## LIST OF CONTENTS

CONTENT	Page. No
Declaration	i
Certificate	ii
Acknowledgement	iii-v
Contents	vi-xii
List of Tables	xii-xiv
List of Figures	xiv
List of Graphs	xiv
List of Appendices	xv
Abbreviations	xvi

Chapter 1	CONCEPTUAL FRAMEWORK AND REVIEW OF RELATED LITERATURE	1-118
1.0	Introduction	1
1.1	Information and Communication Technology (ICT)	5
1.1.1	Model for ICT Integration	8
1.1.2	Development of ICT in India	11
1.2	Constructivism	14
1.2.1	Constructivist Learning Approach – Epistemological Foundations	15
1.2.2	Concept of Constructivism	21
1.2.3	Types of Constructivism	23
1.2.4	Principles of Constructivism	25
1.2.5	Characteristics of Constructivist Learning Approach	25
1.2.6	Constructivist Classroom	26
1.2.7	The Nature of the learner	29
1.2.8	Motivation for Learning	30
1.2.9	Role of the Teacher	31
1.2.10	The Nature of the learning process	32
1.2.11	Constructivist view of Assessment	33
1.2.12	Constructivist Teaching - Learning Models	35

1.2.12.1	The Learning Cycle Model	35
1.2.12.2	5E Model	36
1.2.12.3	The 7E Model	38
1.2.12.4	ICON model	39
1.2.12.5	Driver & Oldham's model	39
1.2.12.6	Generative Learning Model (GLM)	39
1.3	Nature of Science	40
1.3.1	Science Education	42
1.3.2	Aims of Science Education	45
1.3.3	The Scenario of Science Teaching Learning	46
1.4	Constructivist view of Science Education	48
1.5	ICT Aided Constructivist Science Education	51
1.5.1	Model of ICT Aided Constructivist Learning Approach	56
1.6	ICT Aided Constructivist Learning Approach (ICTACLA) in Science for the Professional Development of Preservice Teachers	58
1.6.1	Teacher Education	58
1.6.2	Pre-Service Teacher Education	59
1.6.3	General objectives	60
1.6.4	Pre-Service Teacher Education for Secondary Stage	60
1.6.4.1	Specific Objectives	61
1.6.5	Present scenario of Pre-Service Teacher Education	62
1.6.6	ICTACLA for Professional Development of Pre-Service Teachers	65
1.7	Review of Related Literature	73
1.7.1	Review of the Theoretical Literature	73
1.7.2	Reviews of Related Studies on Constructivism	79
1.7.3	Reviews of Related Studies on ICT Aided Constructivism	92
1.7.4	Reviews of Related Studies on ICTACLA for the Professional Development of Teachers	99
1.7.5	Implications of the Review for the Present Study	106
1.7.6	Rationale for the Present Study	112
1.8	Present Study	116

1.9	Objectives of the Study	116
1.10	Hypotheses	116
1.11	Operational Definition of the terms	118
1.12	Delimitations of the Study	118
Chapter 2	METHODOLOGY	119-128
2.0	Introduction	119
2.1	Experimental Design	119
2.2	Population for the Study	120
2.3	Sample for the Study	120
2.4	Tools and Techniques	120
2.4.1	Questionnaire	120
2.4.2	Reaction scales	121
2.4.3	Observation schedule	121
2.4.4	Achievement Tests	122
2.4.5	Semi-Structured Interview Schedule	122
2.4.6	Focused Group Discussions (FGD)	122
2.4.7	Pre-Service Teacher's Diary	123
2.4.8	Researcher's Diary for Field Notes	123
2.4.9	Rubric	123
2.5	Development of the program on ICTACLA	123
2.6	Collection of the Data	125
2.7	Data Analysis Techniques Employed	128
Chapter 3	ANALYSIS AND INTERPRETATION	129-210
3.0	Introduction	129
3.1	Objective no. 2.1	129
3.1.1	Hypothesis	129
3.1.2	Tool	129
3.1.3	Data Collection	129
3.1.4	Data Analysis	129
3.1.5	Interpretation	132
3.2	Objective no. 2.2	133

