CHAPTER – 1

INTRODUCTION

1.0 INTRODUCTION

According to Lamb, “a world without math is unimaginable” (Lamb, 2011). Many children have less interest in mathematics (Frenzel et al., 2010), and find learning maths very difficult. Why this is so may not be clear, because many children find well-presented mathematical ideas inspiring (Hohenwarter et al., 2008; Tatar, 2013). Demands of science and mathematics can turn school into an unpleasant experience (Kihwele, 2014). Anxiety caused by daily mathematics lessons starts in elementary school (Ramirez et al., 2013), becoming dominant features of school experience (Maloney et al., 2010), and causing Math Anxiety (Taylor et al., 2013) leading to poor performance in Mathematics.

Limitations in cognitive skills and subject results greatly reduce students’ career choices, and the value of their school education. One major problem causing such limitations is Math Anxiety (Ashcraft et al., 2009). Research reports that substantial number of students develop Math Anxiety at early stages of life (Gerardo Ramirez et al., 2013). Math Anxiety can be defined as “a feeling of being unable to manage, paralysis, mental confusion that appears in some people when faced with a mathematical problem to solve” (Tobias et al., 1980). Another definition considers Math Anxiety a “chasm” separating the “concrete” from the “abstract” (Reys at el., 2014). Here the “concrete” may be modelling, manipulating while the “abstract” is generalizing, representing, symbolizing. The chasm is created by dislike of math, apathy, or poor motivation. Generally, anxiety affects cognition by disrupting normal processing within the working memory system. Math Anxiety may disrupt cognitive processing by compromising ongoing activity in working memory, a skill important for performing calculations in class exercises, tests and examinations (M H Ashcraft et al.,

2009). Here the term working memory refers to the brain's capacity to provide temporary storage and manipulation of information necessary for complex cognitive tasks like language comprehension, learning, mathematical processing and reasoning (Baddeley, 2010).

Since Math Anxiety, working memory and math performance are interlinked (Mark H. Ashcraft et al., 2001) each one affects the other two. End results may be disturbed working memory and associated cognitive skills, and poor math performance. Reduced cognitive reflection of the students caused by Math Anxiety negatively affects ability to make good decisions in problem solving (Morsanyi et al., 2014). This disturbed state may lead to emotional imbalance, stress related problems, aggression, and lowered intelligence. It's a potential risk factor in impairing comprehension skills and behavioral intention (Silk et al., 2014). An early review of Math Anxiety found its cause in low self-esteem, low self-confidence, not believing that mathematics has a purpose, ways of teaching of mathematics, and sticking to single methods of solving problems; these resulted in difficulty in breathing, increased heart rate, clammy hands, upset stomach, and light headedness (Plaisance, 1980). These continue throughout student life and may magnify from primary, to secondary, to pre-university level. Later, technical courses can assure well-paid job opportunities, but require computation skills and mathematics learning in detail. The highly competitive environment created by market-oriented applied courses makes it essential for students to perform well on mathematics exams, creating pressurized situations. Students suffering from Math Anxiety may run away from such courses, and experience great stress and frustration when choosing a career. Failure to manage Math Anxiety and its effects on cognitive skills strongly impact learning processes in children and adolescents, which become major issues. Some papers have shown how to reduce it (Bellinger et al., 2015). A specific anxiety rating

scale for Math Anxiety, developed by Richardson and Suinn (1972), was revised and validated.

How to remedy these problems? Relevant questions are: “How to improve math exam performance?”, “How to reduce Math Anxiety?”, and “How to improve cognitive skills?” This study compares two methods of reducing Math Anxiety and improving cognitive skills: Yogā Prāṇāyāma, a well-researched means of anxiety reduction (Khalsa et al., 2012; Sharma et al., 2013); and, Vedic Maths, teaching methods of Swami Bharati Krishna Tirtha Maharaj (Bharati Krsna Tirthaji Maharaja, 1992), which offers students choice of ways to carry out calculations (Syed Ismail et al., 2010) and benchmark for doing so. Both Yogā Prāṇāyāma and Vedic Maths are described and discussed in detail below.

Yogā Prāṇāyāma: One method known to strengthen or develop cognitive skills is Yogā Prāṇāyāma. Yogā has been much researched in schools (Ferreira-Vorkapic et al., 2015; Serwacki et al., 2012), and Yogā Prāṇāyāma is known to reduce anxiety in adults (Li et al., 2012). Sūrya Bhedana, Chandra Bhedana and Nāḍī Śuddhi Prāṇāyāma, which slowly restore balance between left and right lobes of the brain, may be practised to sharpen the critical faculty and creativity (Nagendra, 2005). One study suggests a yogic lifestyle module to reduce state and trait anxiety (Gupta et al., 2006).

