree of freedom (2,516) and significance level 0.000 we reject the Null hypothesis and conclude that there exist significance difference among the three methods for schools under CBSE.

ICSE Schools

Table: 23 Descriptive Statistics for Three Methods of Teaching (ICSE Schools) (Post Test)

Post Test	Sample Size	Mean	SD	SE (Mean)
Lecture Cum Demons. Method	11	17.09	0.70	0.21
Inquiry Methods	11	17.27	1.10	0.33
Laboratory method	11	18.27	1.10	0.33

Table: 24 Analysis of Variance for Post-Test Scores of Lecture cum Demonstration, Inquiry and Laboratory Method of Teaching (ICSE Schools)

Sources of variance	df	Sum of Squares (SS)	MeanSquare (Variance)	F	Significance
Between Groups	2	8.91	4.46	4.57	0.02
Within Groups	30	29.27	0.98		
Total	32	38.18			

Null hypothesis rejected.

Interpretation: In all cases we reject Null hypothesis. It is concluded that there exists significance difference among the three methods of teaching science. From Table: 19, Table:21 and Table: 23 it is observed that Laboratory Method is seemed to be the best method among the three Methods with mean scores 12.72,13.40,18.27 respectively. Figure 8 clearly reflects Comparison of Mean scores among SEBA, CBSE and ICSE Schools.

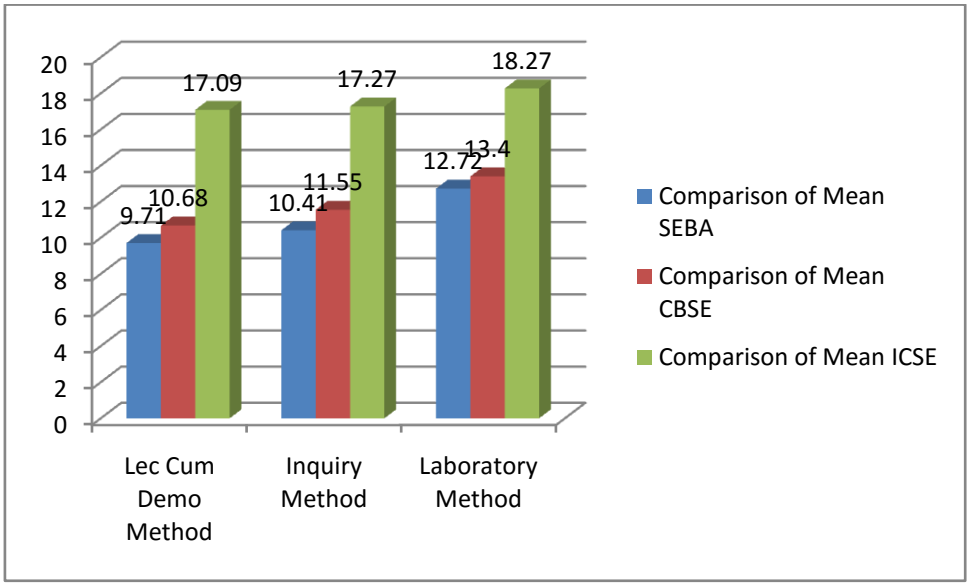

Figure: 8 Comparison of Mean scores among SEBA, CBSE and ICSE Schools

4.4. Objective (6): To find out the problems faced by the teachers in teaching General Science by using three different methods (Lecture Cum Demonstration, Inquiry and Laboratory) at the secondary level.

H_{06} : The secondary level teachers face various problems while using different methods of teaching General Science in their respective schools which can be identified from their responses.

Teachers Schedule: An interview schedule comprising thirty (30) items for the teachers was prepared, and circulated among seventy six (76) teachers. Including 1, 2 or 3 science teachers taught in the sixty (60) sample schools (15 % of target population) selected for this purpose. It was very much encouraging for the researcher that most of the teachers (49) returned the schedule in time and rest have submitted in the earlier part of 2015. All the open and closed ordered questions were answered by the teachers except one teacher. Finally a total of seventy six (76) interview schedule were collected and translated. Each teacher opined scientific views and effectiveness of each method and combination of different methods in teaching - learning of General Science.