3.2.1	Hypothesis	133
3.2.2	Tool	133
3.2.3	Data Collection	133
3.2.4	Data Analysis	133
3.2.5	Interpretation	136
3.3	Objective no. 2.3	136
3.3.1	Tool	136
3.3.2	Data Collection	136
3.3.3	Data Analysis	136
3.3.4	Interpretation	138
3.3.5	Conclusion	140
3.4	Objective no. 2.4	140
3.4.1	Hypothesis	140
3.4.2	Tools	140
3.4.3	Data Collection	140
3.4.4	Data Analysis	140
3.4.5	Interpretation	144
3.4.6	Conclusion	144
3.5	Objective no .2.5	145
3.5.1	Hypotheses	145
3.5.2	Tool	145
3.5.3	Data Collection	145
3.5.4	Data Analysis	146
3.5.4.1	Observations made by the Researcher	146
3.5.4.1.1	Interpretation	150
3.5.4.1.2	Conclusion	150
3.5.4.2	Observations made by Pre-Service Teachers	151
3.5.4.2.1	Interpretation	154
3.5.4.2.2	Conclusion	155
3.5.4.3	Observations made by Teacher Educators	156
3.5.4.3.1	Interpretation	160
3.5.4.3.2	Conclusion	161

3.5.5	Data Triangulation	162
3.5.5.1	Interpretation	162
3.6	Objective no. 2.6	163
3.6.1	Tools	163
3.6.2	Data Collection	163
3.6.3	Data Analysis	163
3.6.3.1	Content Analysis of the written Semi-Structured	163
3.6.3.2	Content Analysis of Focused Group Discussion	175
3.6.3.3	Conclusion	178
3.7	Objective no. 2.7	179
3.7.1	Tools	179
3.7.2	Data Collection	179
3.7.3	Data Analysis	179
3.7.3.1	Content Analysis of Pre-Service Teacher's Diary	179
3.7.3.2	Content Analysis of Researchers' Diary for Field notes	190
3.7.3.2.1	Reflections of Researcher during Observation	197
3.8	Objective no. 3	198
3.8.1	Hypotheses	198
3.8.2	Tool	199
3.8.3	Data Collection	199
3.8.4	Data Analysis & Interpretation	199
3.8.5	Conclusion	208
3.9	Content Analysis of Lesson plans developed by the Pre- Service Teachers employing ICTACLA	209
3.9.1	Interpretation	210
3.9.2	Conclusion	210
Chapter 4	FINDINGS AND DISCUSSION	211-231
4.0	Introduction	211
4.1	Findings of Objective no .1	211
4.2	Findings of Objective no. 2.1, 2.2 & 2.3	211
4.2.1	Discussion	211
4.3	Findings of Objective no 2.4	212
4.3.1	Discussion	212

