

# Math Anxiety: The Poor Problem Solving Factor in School Mathematics

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**Abstract-** Math anxiety indicates psychologically a negative mind-set towards solving mathematical problems which impacts on students' learning practices and outcomes. In looking more closely at why a remarkable no of students may be struggling for improvement in mathematics in comparison to other subjects, it is timely to consider, the math anxiety factor. This literature review looks at the concept of math anxiety and solving mathematical problems highlighting math anxiety as an important factor of poor performance in terms of solving mathematical problems of school students in mathematics and how to assist in mitigating math anxiety.

**Index Terms-** problem solving, teaching and learning, math anxiety.

## I. INTRODUCTION

From home to the work place, mathematics tools have become a part of our day-to-day life. In many circle of computer literacy, technological and mathematical competences are perceived as essential skills. Mathematics is truly the gateway of engineering and all other scientific and technological fields. The shortage of workers in technological fields is a matter of national concern. Thus, schools have responded to this need for mathematical competence by enhancing their course offering in mathematics. Also, as mathematics become part of daily life, the need for proper teaching and learning has become extremely essential. Because of this increase in needs, demands have also been placed in schools to educated students and make them "mathematically equipped". In today's high-tech world it is very important for young children to build confidence in mathematics for ever-increasing dynamic and competitive society (Furner and Berman-2003). At one time, Mathematics literacy might have been defined as knowing basic number facts and having proficiency with basic skills and procedures. But there is an increasing need for the students to understand and be able to use mathematics for the rapid change of the world. The way of describing mathematics literacy stated (Washington, D C-2001) how a person becomes mathematically literate:

**Conceptual understanding:** understanding mathematical concepts, operations and relations

**Procedural fluency:** skill in carrying out procedures flexibly, accurately, efficiently and appropriately

**Strategic competence:** the ability to formulate, represent, and solve mathematical problems.

**Adaptive reasoning:** the capacity of logical thought, reflection, explanation and justification.

**Productive disposition:** habitual inclination to see mathematics as sensible, useful and worthwhile combine with a belief in diligence and one's own efficiency.

Problem solving plays a significantly important role in mathematics teaching and learning. Trough problem solving students can enhance their thinking skills, apply procedures, deepen their conceptual understanding. Problem solving is like a vehicle by which students start thinking critically. During problem solving activities students involve with given information, formula, computations, figures, graphs etc. with synthesizing ideas, for which students must be involved with the entire learning system without any math anxiety. The study intends to highlight math anxiety as a factor of poor performance in problem solving and how to assist in mitigating this anxiety among school students.

Problem solving is the significantly important task and central part of teaching mathematics. Strategically handled proper effective teaching methodology can help the students to develop their problem solving skills. A crucial situation arises when one is in danger but does not know. A problem becomes critical due to lack of awareness of its existence. Teaching via problem solving has been emphasized more than teaching problem solving (Lester, Masingila, Mau, Lambdin, dos Santon and Raymond, 1994). Emphasising more on problem solving skill development many researchers have attempted to clarify what is meant by a problem-solving approach to teaching mathematics highlighting on teaching mathematical topics through problem-solving devices and relating with the real day to day life activities characterized by the teacher, which are helping students construct a deep understanding of mathematical concepts and procedures by involving them in doing mathematics: creating, conjecturing, exploring, testing, and verifying' (Lester et al., 1994, p.154). A problem-solving skill is like a vehicle for students to construct their own ideas, enhance logical thinking, transfer skills to unfamiliar situations and to take responsibility for their own development of learning. So, the problem solving component in mathematics teaching and learning has to be emphasized by the educators, parents and schools. Several researchers noted some important characteristics regarding problem-solving approach which include:

- mathematical dialogue and consensus between students (Van Zoest et al., 1994)
- To encourage students by making generalisations of rules and concepts (Evan and Lappin, 1994).
- teachers accepting right/wrong answers in a non-evaluative way (Cobb et al., 1991)

- teachers guiding, coaching, asking insightful questions and sharing in the process of solving problems (Lester et al., 1994)
- teachers knowing when it is appropriate to intervene, and when to step back and let the pupils make their own way (Lester et al., 1994)
- interactions between students/students and teacher/students (Van Zoest et al., 1994)
- teachers providing just enough information to establish background/intent of the problem, and students clarifying, interpreting, and attempting to construct one or more solution processes (Cobb et al., 1991)

The research on math anxiety has become more extensive as the researchers try to find why so many people intend to keep themselves away from mathematics. National Council of Teachers of Mathematics (NCTM, 1989) recognizes math anxiety as a problem and has specifically included in its assessment practices, as the teachers' job is to assess students' mathematical dispositions.

