CONTENTS

Sl. No.	DETAILS	PAGE.NO.
1.0	**INTRODUCTION**	**1-6**
2.0	**LITERARY RESEARCH ON PRĀṆĀYĀMA AND VEDIC MATHS**	**7-39**
2.1	**BACKGROUND AND SCOPE**	**7**
2.2	**AIMS AND OBJECTIVES**	**7**
2.3	**SOURCE MATERIAL**	**8**
2.4	**CONCEPT OF PRĀṆĀ**	**9-12**
2.4.1	Prāṇā	9
2.4.2	Prāṇamaya Kośa	9-10
2.4.3	All-pervading Prāṇā	10
2.4.4	Gross manifestation of Prāṇā	10
2.4.5	Prāṇā the Lord	10
2.4.6	Source of Prāṇā	12
2.4.7	Prāṇā Sacrifice	12
2.5	**TYPES OF PRĀṆĀ**	**13-18**
2.5.1	Pañca Prāṇā	13
2.5.2	Disturbances in Prāṇā	16
2.6	**PRĀṆĀYĀMA**	**19-29**
2.6.1	The Remedy for Prāṇā Disturbances	19
2.6.2	Method of Prāṇāyāma	20
2.6.3	Benefits of Prāṇāyāma	21
2.6.4	Nāḍī Śodhana	24
2.6.5	Sûrya Bhedana	26
2.6.6	Bhastrikā Prāṇāyāma	27

2.6.7	Bhrāmari Prāṇāyāma	29
2.7	**VEDIC MATHS**	**30-38**
2.7.1	Terms used in the Vedic Maths Sūtras and Upasūtras	30
2.7.2	The 16 Sūtras	31
2.7.3	The Upasūtras (Corollaries)	33
2.7.4	Illustrative applications of some Sūtras	35
2.8	**SUMMARY**	**39**
3.0	**REVIEW OF SCIENTIFIC LITERATURE**	**40-65**
3.1	**MATH ANXIETY**	**40-53**
3.1.1	Prevalence of Math Anxiety	41
3.1.2	Effects of Math Anxiety	42
3.1.2 A	Performance	42
3.1.2 B	Psychological	45
3.1.2 C	Cognitive	46
3.1.3	Mechanisms of Math Anxiety	48
3.1.4	Treating Math Anxiety	51
3.2	**PRĀṆĀYĀMA**	**53-58**
3.2.1	Prāṇāyāma for Anxiety Reduction	54
3.2.2	Prāṇāyāma and Cognitive Skills	56
3.2.3	Prāṇāyāma for Children/Adolescents	58
3.3	**VEDIC MATHS**	**59-64**
3.3.1	Origin and Uniqueness of Vedic Maths	59
3.3.2	Criticism on Vedic Maths	59
3.3.3	Research supporting Vedic Maths	61
3.3.4	Recent Developments in Vedic Maths	63
3.4	**SHORT SUMMARY AND CONCLUSIONS**	**64-65**
4.0	**AIMS AND OBJECTIVES**	**66-68**
4.1	**AIMS OF THE STUDY**	**66**

4.2	**OBJECTIVES OF THE STUDY**	**66**
4.3	**HYPOTHESIS**	**67**
4.4	**NULL HYPOTHESIS**	**67**
4.5	**RATIONALE OF USING VEDIC MATHS AND YOGĀ PRĀṆĀYĀMA AS INTERVENTONS**	**68**
5.0	**METHODS**	**69-90**
5.1	**PARTICIPANTS**	**69-71**
5.1.1	Sample size	69
5.1.2	Location, Source and Selection of Participants	69
5.1.3	Inclusion criteria	71
5.1.4	Exclusion criteria	71
5.1.5	Informed Consent and Ethical Considerations	71
5.2	**DESIGN OF THE STUDY**	**71-72**
5.2.1	Demographics	71
5.2.2	Study 1	71
5.2.3	Study 2	72
5.2.4	Study 3	72
5.3	**INTERVENTION**	**73-82**
5.3.1	Yogā Prāṇāyāma	73
5.3.2	Vedic Maths	74
5.3.3	Details of the Yogā Prāṇāyāma Interventions	75
5.3.4	Details of the Vedic Maths Interventions	78
5.3.5	Control Group	82
5.4	**ASSESSMENT INSTRUMENTS**	**82-86**
5.4.1	Mathematics Anxiety Rating Scale Revised - MARS-R	82
5.4.2	Children's Cognitive Assessment Questionnaire – CCAQ	82
5.4.3	STROOP	83
5.4.4	Digit Span Test: Forward and Backward	83
5.4.5	Mindfulness Attention Awareness Scale (MAAS)	83
5.4.6	Nonphysical Aggression Scale from Pittsburgh Youth Study	84