4.4	Findings of Objective no 2.5	213
4.4.1	Discussion	213
4.5	Findings of Objective no 2.6	215
4.5.1	Semi-Structured Interview	215
4.5.1.1	Discussion	217
4.5.2	Focused Group Discussion	217
4.5.2.1	Discussion	218
4.6	Findings of Objective no. 2.7	219
4.6.1	Pre-Service Teachers Dairy	219
4.6.1.1	Discussion	221
4.6.2	Researchers" Diary for Field notes	222
4.6.2.1	Discussion	223
4.7	Findings of Objective no. 3	225
4.7.1	Discussion	226
4.8	Findings & Discussion of Rubric for Lesson Plans	230
4.9	Conclusion	231
Chapter 5	SUMMARY AND IMPLICATIONS	232-265
Chapter 5 5.0	SUMMARY AND IMPLICATIONS Introduction	<b>232-265</b> 232
<del></del>		
5.0	Introduction Information and Communication Technology and	232
5.0	Introduction Information and Communication Technology and Constructivist Learning Approach Information and Communication Technology Aided	232 233
5.0 5.1 5.2	Introduction Information and Communication Technology and Constructivist Learning Approach Information and Communication Technology Aided Constructivist Learning for Pre- Service Teachers	<ul><li>232</li><li>233</li><li>235</li></ul>
5.0 5.1 5.2 5.3	Introduction Information and Communication Technology and Constructivist Learning Approach Information and Communication Technology Aided Constructivist Learning for Pre- Service Teachers Review of Related Literature	<ul><li>232</li><li>233</li><li>235</li><li>238</li></ul>
5.0 5.1 5.2 5.3 5.4	Introduction Information and Communication Technology and Constructivist Learning Approach Information and Communication Technology Aided Constructivist Learning for Pre- Service Teachers Review of Related Literature Implications for the Present Study	232 233 235 238 240
5.0 5.1 5.2 5.3 5.4 5.5	Introduction Information and Communication Technology and Constructivist Learning Approach Information and Communication Technology Aided Constructivist Learning for Pre- Service Teachers Review of Related Literature Implications for the Present Study Rationale for the Present Study	232 233 235 238 240 242
5.0 5.1 5.2 5.3 5.4 5.5 5.6	Introduction Information and Communication Technology and Constructivist Learning Approach Information and Communication Technology Aided Constructivist Learning for Pre- Service Teachers Review of Related Literature Implications for the Present Study Rationale for the Present Study Present Study	232 233 235 238 240 242 246
5.0 5.1 5.2 5.3 5.4 5.5 5.6 5.7	Introduction Information and Communication Technology and Constructivist Learning Approach Information and Communication Technology Aided Constructivist Learning for Pre- Service Teachers Review of Related Literature Implications for the Present Study Rationale for the Present Study Present Study Objectives of the Study	232 233 235 238 240 242 246 246
5.0 5.1 5.2 5.3 5.4 5.5 5.6 5.7 5.8	Introduction Information and Communication Technology and Constructivist Learning Approach Information and Communication Technology Aided Constructivist Learning for Pre- Service Teachers Review of Related Literature Implications for the Present Study Rationale for the Present Study Present Study Objectives of the Study Hypotheses	232 233 235 238 240 242 246 246 246
5.0 5.1 5.2 5.3 5.4 5.5 5.6 5.7 5.8 5.9	Introduction Information and Communication Technology and Constructivist Learning Approach Information and Communication Technology Aided Constructivist Learning for Pre- Service Teachers Review of Related Literature Implications for the Present Study Rationale for the Present Study Present Study Objectives of the Study Hypotheses Operational Definition of the terms	232 233 235 238 240 242 246 246 246 248
5.0 5.1 5.2 5.3 5.4 5.5 5.6 5.7 5.8 5.9 5.10	Information and Communication Technology and Constructivist Learning Approach Information and Communication Technology Aided Constructivist Learning for Pre- Service Teachers Review of Related Literature Implications for the Present Study Rationale for the Present Study Present Study Objectives of the Study Hypotheses Operational Definition of the terms Delimitations of the Study	232 233 235 238 240 242 246 246 246 248 249

Webliography	7	288-291
Bibliography		.266-287
5.22	Conclusion	264
5.21	Suggestions for Further Research	263
5.20	Implications of the Study	261
5.19	Study Based Reflections	259
5.18.3	Findings of Objective no. 3	257
5.18.2	Findings of Objective no. 2	257
5.18.1	Findings of Objective no. 1	256
5.18	Findings of the Study	256
5.17	Data Analysis Techniques Employed	256
5.16	Collection of the Data	253
5.15	Development of the Program on ICTACLA	252
5.14	Tools and Techniques	249