## II. CONCEPT "MATH ANXIETY"

Mathematics anxiety can be defined as feelings of tension and anxiety that interfere with the manipulation of numbers and the solving mathematical problems in a open variety of societal life and academic situations. Math anxiety indicates psychologically a feelings of tension (Richardson & Suinn, 1972) which interferes in learning and performances. In D'Ailly & Bergering, (1992) it was mentioned as a fear and apprehension. Mathematics anxiety, considered a fear or phobia, produces 'a negative response specific to the learning, or doing, of mathematical activities that interferes with performance' (Whyte, 2009, p. 4). It is defined as low self confidence, a negative mindset towards mathematics learning (Jain & Dowson, 2009), feeling threatened (Zohar, 1998), a factor of failing to reach potential (Perry, 2004) and a temporary reduction in working memory (Ashcraft & Kirk, 2001). Tobias and Weissbrod (1980) defined math anxiety as panic, helplessness, paralysis and mental disorganization that arises at the time of solving mathematical problems (Fiore, 1999, p-403). Tobias (1993) described math anxiety as a feeling of sudden death. In pursuance of these definitions and considerations by the researchers it can be considered to be a factor, which interferes with the manipulation of numbers and the solving of mathematical problems in academic, and social environments (Richardson & Suinn, 1972; Suinn, Taylor & Edwards, 1988). Thus, math anxiety as a psychological construct interferes in developing students' thinking skills it can be considered as a significantly important factor of poor problem solving skills of school students in mathematics.

There are some symptomatic characteristics of math anxiety helping in identifying children suffering from math anxiety, which are in the form of physical, psychological and behavioral (Plaisance, 2009; Jackson, 2008; Woodard, 2004):

**Physical symptoms:** It includes increased heart rate, clammy hands, upset stomach, light headedness.

**Psychological symptoms:** It includes inability to concentrate, feeling of helplessness, worry, and disgrace.

**Behavioral Symptoms:** It includes avoidance of mathematics classes, putting off the mathematics homework until the last minute and irregular study.

## III. CO-RELATION WITH PERFORMANCE AND ACHIEVEMENT

Several researchers revealed in their studies that math anxiety is negatively correlated with the performance in mathematics, and if this issue is not dealt with properly, it could have a terrible effect in many areas of our education system. Fennema and Sherman (1976), using their math attitudes scales (MAS), found that math anxiety and mathematics ability concepts were highly correlated ( $r = -.89$ ) in a sample of secondary school students. Mathematics anxiety has a highly negative relationship with mathematics performance and achievement, which has been described in Green, 1990; Hembree, 1990; Mevarech, Silber & Fine, 1991; Norwood, 1994; and Wigfield & Meece, 1988. All the mathematical features of a syllabus concerned may not be interested to some individuals. How certain features of mathematics, such as its precision, logic, and over emphasis to develop problem solving skills, make it particularly anxiety provoking for some individuals was discussed in Richardson and Woolfolk (1980). Math anxiety is an important factor in poor performing and achieving mathematics, Richardson & Suinn, 1972; Suinn, Edie, Nicoletti, & Spinelli, 1972 documented the negative effects of math anxiety on math performance and achievement.

From the extensive research on co-relationship between math anxiety and students' performance in mathematics it can be noted that the math anxiety is a crucial factor for the students' poor performances in mathematics. If this factor is not taken into account sincerely and handled properly and effectively by the parents, educators, students themselves, schools and the policy making authorities concerned then it could have a terrible consequences for the entire education system, for instance, some major negative consequences of math anxiety are mathematics avoidance (Hembree, 1990), the effects of math anxiety are tied to those cognitive operations that rely on the resources of working memory ( Mark H. Ashcraft1, 2002), distress (Tobias, 1978) and interference with conceptual thinking and memory processes (Skemp, 1986).

