CONTENTS

Title Page	i
Declaration	ii
Acknowledgement	iv
Certificate	vi

CHAPTER I CONCEPTUAL FRAMEWORK

Sr. No.	Chapter	Page No.
1.0.0	Introduction	1
1.0.1	Scientific Paradigm	2
1.0.2	Paradigms of Learning and Instruction	2
1.0.3	Types of Constructivism	3
1.0.4	Constructivism as a Learning Theory	4
1.0.5	Learning Process in Constructivist Approach	5
1.1.0	Constructivism and Science Education	6
1.1.1	Constructivist Approach and Experiential Learning	6
1.1.2	Constructivism, Science and Cognitive Psychology	8
1.1.3	Various Approaches in Science Teaching for Conceptual	9
	Reconstruction	
1.2.0	Social Construction of Knowledge	10
1.3.0	Nature and Characteristics of Science	10
1.3.1	Physics and Skill Development	11
1.3.2	Constructivism and Physics Teaching	13
1.3.3	Constructivist Approach to Teach Physics	15
1.3.4	Learner's Changing Profile and Need For Constructivist	16
	Approach	
1.4.0	Technical Education in India	17
1.4.1	Technical Education in 11 th and 12 th Five Year Plans	18
1.4.2	Recommendations on Higher Technical Education	19
1.4.3	Technical Education and Skill Shortage in India	21
1.4.4	Strata of Technical Education in India	24

1.4.5	Diploma in Engineering	25
1.4.6	Gujarat Technological University	26
1.4.7	Polytechnic Colleges in Vadodara	27
1.4.8	Subjects taught at Diploma Level	28
1.4.9	Looking Beyond Content: Skill Development for Engineers	28
1.5.0	Physics taught at Diploma Level in Technical Education	29
1.5.1	Teaching-Learning Approaches used in Technical	30
	Education	
1.6.0	Research Questions	32
1.7.0	Rationale of the Study	32
1.8.0	Statement of the Problem	35
1.8.1	Objectives of the Study	35
1.8.2	Operational Definitions of the Terms	36
1.8.3	Hypotheses of the Study	36
1.9	Conclusion	37

CHAPTER II REVIEW OF RELATED LITERATURE

Sr. No.	Chapter	Page No.
2.0	Introduction	39
2.1	Review of studies	39
2.1.1	Studies on Development and Implementation of Instructional Packages.	40
2.1.2	Overview of the Studies of Development and Implementation of Instructional Packages	48
2.1.3	Studies on Teaching-Learning of Different Subjects	49
2.1.4	Overview of the Studies on Teaching-Learning of Different Subjects	54
2.1.5	Studies on Constructivist Approach in Different Subjects	55
2.1.6	Overview of the Studies on Constructivist Approach in Different Subjects	62
2.2	Implication of the Review of Related Literature for the Present Study	63

CHAPTER III

RESEARCH METHODOLOGY

Sr. No.	Chapter	Page No.
3.0	Introduction	65
3.1	Statement of the Study	65
3.2	Objectives of the Study	65
3.3	Operational Definitions of the Terms	66
3.3.1	Instructional Design	66
3.3.2	Constructivist Approach	66
3.3.3	Effectiveness	66
3.3.4	Traditional Approach	66
3.4	Delimitation of the Study	66
3.5	Research Method and Design of the Study	67
3.6	Variables of the Study	67
3.6.1	Dependent Variables	67
3.6.2	Independent Variables	67
3.6.2.1	Components of the Instructional Design of the Study	67
3.7	Hypotheses	68
3.8	Population	69
3.9	Sample and Sampling Technique	69
3.10	Nature and Source of Data	71
3.11	Tools of the study	72
3.11.1	Construction of tools	72
3.11.2	Validation of Tools	73
3.12	Process of data collection	73
3.13	Data Analysis	78
3.14	Conclusion	79