As many as thirty (28+2 = 30) questions were included in this schedule and all were addressed to trained Science teacher teaching at class X standard.The teachers were free to express their views and opinions from their own experience and field of action. Most of the teachers have explained their problems and forwarded suggestions very clearly. All the teachers were interested for this experiment and also eager to do something for the benefit of science education. The teacher schedule has five (5) sections. These are: (i) Lecture cum Demonstration method (ii) Inquiry method (iii) Laboratory method (iv) Combination of methods and (v) Effectiveness of methods in teaching General Science.

The 'Missile Men' Abdul Kalam preferred teaching as the choicest activity and he travelled regularly all over India to meet the students to develop their curiosity and to produce great teacher-leader, educationist and scientist (Newsletter, USTM, July-Sept. 2014). At present research findings reflect positive attitude interest and

enthusiasm of teachers and students towards teaching-learning process which determine the efficacy of the system.

Thus, the relationship between positive attitude towards a systems and its successful application in the real life situation are very important. If we wish to assess the successful implementation of the science education and the proper use of methods in science teaching-learning process, we are to know first of all, attitude, interest and problems of the teachers and students for science teaching in the classroom situation.

Responses regarding the use of different methods for classroom teaching, Proper arrangement of class for teaching, development, of skills, including of scientific values etc. are analysed to enhance teaching-learning process.

4.4.1 Responses of Teachers regarding use and effectiveness of Lecture Cum Demonstration Method –section: i

Table: 25 Responses of Teachers Regarding the Effectiveness of LectureCum Demonstration Method

Sl. No.	Items regarding teaching efficiency	Yes (No & %)	No (No & %)	No Answer (N0 & %)	Calculated χ^2
1	Do you have any pre-plan of your Science demonstration lesson?	75, 98.63%	_	1, 1.32%	146.10
2	Have you followed the step by step plan?	75, 98.63%	_	1, 1.32%	146.10
3	Do you think your lecture cum demonstration lesson motivate your students?	74, 97.00%	1, 1.32%	1, 1.32%	140.26
4	Do you think your demonstration makes your explanation of the topic more clearly to the students?	72, 94.68%	1, 1.32%	3, 3.96%	129.04

Cont. Table:25					
5	Do you think your lecture can replace demonstration method?	59, 77.58%	13,17.09%	4, 5.26%	68.72
6(a)	Is there proper arrangement in your classroom to make demonstration visible to all students?	54, 70.01%	21,27.62%	1, 1.32%	56.56
6(b)	Are you satisfied with the use of demonstrating materials along with additional materials appropriate to your purpose? (chalk ,board, diagram, chart etc.)	54, 70.01%	20,26.30%	2, 2.63%	55.06
7(a)	Do you think that time allotted in the routine is sufficient for demonstration?	42, 55.23%	32,42.08%	2, 2.63%	34.22
7(b)	Do you permit your students to interact with you when demonstration is going on?	71, 93.36%	3,3.95 %	2, 2.63%	123.52

d.f=2, Tabulated χ^2 =5.991 (0.05) = 9.210 (0.01)

On analyzing the results of table:25 it is observed that on the basis of opinion and views of teachers on the use of lecture cum demonstration method in science teaching can be interpreted. It is found that 99% teachers are energetic and competent which gives hope to a bright future for science education in this region. But due to the lack or unavailability of scientific apparatus, in some schools the teachers are not interested to 'demonstrate' in the normal class room situation though they are well acquainted with lecture demonstration method.

97% teachers like to motivate students through lecture demonstration method.

94.68% teachers can explain more clearly during lecture-demonstration.

77.58% teachers believe that demonstration method is not replaced by lecture method, while 17.09% teachers believe that demonstration is replaced by lecture method. Most probably, from psychological point of view, the nature of demonstration method (to observe) attract the teachers to a large extent. As we know that learning by observation is much better than only to listening.

70.01% teachers were satisfied with the use of demonstrating material while 26.30% were not satisfied and 2.63% teachers were indifferent towards demonstrating materials.

55.23% teachers felt that allotted time for demonstration is enough while 42.08% were in favour of requirement of additional time for demonstration.