## IV. CAUSES AND PREVENTION OR MITIGATION

It is not easy task to determine the causes of math anxiety, where and how it begins and grows. There is some lack of agreement about the possible causes of mathematics anxiety in children ( Newstead, 1995). In his studies the possible causes include teacher anxiety, societal, educational or environmental factors, innate characteristics of mathematics, failure and the influence of pre-school experiences of mathematics. Beginnings of anxiety can often be traced to negative classroom experiences seems particularly strong and well-documented (Tobias, 1978; Stodolsky, 1985). In assessment and evaluation system also there is a tendency to develop a negative attitude to the students' minds. Scarpello (2007) stated over reliance on high-stakes tests

has reinforced development of negative attitudes towards mathematics and increased students anxiety levels in mathematics. Teachers have reduced the diagnostic efficiency of mathematics tests by administering them in pressurised situation (Spark, 2011 ; Geist, 2010; Ashcraft & Krause, 2007; Cavanaugh, 2007).

Without conceptual understanding the mathematical situations with computation skills it is harder to learn, for instance, memorised-by-writing rules and the manipulation of symbols with little are harder to learn mathematics than an integrated conceptual and understandable structure, and this can result in affective blocks for the children (Skemp, 1986). Traditional belief on results of any tests or examinations also may create a tendency towards math anxiety (Schoenfeld, 1988). Teachers' too much emphasis on memorising formulae, learning mathematics through drill and practice (Greenwood, 1984), applying traditional way- committing at home and vomiting in examination hall, can create math anxiety. Everyone is capable of learning, but may learn best in different ways. Therefore, lessons must be presented in a variety of ways, for instance, some teaching techniques could cause math anxiety Oberlin (1982): i) assigning the same work for everyone, ii) covering the text book problem by problem, iii) giving written work every day, iv) insisting that there is only one correct way to solve a problem, and v) assigning math problems as punishment for misbehavior. Thus, math anxiety can be considered as a function of teaching techniques used in the class rooms to convey mathematical skills which involve how a mathematical problem is solved mechanically, 'revision-memorise' teaching principles, which emphasises memorisation rather than conceptual understanding, procedural fluency and reasoning.

It can be expected that a friendly teaching approach which includes how to relate the mathematical problems with day to day life activities and process-oriented teaching method emphasising conceptual understanding rather than drill and practice will mitigate anxiety. It has also been suggested that encouraging students to discuss mathematical situations among themselves may have better consequences in terms of mitigation of anxiety (von Glasersfeld, 1991; Vacc, 1993). Also, to develop problem solving skills it is extremely important to take place discussion about various devices of solving problems among the students which prevents also math anxiety (Greenwood, 1984). It is also possible that if the teachers start with a recapitulation of previous discussion and present the next in clearer and easier manner so that the students can handle the concepts comfortably with helping them to solve the mathematical problems rather than imposing them to create own solution steps, then it will strongly support the students' emotional need (Vinner, 1994). The teachers provide a leadership or guiding role in teaching and learning environment and therefore are highly influential as there exists no doubt of the role teachers play in what happens in their classrooms (Kulbir Singh Sidhu 1995). In the studies of Clute, (1984) and Norwood, (1994) it has been revealed that teachers' strong presentation in a transmission-type class room actually mitigate discomfort and math anxiety for those students who lack self efficacy in their own intuitions.

New concepts can be taught through play acting, cooperative groups, visual aids, hands on activities or information technology. Some important and effective

suggestions provided in [National Council of Teachers of Mathematics](#) (NCTM,1989, 1995b) for teachers seeking to prevent math anxiety include:

- Accommodating for different learning styles
- Creating a variety of testing environments
- Designing positive experiences in math classes
- Refraining from tying self-esteem to success with math
- Emphasizing that everyone makes mistakes in mathematics
- Making math relevant
- Letting students have some input into their own evaluations
- Allowing for different social approaches to learning mathematics
- Emphasizing the importance of original, quality thinking rather than rote manipulation of formulas

