

TABLE OF CONTENT

Titles	Pg. No.
Declaration	II
Certificate	III
Acknowledgement	IV
Table Of Contents	VI-XII
List Of Tables	XIII-XVI
List Of Figures	XVII-XIX
List Of Appendices	XX-XXII
 CHAPTER - I CONCEPTUAL FRAMEWORK	 1-52
1.0 Introduction	2
1.1 Mathematics Education In India: An Overview	4
1.2 School Mathematics Education: A Polity Perspective	8
1.2.1 Aims Of School Mathematics Education	8
1.2.2 Challenges For School Mathematics Education	9
1.2.3 Recommendations For School Mathematics Education	10
1.3 Focusing On Secondary School Mathematics Education	10
1.3.1 Significance Of The Secondary School Mathematic Education	11
1.3.2 Objectives Of The Secondary School Mathematics Education	12
1.3.3 Curricular Features Of The Secondary School Mathematics Education	13
1.4 Mathematics Teaching And Learning: The Concerns	14
1.4.1 Mathematics Learning: The Problems	14

1.4.2	Mathematics Teaching: The Problems	16
1.5	Improvisation Of Mathematical Understanding	18
1.5.1	Misconceptions: The Gaps In Understanding The Mathematics	20
1.5.2	Conceptual Understanding: Necessity For Mathematics Education	21
1.6	Taxonomies Of Learning: The Highlights	23
1.7	The S.O.L.O. (SOLO) Taxonomy: An Abstract View	32
1.7.1	Means Of Constructive Alignment With SOLO Levels	34
1.7.2	Psychological Aspects Of The SOLO Taxonomy	35
1.7.3	The Application Of SOLO Taxonomy: SOLO Based Examples	36
1.7.4	Advantages Of SOLO Model For The Evaluation Of Students Learning	41
1.7.5	Observing From Bloom's Taxonomy To SOLO Taxonomy	41
1.8	Rationale Of The Study	44
1.9	Statement Of The Problem	47
1.10	Objectives Of The Study	47
1.11	Hypotheses	48
1.12	Explanation Of The Terms	50
1.12.1	Instructional Strategy	50
1.12.2	SOLO Taxonomy	50
1.13	Operationalization Of The Terms	50
1.13.1	Achievement	50
1.13.2	Effectiveness	51
1.13.3	Reactions	51
1.14	Delimitation Of The Study	51
1.15	Scheme Of Chapterization	51

CHAPTER - II	REVIEWS OF RELATED LITERATURE	53-135
2.0	Introduction	54
2.1	Part - I: Reviews On Misconceptions In Learning Of Mathematics	55
2.1.1	Arithmetic	57
2.1.2	Measurement	59
2.1.3	Geometry	61
2.1.4	Algebra And Calculus	63
2.1.5	Probability And Statistics	68
2.1.6	Summary Of Reviews In Part-I	70
2.2	Part - II: Reviews On Other Attributes Concerned With Mathematics Education	74
2.2.1	Attitudes	74
2.2.2	Problem Solving	77
2.2.3	Interactions And Responses	79
2.2.4	Manipulative	81
2.2.5	Constructivism	83
2.2.6	Assessment And Achievement	90
2.2.7	Summary Of Reviews In Part-II	96
2.3	Part - III: Reviews On Instructional Strategies For Mathematics Education	101
2.3.1	Summary Of Reviews In Part-III	105
2.4	Part - IV: Reviews On Conceptual Understanding Or In-depth Learning In Mathematics	107
2.4.1	Summary Of Reviews In Part-IV	111
2.5	Part - V: Reviews On S.O.L.O. Taxonomy	113
2.5.1	Summary Of Reviews In Part-V	125
2.6	Research Trends And Research Gaps: Mathematics	130
2.7	Implications For The Present Study	132

CHAPTER - III	METHODOLOGY AND PROCEDURES	136-168
3.0	Introduction	137
3.1	Methodology	137
3.1.1	Research Method and Design of the study	138
3.1.2	Variables for the Experimental study	139
3.1.3	Threats and Validity for the Experimental study	140
3.1.3.1	Internal Validity	140
3.1.3.2	External Validity	144
3.2	Population and Sample	145
3.2.1	Matching for the equivalence of two groups	146
3.3	Tools for Data collection	149
3.3.1	Tools to measure the components of the study	149
3.3.1.1	Achievement Tests	150
3.3.1.2	Reaction Tools	151
3.3.2	Tools to support the study	153
3.3.2.1	Field Notes	153
3.3.2.2	Observation Notes	154
3.3.2.3	Reflection Notes	155
3.4	Techniques of Data Analysis	155
CHAPTER - IV	INSTRUCTIONAL PLANNING AND DELIVERY	169-200
4.0	Introduction	170
4.1	Planning of SOLO based Instructional Strategy	171
4.1.1	Field visits for the class-observations	171
4.1.2	Schedule of Field visits for the class observations	173
4.1.3	Findings based on the Field visits for the class observations	176