93.36% teachers interacted with the students during demonstration and used some strategies to keep the students active and alive, and motivate the whole class. In this way they converted the teacher-centric demonstration method to child centric approach.

Each statement in Table: 25 is tested using Chi-square statistic depending upon the cell frequencies of teachers' response. For each statement chi-square statistic is constructed under Null Hypothesis. The response distributed equally in the table. In each statement the Chi-square value is found to be significant with 2 d.f. at 0.05 and 0.01 level of significance (5.991, 9.210 respectively). Therefore the Null Hypothesis is rejected.

4.4.2 Responses of Teachers regarding use and effectiveness of Inquiry method-section:ii

Table: 26 Responses of Teachers Regarding the Effectiveness of Inquiry Method

Sl. no.	Items regarding teaching efficiency	Yes (Nos & %)	No (No & %)	No answer (No & %)	Calculated χ^2
1	Have you encouraged your students to clarify their doubts?	75, 98.63%	_	1, 1.32%	146.10
2	Does your method of science teaching develop scientific temper among your students?	75, 98.63%	_	1, 1.32%	146.10
3	Have you encouraged your students to accurately observe or think and record carefully the observation or prediction? Cont. Table:26	74, 97.31%	1, 1.32%	1, 1.32%	140.26
4	Have you trained your students in developing problem-solving attitude in theory and in science process?	71, 93.37%	5, 6.58%	_	123.99

	Cont. Table: 26				
5	Have you seen enquiring attitude among the students?	71, 93.37%	5, 6.58%	_	123.99
6	Have you given them the opportunity /training in open-ended experiments, scientific method & investigatory science activities?	66, 86.79%	7, 9.21%	3, 3.95%	98.25

d.f=2, Tabulated χ^2 =5.991 (0.05) = 9.210 (0.01)

After analyzing the results of table: 26 it is found that teachers' opinions and views on the use of Inquiry method in science teaching is beneficial. From their responses effectiveness of teaching can be interpreted. It is found that,

98.63% teachers are able to encourage the students to clarify their doubts. They develop divergent thinking, enquiring attitude among the students. Only 1.32% is not able to do the same.

Majority of the teachers (98.63%) are in favour of scientific method to develop scientific temper or innovation through science teaching-learning process.

97.31% teachers stimulated students for keen observation and proper records. Student get choose to solve problem with the verification in a stress free environment.

Majority of the teachers (93.37%) are in support of training/skill among the students which develop problem solving attitude in their practical and real-life situation.

93.37% teachers observed enquiring attitude among the students while 6.58% are not. They try to develop problem solving attitude among the students which help them to solve every day's problem of life.

86.79% teachers gave the training for investigatory science activities while 9.21% teachers can't do.

Here also each statement in Table: 26, is tested as in Table: 25 and Null Hypothesis is rejected.

4.4.3 Responses of Teachers regarding use and effectiveness of Laboratory method, section: iii

Table: 27 Responses of Teachers Regarding the Effectiveness of Laboratory Method

Sl. no.	Items regarding teaching efficiency	Yes (No.& %)	No (No. & %)	No Answer (No.& %)	Calculated χ^2
1	Are you satisfied with the provision of laboratory facility in your school?	21, 27.61%	55, 72.32%	_	60.82
2	Do you ascertain that the students are able to catch the teaching points after experiment?	45, 59.17%	_	31, 40.76%	41.87
3	Have you helped them to do their own generalization after laboratory work?	75, 98.62%	_	1, 1.32%	146.10
4	Have you applied difficult skills particularly manipulation skills in teaching general science?	58, 76.27%	17, 23.35%	1, 1.32%	68.25
5	Are you satisfied with the learning outcome or behavioral change of students after using laboratory method in teaching at your school?	70, 92.05%	5, 6.57%	1, 1.32%	118.46
6	Are you satisfied with the performance of students during laboratory condition?	47, 61.80%	25, 32.87%	4 5.26%	36.50

d.f=2, Tabulated χ^2 =5.991 (0.05) = 9.210 (0.01)

After analyzing the result of table: 27 the opinions and views of teachers regarding use and effectiveness of laboratory method can be interpreted. The findings are—

72.32% teachers from government schools are not satisfied with laboratory conditions. Only the private schools have proper science laboratory (27.61%), almost all the teachers are in favour of laboratory method.