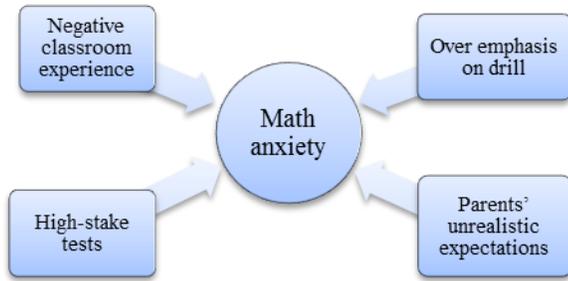
According to the study, Hackworth (1992), the important activities, reported also in Furner, J. M. & Berman, B. T. (2003) which will assist in mitigating math anxiety:

- i) discussing and writing about mathematics feelings
- ii) becoming acquainted with good math instruction as well as study techniques
- iii) learning study methods that enable students to recognize different types of information learning
- iv) being an active learner and creating problem-solving techniques
- v) evaluating one's own learning
- vi) developing calming, positive ways to deal with fear of math (e.g., visualization, positive messages, relaxation techniques, and "frustration breaks")
- vii) building confidence in math through gradual, repeated success, .

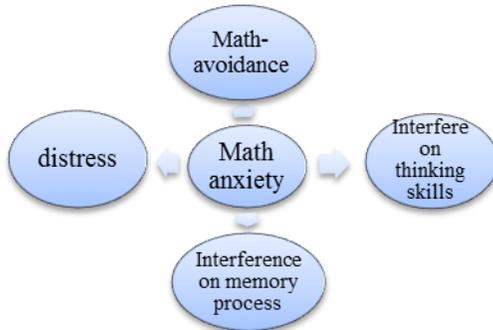
In the study of Zemelman, S., Daniels, H., & Hyde, A. (1998) they found that the use of the following methods constituted best practices for teaching mathematics:

- i) manipulatives (to make learning math concrete)
- ii) cooperative group work
- iii) discussion
- iv) emphasizing the importance of questioning and making conjectures
- v) justifying one's thinking
- vi) writing as a way to explore mathematical thoughts and problem-solving methods
- vii) the problem-solving approach to instruction
- viii) and calculators, computers, and other technology.

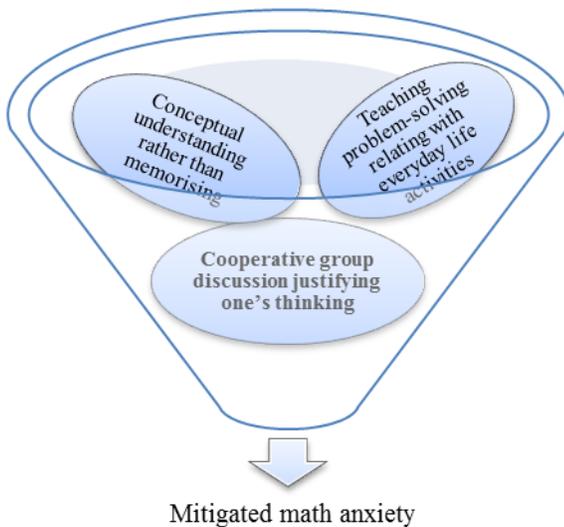
The summery of the study is provided in figure- 1, 2 and 3 reflecting causes, consequences and commitment to mitigate math anxiety:



**Figure-1: Causes**



**Figure-2: Consequences**



**Figure-3: Commitment**

## V. CONCLUSION

Problem solving is the significantly important component of teaching and learning mathematics, it must be looked upon in a positive light to mitigate math anxiety, the psychological construct which interferes in developing students' thinking skills.

It can be considered as a significantly important factor of poor problem solving skills of school students in mathematics. Therefore, the educators must re-define traditional teaching methodologies which often do not match students' learning styles and skills needed in society. Educators can play an instrumental role in fostering an environment of teaching and learning by presenting topics in a activity oriented manner to mitigate or prevent math anxiety. For instance, concept can be taught through mathematical modeling related to day to day life activities, forming math clubs for interaction among students on mathematical phenomena, audio-visual aids, hands on activities and technology. If once children see mathematics as fun, then it will be anxiety free for them, and, the enjoyment with mathematics could remain within them throughout the rest of their lives.

If this issue is not dealt with sincerely, it could have a terrible effect in many areas of our education system. There are some major consequences for math anxiety to be alert as mentioned earlier, mathematics avoidance, distress, interference with conceptual thinking and memory processes which may create deficiency of workers in the field of today's high-tech world.

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