5.4.7	Emotion Regulation Questionnaire (ERQ)	84
5.4.8	An additional Assessment: Exam Result Analysis	84
5.4.8A	Conventional Mathematics Teaching	85
5.4.8B	Vedic Maths Teaching	85
5.5	**DATA EXTRACTION**	**88-90**
5.5.1	Mathematics Anxiety Rating Scale Revised - MARS-R	88
5.5.2	Children's Cognitive Assessment Questionnaire – CCAQ	88
5.5.3	STROOP	88
5.5.4	Digit Span Test: Forward and Backward	89
5.5.5	Mindfulness Attention Awareness Scale (MAAS)	89
5.5.6	Nonphysical Aggression Scale from Pittsburgh Youth Study	89
5.5.7	Emotion Regulation Questionnaire (ERQ)	90
5.6	**DATA ANALYSIS**	**90**
6.0	**RESULTS**	**91-112**
6.1	**STUDY 1 PILOT STUDY**	**91-96**
6.1.1	Math Anxiety Rating Scale - Revised	91
6.1.2	STROOP test	93
6.1.3	Children's Cognitive Assessment Questionnaire	94
6.1.4	Digit Span test	96
6.2	**STUDY 2: FIRST MAIN STUDY**	**97-100**
6.2.1	Math Anxiety Rating Scale - Revised	97
6.2.2	Children's Cognitive Assessment Questionnaire	98
6.3	**STUDY 3: SECOND MAIN STUDY – MINDFULNESS, AGGRESSION AND EMOTION REGULATION**	**100-104**
6.4	**COMPARISION BETWEEN STUDY 2 AND 3**	**104-109**
6.4.1	Results of MARS-R	104
6.4.2	Results of CCAQ	106
6.5	**FINAL EXAM RESULT ANALYSIS**	**109-112**
7.0	**DISCUSSION**	**113-140**

7.1	**STUDY 1: PILOT STUDY**	**113-115**
7.2	**STUDY 2: FIRST MAIN STUDY**	**115-116**
7.3	**STUDY 3: SECOND MAIN STUDY**	**116-119**
7.4	**COMBINED DATA**	**119-123**
7.4.1	Vedic Maths and MARS-R	119
7.4.2	Vedic Maths and Cognitive Skills (CCAQ)	120
7.4.3	Digit Span Test	122
7.5	**ANALYSIS OF EXAM RESULTS**	**123-125**
7.6	**USE OF PATTERNS IN VEDIC MATHS**	**125-129**
7.6.1	An Example (Jammu and Kashmir Common Entrance Test, 2007)	125
7.6.2	Popularity of Vedic Maths	126
7.6.3	Vedic Maths and competitive exams	127
7.7	**IMPLICATIONS FOR ENDORPHIN RELEASE BY VM METHODS**	**130-140**
7.7.1	Endorphins and the endorphin system	130
7.7.2	Endorphin and Yogā	131
7.7.3	The role of the Endorphin System in Normal Behaviour	132
7.7.4	The Endorphin System in Human Behaviour a General Role	134
7.7.5	The Endorphin System and Creative Thinking	136
8.0	**APPRAISAL**	**141-148**
8.1	**SUMMARY OF THE FINDINGS**	**141-142**
8.2	**CONCLUSIONS FROM INDIVIDUAL ASSESSMENT TESTS**	**142-143**
8.2.1	MARS-R	142
8.2.2	CCAQ (Cognitive Skills)	142
8.2.3	Digit Span Test	143
8.2.4	MAAS (Mindfulness)	143
8.2.5	Pittsburgh Aggression Scale	143

8.3	**IMPLICATIONS OF THE STUDY**	**144-145**
8.3.1	Study 1 (Pilot study)	144
8.3.2	Study 2	144
8.3.3	Study 3	145
8.3.4	Final Exam Results in Mathematics	145
8.4	**APPLICATION OF THE STUDY**	**146**
8.5	**STRENGTHS OF THE STUDY**	**146-147**
8.6	**LIMITATION OF THE STUDY**	**147**
8.7	**SUGGESTIONS FOR FUTURE RESEARCH**	**148**
	REFERENCES	**149-169**
	APPENDICES	**170-203**
1.0	**VEDIC MATHS APPICATION IN DIFFERENT COMPETITIVE EXAMINATION**	**170-186**
2.0	**INFORMED CONSENT FORMS: A SAMPLE COPY**	**187-190**
3.0	**INSTITUTIONAL ETHICAL COMMITTEE APPROVAL**	**191-192**
4.0	**QUESTIONNAIRE(S) – SAMPLE COPY**	**193-201**
5.0	**ABBREVATIONS**	**202**
6.0	**LIST OF PUBLICATIONS FROM THIS DOCTORAL THESIS**	**203**