CHAPTER IV PRESENTATION AND IMPLEMENTATION OF INSTRUCTIONAL DESIGN

Sr. No.	Chapter	Page No.
4.0	Introduction	80
4.1	Considerations for Planning Instructional Designs Based on	80
	Constructivist Approach	
4.2	Plan of Implementation	82
4.3.0	Unit I: System International (SI) Units and measurements	83
4.3.1	Instructional Designs for unit I: SI Unit and Measurement	84
4.3.2	Instructional Design 2: Vernier Calipers	87
4.3.3	Instructional Design 3 Micro meter screw gauge	89
4.3.4	Instructional Design 4: Accuracy and Precision.	91
4.3.5	Participant Observation for unit I: SI System and	94
	Measurement	
4.4.0	Unit II : Sound and Waves	96
4.4.1	Instructional Design 5 Waves	96
4.4.2	Instructional Design 6: Wave Parameters	102
4.4.3	Instructional Design 7: Types of Waves	106
4.4.4	Instructional Design 8: Interference and its types	110
4.4.5	Participant Observation for unit II: Sound and Waves	112
4.5.0	Unit III: :Light	113
4.5.1	Instructional Design 9: Properties of Light	113
4.5.2	Instructional Design 10: Dispersion of Light	119
4.5.3	Instructional Design 11: Superposition of Waves	122
4.5.4	Instructional Design 12: Resonance	124
4.5.5	Participant Observation for Unit III: Light	128
4.6	Overall Reflections on Implementation of Instructional	129
	Design	

CHAPTER V DATA ANALYSIS AND INTERPRETATION

Sr. No.	Chapter	Page No.
5.0	Introduction	130
5.0.1	Assessing equivalence of experimental and control groups	130
5.0.1.1	Assessing equivalence with respect to Intelligence test	130
	scores of both the groups Examination in science	
5.0.1.2	Assessing equivalence with respect to achievement of	131
	students in standard X Board	
5.1	Data Analysis in objective 3 formulated for the study to	133
	determine the effectiveness of instruction	
5.1.0	Data Analysis of Post test for Unit I: SI Units and	133
	Measurements	
5.1.1	Analysis and Interpretation of N, Mean, SD and t-value of	134
	the experimental and control group for post-test I	
5.2	Data Analysis of Post test for unit II: WAVES	135
5.2.1	Analysis and Interpretation of N, Mean, SD and t-value of	135
	the experimental and control group for post-test II	
5.3	Data Analysis of post- test for unit III: LIGHT	136
5.3.1	Analysis and Interpretation of N, Mean, SD and t-value of	137
	the experimental and control group for post-test III	
5.4	Data Analysis of Comprehensive Post test for unit I, II and	138
	III	
5.4.1	Analysis and Interpretation of N, Mean, SD and t-value of	139
	the experimental and control group of Comprehensive Post-	
	test for unit I, II and III	
5.5	Data Analysis of Delayed Comprehensive Post test for unit	140
	I, II and III	
5.5.1	Analysis and Interpretation of N, Mean, SD and t-value of	140
	the experimental and control group of Delayed Response	
	test for unit I, II and III	
5.6	Researcher's Observation of students during Instructional	141
	Process	

5.7	Semi-Structured Interview for Students	144
5.7.1	Analysis of Semi-Structured Interview for Students	145
5.7.2	Interpretation of Semi-Structured Interview for Students	146
5.8	Discussion on Data	146

CHAPTER VI

SUMMARY AND FINDINGS

Sr. No.	Chapter	Page No.
6.0	Introduction	151
6.1	Constructivism, Science and Cognitive Psychology	151
6.2	Social Construction of Knowledge	152
6.3	Physics	153
6.4	Skill Shortage in India	153
6.5	Review of related literature	154
6.6	Rationale of the study	156
6.7	Research Questions of the study	158
6.8	Statement of the Problem	159
6.9	Objectives of the study	159
6.10	Operational Definitions of the terms	159
6.11	Delimitation of the study	160
6.12	Hypotheses	160
6.13	Nature and Sources of the data required for the study	161
6.14	Design of the Study	161
6.15	Population of the study	162
6.16	Sample and Sampling Technique	162
6.17	Tools of the Study	162
6.17.1	Construction of Tools	163
6.17.2	Validation of Tools	163
6.18	Process of Data Collection	163
6.19	Data Analysis	168
6.20	Major Findings of the Study	168
6.21	Implications of the Study	169
6.22	Suggestions for Future Studies	170
6.23	Conclusion	170
	Bibliography	171
	Appendices	187