Vedic Maths: Vedic Maths has proved popular in many countries (Nelson, 2015) but its advantages are only now beginning to be scientifically studied. Since its introduction by the Śaṅkarācārya of Purī in the 1950’s (Bharati Krsna Tirthaji Maharaja, 1992), the system of Vedic Maths has proved increasingly popular in schools and school systems around the world, and many books have been written about its applications in ways not

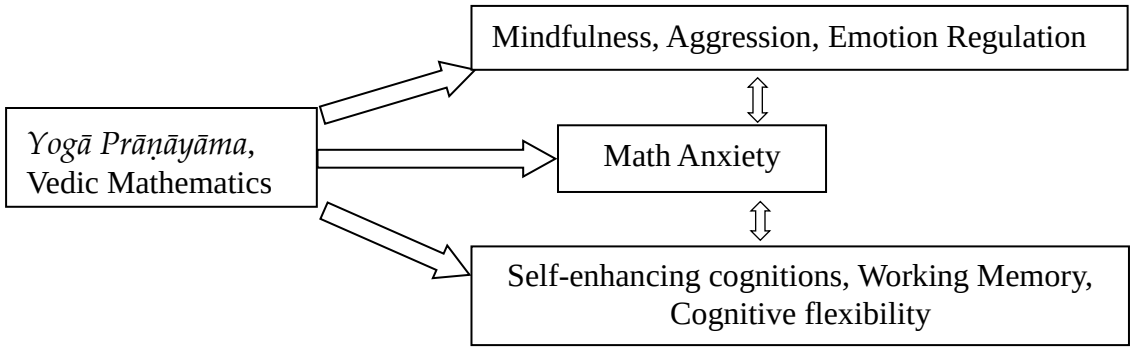
envisaged by its founder (Glover, 2005; Nicholas et al., 2010; Williams, 2009), including those to improving professional design of computer chips (Chunduri et al., 2013).

Schools in the United States and the United Kingdom have noticed the enthusiasm with which the various Sūtras of Vedic Maths are treated once they have been understood. The thirty-two such 'Sūtras', 16 main ones, and 13 subordinate 'Upasūtras' (Bharati Krsna Tirthaji Maharaja, 1992), offer enigmatic phrases to indicate a particular method of manipulating figures, or performing other tasks in school mathematics. They follow an ancient form of epigrammatic writing e.g. (Patanjali, 2015), which possesses a charming appeal that survives to this day, possibly because the human mind seems to enjoy the challenge of figuring out a disguised meaning. Once the light has dawned, and the student has been shown, and 'seen', how the pattern indicated by the Sūtra or Upasūtra is intended to be applied, its brevity seems to carry a compelling reason for doing so, and for remembering how to do so.

In India, Sūtras of this kind have been treasured as the means to understanding complex tasks and complex patterns of logical reasoning for time immemorial. Every orthodox ancient 'System of Indian Philosophy' from the famed texts of Nyāya (Vidyabhusana, 1930) to Vedānta (B. N. Sharma, 1986), offers the essential summary of its reasoning and conclusions in the form of Sūtras. Even the famous advances in conventional mathematics, whereby India's mathematicians led the world at certain times in world history (Ramasubramanian et al., 2011), were often expressed in abbreviated verse form (Srinivas et al., 2014), the interpretation of which requires considerable expertise to interpret into more mundane modern form or terminology (Ramasubramanian, 2015).

Compared to conventional mathematical methods, Vedic Maths methods are easier to perform and computationally faster (Bhardwaj et al., 2012). They reduce cumbersome-looking calculations in conventional mathematics teaching to simpler procedures (Chidgupkar et al., 2004). Magical appearances bring a "fun element" to teaching and learning basic maths computations. Students naturally enjoy the simplifications and gain a deeper feel for mathematics. In the process they gain greater aptitude for the subject. Resulting cognitive flexibility may reduce Math Anxiety and increase math performance. Establishing links between such parameters is the goal of this study.

FIGURE 1: PARAMETERS IN STUDIES



Need for the study

Mathematical skills are important for daily life activities. A study reported 38% of workers aged 16 to 65 use fractions at work at least once a week, 29% simple algebra or formulas, and 4% advanced math (Foley et al., 2017). Math Anxiety, which may lead to math avoidance, is more compared to other subjects. In schools, competitive professional examinations select those entering higher education for various professions. Today, they put new pressures and workloads on school children that some even argue to be unnecessary. Reducing the effects of such pressures is a matter of national urgency. These unwanted pressures lead to anxiety and result in poor

performance in different examinations. Therefore, there is a need for a strong intervention which can decrease students' Math Anxiety and improve other skills required for daily mathematics activities.

Scope of study

No study reports Yogā Prāṇāyāma and Vedic Maths methods as two possibilities to manage Math Anxiety and Cognitive Skills. This study can be taken as a beginning in Math Anxiety and cognitive skills research with unique interventions. If the null hypothesis is false then we can treat Prāṇāyāma and Vedic Maths as two different tools in education scenario. They reduce the burden of Math Anxiety in students and enhance cognitive skills. If Math Anxiety is addressed effectively then students have a chance of getting good careers. Also, students with good self-esteem always show emotional balance and healthy aggression. This leads to a balanced personality who is always an asset to the country's growth.