59.17% teachers use different techniques (questioning, activity etc.) to ascertain the knowledge level of student after teaching, while the rest are not able to do so.

Almost all (98.62%) the teachers are able to bring the students to the generalization step which is an essential step of science and mathematics teaching.

76.27% teachers applied different skills during activity in teaching general science. But 23.35% teachers are not aware of these skills. Drawing skill and manipulation skill are essential for science teaching and learning.

Almost all the teachers (92.05%) are satisfied with the behavioural change of students after individual performance in laboratory. 6.57% teacher are not able to observe the same. It helps to access students' capabilities to solve the problems in new situation or unfamiliar situation.

61.80% teachers are satisfied with the performance of student during laboratory condition. Though the others are (32.87%) not. But they prefer the activity method during teaching process in the class room situation.

In Table: 27 chi-square test is conducted for each statement and null hypothesis is rejected. Therefore each teacher responded independently.

4.4.4 Responses of Teachers regarding combination of methods in teaching science.section:iv

Table: 28 Responses of Teachers Regarding Combination of Methods

Sl.no.	Items regarding teaching efficiency	Yes (No. & %)	No (No. & %)	No Answer (No. & %)
1	Have you applied all the methods appropriately and correctly?	73, 95.99%	3, 3.95%	_
2	Do you prefer the combination of the methods in science teaching?	73, 95.99%	2, 2.63%	1, 1.32%
3	Which of the method of science teaching you prefer the most?			
	(a)Lecture cum Demonstration	45, 59.18%		
	(b) Inquiry	4, 5.26%		
	(c) Laboratory	27, 35.51%		

Almost all the teachers (95.99%) are able to apply the methods appropriately. And they were highly satisfied with the feedback from students.

It is cleared from the figure 9 that-

95.99% teachers preferred combination of methods in general science teaching.

59.18 % preferred lecture cum demonstration methods in general science teaching.

5.26 % preferred inquiry methods in general science teaching.

35.51% preferred laboratory methods in general science teaching.

Rest of the teachers showed indifferent attitude.

Most of the teachers created a psychological and scientific environment which leads them for innovation in scientific field/social context.