4.2	Development of SOLO Based Instructional Strategy	179
4.2.1	Designing of SOLO based Instructional Strategy	179
4.2.1.1	Brief of Unit Plan for Chapter-12 Heron's Formula	183
4.2.1.2	Brief of Unit Plan for Chapter-4 Linear Equation In Two Variables	185
4.2.1.3	Brief of Unit Plan for Chapter-8 Quadrilaterals	187
4.2.1.4	Brief of Unit Plan for Chapter-14 Statistics	188
4.2.1.5	Brief of Unit Plan for Chapter-15 Probability	190
4.2.2	Validation of SOLO based Instructional Strategy	192
4.2.3	The Pilot study for the developed SOLO based Instructional Strategy	192
4.2.3.1	Schedule for the Pilot study	192
4.2.3.2	Observations drawn from the Pilot study	193
4.3	Implementation of developed Instructional Strategy	195
4.3.1	Schedule for implementation of SOLO based Instructional Strategy	195
CHAPTER - V	DATA ANALYSIS AND INTERPRETATION	201-279
5.0	Introduction	202
5.1	Graphical Presentations And Interpretations	203
5.2	Descriptive Statistics And Interpretations	208
5.3	Data Analysis and Interpretations on Achievements	212
5.3.1	Analysis and interpretations on the chapter-wise achievement test-scores with respect to Objective - 3 And Hypotheses - H_1 to H_5	212
5.3.1.1	Hypothesis (H_1) Testing On Achievement Test For Chapter - 12	212
5.3.1.2	Hypothesis (H_2) Testing On Achievement Test For Chapter - 4	214
5.3.1.3	Hypothesis (H_3) Testing On Achievement Test For Chapter - 8	216

	5.3.1.4	Hypothesis (H ₄) Testing On Achievement Test For Chapter - 14	217
	5.3.1.5	Hypothesis (H ₅) Testing On Achievement Test For Chapter - 15	219
5.3.2		Analysis And Interpretations On An Overall Achievement Test-scores With Respect To Objective - 4 And Hypothesis - H ₆	221
5.3.3		Analysis And Interpretations On The SOLO Level-wise Achievements With Respect To The Objective - 5 And Hypotheses - H ₇ to H ₁₁	223
	5.3.3.1	Graphical Presentations For Comparison Of Groups On SOLO Levels	223
	5.3.3.2	Descriptive Analysis For Comparison Of Groups On SOLO Levels	229
	5.3.3.3	Hypotheses (H ₇ to H ₁₁) Testing On Overall Achievement Test At All The Five Levels Of SOLO Taxonomy	231
5.3.4		Overall Interpretations On The Analysis Of Achievement Tests	233
5.4		Data analysis and interpretations on reactions	233
5.4.1		Analysis And Interpretations On The Chapter - wise Reactions With Respect To Objective - 6 And Hypotheses - H ₁₂ to H ₁₆	234
	5.4.1.1	Hypothesis (H ₁₂) Testing On The Reactions For A Chapter - 12	234
	5.4.1.2	Hypothesis (H ₁₃) Testing On The Reactions For A Chapter - 4	239
	5.4.1.3	Hypothesis (H ₁₄) Testing On The Reactions For A Chapter - 8	243
	5.4.1.4	Hypothesis (H ₁₅) Testing On The Reactions For A Chapter - 14	247
	5.4.1.5	Hypothesis (H ₁₆) Testing On The Reactions For A Chapter - 15	251
5.4.2		Analysis And Interpretations On The Overall Reactions With Respect To Objective - 7 And Hypothesis - H ₁₇	256
5.5		Analysis and Interpretation based on Rasch Model	272
5.6		Conclusion	278

CHAPTER - VI	SUMMARY AND IMPLICATIONS	280-302
6.0	Introduction	281
6.1	An overview on methodology of the study	281
6.2	Major results and conclusions of the study	285
6.3	Discussions	290
6.3.1	Conceptual understanding and misunderstanding in Mathematics	290
6.3.2	Reviews on selected chapters of class-IX Mathematics textbook	291
6.3.3	SOLO Hexagon: Graphical organizer for concept arrangements	292
6.3.4	Practical approach in Mathematics through activities	293
6.3.5	Reviews on hands-on activities conducted during the study	293
6.3.6	Students' learning experiences	295
6.3.7	Reflections on the practices with SOLO taxonomy based Instructional strategy	295
6.3.8	Rasch model for the measurement	295
6.3.9	SOLO taxonomy based assessment and evaluation	296
6.4	Implications of the present research study	297
6.5	Suggestions	298
6.6	Perspectives to practice with S.O.L.O. Taxonomy	299
6.6.1	Understanding: Connecting or relating the contexts	300
6.6.2	Integrated SOLO-Bloom Taxonomy	300
6.7	Conclusion	302
BIBLIOGRAPHY		303-334
APPENDICES		i - ccxli