List of Appendices

Appendix 1 : List of Experts for Validation of Tools

Appendix 2 A: Post-tests

Appendix 2 B: Scoring Key o Post-tests

Appendix 3 : Hand outs for students

Appendix 4 : Semi-Structured Interview for Students

Appendix 5 : Photographs of Implementation of Constructivist Approach

Appendix 6 : Scores of Students of Post-tests

Appendix 7 : Draft Version of Instructional Design

Appendix 8 : Paper Publications

LIST OF TABLES

Table	Particulars	Page
No.		No.
1.1	Summary of Major Committees and Recommendations	20
4.1	Measurement Record Sheet	85
4.2	Formulas and SI units of physical quantities	86
4.3	Measurement of thickness of metallic sheets	88
4.4	Measurement of thickness of given materials by micrometer	90
	screw gauge	
4.5	Activity Sheet for measuring present time	92
4.6	Measurement of thickness of metallic sheets by Vernier Caliper	93
	and Micro meter screw gauge	
4.7	Calculation of speed of waves	103
4.8	Reflection and refraction of light	115
5.1	Mean IQ Scores of students	131
5.2	X Board Examination Scores of students of Science subject of	131
	both the groups	
5.3	N, Mean, SD and t-value of the Experimental and Control Groups	133
	for post-test 1.	
5.4	N, Mean, SD and t-value of the Experimental and Control Groups	135
	for post-test II	
5.5	N, Mean, SD and t-value of the Experimental and Control Groups	137
	for post-test III	
5.6	N, Mean, SD and t-value of the Experimental and Control Groups	138
	for comprehensive post-test for unit I, II and III.	
5.7	N, Mean, SD and t-value of the Experimental and Control Groups	140
	for Delayed response post-test for unit I, II and III.	
5.8	Students' view on learning following Constructivist Instructional	144
	Design	

LIST OF FIGURES

Figure	Particulars	Page
No.		No.
1.1	Experiential Learning cycle by Kolb	7
1.2	Social construction of knowledge in classroom	12
1.3	GER of selected countries	18
1.4	Gross Enrollment Ratio across categories	21
1.5	GER among Socio- Economic Groups	22
1.6	Percentage of workforce receiving skill training (2014)	23
1.7	Growth in Under Graduate Engineers in Different Countries	24
4.1	Implementation of constructivist approach in teaching physics	82
4.2	Time Line in sports	91
4.3	Clips of different types of waves	96
4.4	Wave Frequency	99
4.5	Wave Amplitude	100
4.6	Wave Length	100
4.7	Wave Amplitude	101
4.8	Wave Motion	102
4.9	Wavelength of waves	105
4.10	Compressional (P) wave propagation in a slinky	107
4.11	Directional wave propagation in a slinky	108
4.12	Interference of waves	110
4.13	Constructive and destructive interference waves	111
4.14	Reflection and Refraction	114
4.15 A	Angle of incidence	116
4.15 B	Angle of incidence	117
4.16	Reflection of waves in car sensors	118
4.17	Light when it passes through the prism	119
4.18	Dispersion of light	120
4.19	Light passes through a medium	120
4.20	The principle of superposition	122
4.21	Resonance	124
	1	

4.22	Resonance of Light Waves	125
4.23	The glass appears clear because it does not absorb sunlight	126
4.24	Applications of Resonance	128
5.1	Mean and Standard Deviation of scores in science of students of	132
	experimental and control group in Standard X Board	
	Examination.	
5.2	Mean and SD of scores of unit test I of experimental and control	134
	group respectively	
5.3	Mean and SD of scores of unit test II of experimental and control	136
	group respectively	
5.4	Mean and SD of scores of unit test III of experimental and	138
	control group respectively	
5.5	Mean and SD of scores of comprehensive unit test I, II and III of	139
	experimental and control group respectively	
5.6	Mean and SD of scores of delayed response post-test for unit I, II	141
	and III of experimental and control group respectively	

List of Abbreviations

Sr. No.	Short forms	Abbreviations
1	AMIE	Associate Member of Institution of Engineering
2	ANCOVA	Analysis of Covariance
3	ANOVA	Analysis of Variance
4	APM	Advance Progressive Matrices
5	BRICS	Brazil Russia India China and South Africa
6	GAT	Geometric Achievement test
7	GER	Gross Enrolment Ratio
8	GSTEB	Gujarat State Technical Education Board
9	GTU	Gujarat Technological University
10	HOD	Head Of Department
11	ILO	Industrial Labour Organization
12	INL	Individualized Method of Learning
13	ITC	Industrial Training Center
14	ITI	Industrial Training Institute
15	MHRD	Ministry of Health and Rural Development
16	NCF	National Curriculum Framework
17	NID	National Institute of Design
18	NSSO	National Sample Survey Organization
19	OBC	Other Backward Class
20	PMT	Presentation Method of Teaching
21	PSTT	Pre Service Teacher Trainees
22	SC	Scheduled Caste
23	ST	Scheduled Tribe
24	UBE	Universal Basic Education
25	UEC	University Education Commission
26	UG	Under Graduate