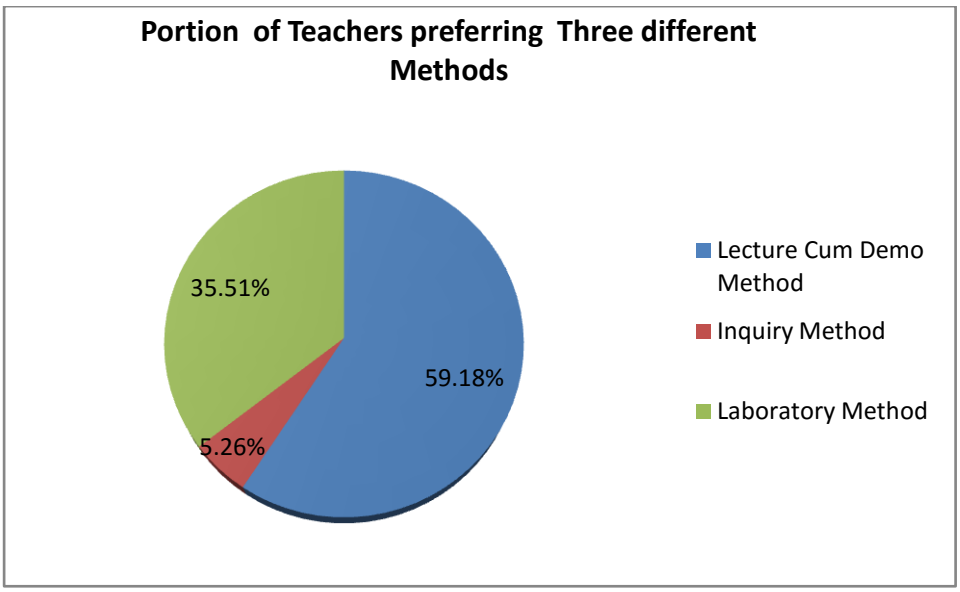

Figure: 9 Portions of Teachers Preferring Three Different Methods

4.4.5 Responses of Teachers regarding effectiveness of methods in teaching of science-section:v

Table:29 Responses of Teachers regarding Effectiveness of methods

Sl.No.	Items regarding teaching efficiency	Yes (No. & %)	No (No. & %)	No Answer (No.& %)
1	Are you satisfied with student's response?	70, 92.05%	6, 7.89%	_
2	Have you reviewed and summarized the key points?	76, 100%	_	_
3	Have you encouraged them to ask/discuss the hard points?	75, 98.63%	1, 1.32%	_
4	Are you satisfied with the feedback and the responses of the students (achieved)?	63, 82.84%	12, 15.78%	1, 1.32%
5	Have you referred the standard books and have included all the critical concepts rules, procedures etc?	65, 85.47%	10, 13.15%	1, 1.32%
6	Have you prepared tests, to check the entry behaviour, transitional behavior and the terminal behaviour of the students?	58, 76.27%	16, 21.04%	2, 2.63%

92.05% teachers were satisfied with students' responses. Only 7.89% teachers were dissatisfied.

All the teachers (100%) were effective in summarization of the topics/subject.

98.63% teachers encouraged the students for discussion during implementation of methods. The rest (1.32%) were indifferent towards active participation of students.

82.84% teachers were satisfied with terminal behaviour of students while 15.78% were not satisfied.

85.47% teachers used reference books and discussed critical points with the help of these methods. But 13.15% teachers were not active in this regard.

76.27% teachers prepared tests and checked the entry behaviour, transitional behaviour and terminal behaviour of the students. 21.04% teachers were not able to test the behavioural change of the students.

4.5 FINDINGS OF THE STUDY:

Secondary Education system plays a significant role for the adolescents which are a transitional stage for the growing students. The future prospect of the students depends upon the system of secondary education. The students have to select their future disciple/scope with ambition and expectation. In this stage the guardians, teachers and society are playing a significant role for better performance of students in High School leaving Certificate Examination (HSLC). As we know that performance of students depend upon an 'effective' teaching learning process or system. During the system of teaching, 'process' is an important part where teachers can use methods, strategies, techniques etc. to produce good end-products i.e. achievements scores of students. Teachers can make this system a very effective one with the adoption of appropriate method/s in a proper way.

Therefore study the effectiveness of teaching methods in science teachings at secondary level is essential. Further analysis of teachers' views & performance of students are also important. The relationship between achievement scores of learners

and efficacy of methods is strongly needed. Hence teachers' have to play a 'dynamic' role with different categories of students in the classroom situation.

The Major findings of this experiment have been incorporated in this chapter.

4.5.1 Findings of the study: On the basis of Experimentation-The science teachers' of secondary schools teachings at class x had used different methods in teachings of science. Before the experiment a pre-test was conducted which are the control groups. After teachings the experimental groups, a post-test was held. From the achievement scores (post-test) it is found that the academic performance of students is gradually increased in case of child centric approach. From the comparative study of methods it is also found that laboratory method showed the maximum achievement scores while lecture cum demonstration showed the minimum achievement scores.The findings are giver below:

(1) This study reveals that there is significance difference between average scores of pre-test and post-test, when teachings was conducted using Lecture Cum Demonstration method in place of traditional method. Pre-test mean score was 7.32 and post-test score was 9.95, which shows an increase in the mean achievement score of post-test(Table-3).Thus this study shows that Lecture Cum Demonstration method has significant impact on teaching science.

(2) From this study it is also found that there exists significance difference between average scores of pre-test and post-test, when teachings is conducted by using Inquiry method in place of traditional method used by the science teacher. Pre-test mean score was 7.23 and post-test score was 10.68, which shows an increase in the mean score in post-test(Table-4).This study shows that Inquiry method has significant impact on teaching science at secondary level.