## List of Tables

Table No.	Title	Page. No.
1	Major Shifts Needed in Teacher Education	68
2	Objectives and Tools wise Analysis of the Collected Data	128
3	Analysis of the Responses of Pre-Service Teachers against various Statements	130
4	Analysis of responses of School Students against Various Statements	134
5	Frequency and Percentage analysis of Responses of Teacher Educators against various Statements	137
6	Pre-Service Teacher wise, school wise Pre-Test mean score (m1), Post-Test mean score (m2), Correlation, Variance, Standard Deviation, Standard Error of Mean, computed t and table t values at 0.01 level.	141
7	Frequencies and Percentages of elements observed by the Researcher in the classes employing ICTACLA	146

0	Average Observed frequency response against 50 statements of	150
8	the observation schedule. $\mathcal{X}^2$ and its Level of Significance	150
9	Frequencies and Percentages of elements observed by the Pre-	151
9	Service Teachers in the classes employing ICTACLA	131
10	Average Observed frequency response against 50 statements of	155
10	the observation schedule. ** and its Level of Significance	155
11	Frequencies and Percentages of elements observed by the	150
	Teacher Educators in the classes employing ICTACLA	156
	Average Observed frequency response against 50 statements of	1.61
12	the observation schedule. ** and its Level of Significance	161
10	Average Observation Frequencies of Observations made by the	1.60
13	Researcher, Pre-Service Teachers and Teacher Educators	162
14	Categories of Pre-Service Teachers' views on ICTACLA	180
15	Scoring Procedure for Questionnaire	199
1.0	Five Interval Scores of Pre-test and Post-test of the Pre-Service	200
16	Teachers of the Experimental group.	200
17	Five Interval Scores of Pre-test and Post-test of the Pre-Service	200
17	Teachers of the Control group.	200
18	2 X 5 Contingency table for Experimental Group of Pre-Service	201
10	Teachers As Teachers	201
19	2 X 5 Contingency table for Experimental Group of Pre-Service	201
17	Teachers As Learner	201
20	2 X 5 Contingency table for Experimental Group of Pre-Service	202
	Teachers As both Learner & Teacher	
21	2 X 5 Contingency table for Control Group of Pre-Service	202
	Teachers As Teacher	
22	2 X 5 Contingency table for Control Group of Pre-Service	203
	Teachers As Learner	
23	2 X 5 Contingency table for Control Group of Pre-Service	204
	Teachers As both Learner & Teacher	
24	2 X 5 Contingency table for Pre-test of Experimental & Control	204
	Group of Pre-Service Teachers As Teacher	

25	2 X 5 Contingency table for Pre-test of Experimental & Control	205
	Group of Pre-Service Teachers As Learner	
26	2 X 5 Contingency table for Pre-test of Experimental & Control	206
	Group of Pre-Service Teachers As both Learner & Teacher	
27	2 X 5 Contingency table for Post-test of Experimental & Control	206
	Group of Pre-Service Teachers As Teacher	200
28	2 X 5 Contingency table for Post-test of Experimental & Control	207
20	Group of Pre-Service Teachers As Learner	207
20	2 X 5 Contingency table for Post-test of Experimental & Control	200
29	Group of Pre-Service Teachers As both Learner & Teacher	208
20	Frequency, Percentage of Pre-Service Teachers' Lesson Plans	200
30	Categories	209
31	Objectives and Tools wise Analysis of the Collected Data	256
	List of Figures	
Figure No.	. Title	Page. No
1	Model for ICT Integration	8
2	Model of ICTACLA	56
3		
	Concept Map of Theoretical Literature	78
	Concept Map of Theoretical Literature	78
	Concept Map of Theoretical Literature  List of Graphs	78
Graph No.	List of Graphs	78  Page. No.
<b>Graph No.</b>	List of Graphs	
-	List of Graphs Title	Page. No.
1	List of Graphs  Title  Pre-Service Teacher wise School wise Pre-Test and Post-Test mean scores	<b>Page. No.</b> 144
-	List of Graphs  Title  Pre-Service Teacher wise School wise Pre-Test and Post-Test	Page. No.