LIST OF TABLES

TABLE NO.	TITLE	PAGE NO.
2.0 LITERARY RESEARCH ON PRĀṆĀYĀMA AND VEDIC MATHS		
1	**TERMS USED IN THE VEDIC MATHS SŪTRAS AND UPASŪTRAS AND THEIR**	**30-31**
5.0 METHODS		
2	**INTERVENTIONS**	**78**

6.0 RESULTS		
3	MATHEMATICS ANXIETY RATING SCALE - MARS-R: MEAN ± SD	92
4	STROOP TEST: MEAN ± SD	93
5	CHILDREN'S COGNITIVE ASSESSMENT QUESTIONNAIRE – CCAQ: MEAN ± SD	94
6	DIGIT SPAN TEST: MEAN ± SD	96
7	MATHEMATICS ANXIETY RATING SCALE – MARS-R - STUDY 2	97
8	COMPARISON OF PRE-POST DIFFERENCES BETWEEN EXPERIMENTAL GROUPS AND CONTROL GROUP– STUDY 2	98
9	CHILDREN'S COGNITIVE ASSESSMENT QUESTIONNAIRE – STUDY 2	99
10	GROUP COMPARISON - CHILDREN'S COGNITIVE ASSESSMENT QUESTIONNAIRE – STUDY 2	99
11	MINDFULNESS, AGGRESSION, AND EMOTION REGULATION: MEAN ± SD; PRE AND POST DATA – STUDY 3	101
12	WITHIN GROUP DIFFERENCES AND SIGNIFICANCES OF BETWEEN GROUP COMPARISONS – STUDY 3	102
13	MATHEMATICS ANXIETY RATING SCALE– MARS-R: MEAN±SD – COMPARISION STUDY 2 AND STUDY 3	105
14	COMPARISON OF MARS-R PRE-POST DIFFERENCES BETWEEN EXPERIMENTAL GROUPS AND CONTROL GROUP – COMPARISION STUDY 2 AND STUDY 3	106
15	CHILDREN'S COGNITIVE ASSESSMENT QUESTIONNAIRE – CCAQ: MEAN ± SD – COMPARISION STUDY 2 AND STUDY 3	108
16	GROUP COMPARISON - CHILDREN'S COGNITIVE ASSESSMENT QUESTIONNAIRE – COMPARISION STUDY 2 AND STUDY 3	109
17	MEAN SCORES FOR COHORTS FOR YEARS 2010 TO 2015	110

18	MEANS AND STANDARD DEVIATIONS FOR BATCHES WITH AND WITHOUT VEDIC MATHS	111
19	NUMBERS OF STUDENTS OBTAINING DISTINCTIONS AND FULL MARKS	111
20	EFFECT SIZES AND SIGNIFICANCES OF DISTINCTIONS AND FULL MARKS DATA	112

LIST OF FIGURES

FIG. NO.	TITLE	PAGE NO.
	1. INTRODUCTION	
1	PARAMETERS IN STUDIES	5
	5. METHODS	
2	FLOW CHART FOR STUDIES 1 TO 3	73
3	INTEGRATION AS SUMMATION TO FIND THE AREA UNDER A CURVE	87
4	TEXT BOOK PROBLEM	87
	6. RESULTS	
5	COMPARISON OF MATH-ANXIETY PRE-POST DIFFERENCES BETWEEN YB, VM AND JG GROUPS	92
6	COMPARISON OF STROOP PRE-POST DIFFERENCES SCORES BETWEEN YB, VM AND JG GROUPS	94
7	COMPARISON OF CCAQ PRE-POST DIFFERENCES SCORES BETWEEN YP, VM AND JG GROUPS	94
8	COMPARISON OF DIGIT SPAN PRE-POST DIFFERENCES SCORES BETWEEN YB, VM AND JG GROUPS	96
9	MATH ANXIETY POST-PRE MEAN SCORE COMPARISONS FOR YP, VM AND CONTROLS – STUDY 1	98
10	CCAQ POST-PRE MEAN SCORE COMPARISONS FOR YP, VM AND CONTROLS – STUDY 2	99
11	SHOWS MINDFULNESS ATTENTION AWARENESS SCALE PRE–POST MEAN SCORES – STUDY 3	102

12	**NONPHYSICAL AGGRESSION SCALE SCALE PRE–POST MEAN SCORES – STUDY 3**	**103**
13A	**GROUP-TIME INTERACTION EFFECTS ON MINDFULNESS**	**103**
13B	**GROUP-TIME INTERACTION ON AGGRESSION**	**104**
14	**AVERAGE MARKS FOR THE SIX BATCHES FROM 2010 TO 2015**	**110**
15	**NUMBERS OF STUDENTS OBTAINING DISTINCTIONS AND SCORING 100 OUT OF 100**	**112**

LIST OF PLATES

PLATE NO.	TITLE	PAGE NO.
1	**INTERVENTIONS**	**70**