(3) This study indicates that there is significance difference between average scores of pre-test and post-test, when teaching is conducted by using Laboratory method in place of traditional method.Here, Pre-test mean score is 7.36 and post-test score is 12.35, which reflects an increase in the mean achievement

score of post-test(Table-5). Thus this study shows that Laboratory method is more effective in teaching science at secondary level.

(4) From this study it is also observed that all the three methods are effective in teaching General Science, although the maximum effect is observed in case of Laboratory method (Figure-5).

(5) This study shows significant difference in the mean score when compared making different combinations among them.Though all these methods show significant effect but impact of these methods are not equel.To compare the effectiveness of different methods of teaching science comparison is made by using three combinations namely,LectureCum Demonstration and Inquiry method, Lecture Cum Demonstration and Laboratory method and Inquiry and Laboratory method.It is found from this study that out of the three combinations Lecture Cum Demonstration and Inquiry method is the best combination (Table-7).

(6) This study reveals that the performance of the students of private schools (13.98, Table 13) in science subject is better than their counterpart of the Government schools (11.78, Table 11). While studying the effectiveness of different methods of teaching science with reference to the management of the schools, this study indicates that Laboratory method shows more effective results in both type types of schools irrespective of their management type (Figure-6).

(7) This study also highlight the effectiveness of different methods of teaching science with reference to the locality of the schools i.e. urban and rural schools. There exist significant differences among the mean scores of three methods where Laboratory method seems to be the best one in case of urban area (13.47, Table15). Similar effect of Laboratory method is observed in case of schools situated in rural area also (11.45, Table -17).But in comparison to urban and rural areas, students of urban schools showed better results (Figure-7).

(8) This study makes comparison of the achievement of students in science subject under different conducting board such as SEBA, CBSE and ICSE. Out of the three board the achievement scores of students studying under ICSE school is high in comparison to other two boards. Here also laboratory, inquiry and lecture cum demonstration are reflecting their effectiveness where laboratory method is the best method of teaching science and followed by inquiry and lecture cum demonstration method respectively (Figure-8).

4. 5.2 Findings of the study: On the basis of Descriptive Survey Method (on teacher):

A positive view of teachers regarding the use of methods in science teaching is essential which can make teaching learning process very effective. The positive views and interest of teachers can bring effectiveness towards science teaching at secondary level. It can enhance science education in future course of action at different levels. The findings based on teacher schedule are summed up and given below-

(1) This study reveals that 94.68% Teachers can explain science topics more clearly during lecture cum demonstration.

(2) It is also foumd that 98.63% teachers are able to encourage the students to clarify their doubts.

(3) It is observed from this study that majority of the teachers (98.63%) are in favour of scientific method / child centric approach to develop scientific temper through science teaching.

(4) From this study it is observed that most of the teachers (92.05%) are satisfied with the learning outcome of students after laboratory work. It helps to access students' capabilities to solve the problems in new or unfamiliar situation.

(5) This study highlights that 61.80% teachers are satisfied with the performance of student at laboratory condition. But the others are not, though they prefer activity method in science teaching.

(6) This study reveals that, only 27.61% teachers are satisfied with laboratory condition, it is observed that in all the private schools laboratories are well equipped while in some of the government schools laboratories are not well equipped or properly managed. In some schools due to unavailability of apparatus teachers are not interested in laboratory work. But they perform the demonstration in the theory classroom, for keeping the students active and motivating in the class.

(7) This study indicates that, 95.99% teachers prefer the combination of methods in teaching science, out of the three methods viz.: Lecture Cum Demonstration, Inquiry and Laboratory method they prefer Lecture Cum Demonstration and Laboratory method for teaching General Science.

(8) It is observed that, 98.63% teachers encourage the students for discussion during teachings- learning process.

(9) It shows that, all the teachers have summarized the topics and 76.27% checked the entry behaviour, transitional behaviour and terminal behaviour, which reflect the progress of students.

(10) This study reveals an interesting aspect of teaching science in our present day school system that some of the teachers are in favour of lecture cum demonstration method which may be due to unavailability of appropriate apparatus or laboratory condition or lack of preparation or insufficient skills etc. It is found that teachers are habituated with the traditional method of teaching General science at secondary level.