

THE INTERNATIONAL JOURNAL OF HUMANITIES & SOCIAL STUDIES

A Study of Mathematics Anxiety Remediated with the Vedic Math Program

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Abstract:

In this qualitative study, the benefits of the Vedic Math program to reduce the math anxiety levels of a student were studied. The student, a girl studying in a public school in Western New York, was taught multiplication of 2-digit numbers, with 2-digit numbers, using algorithms based on the Vedic Math program. Her math anxiety levels, before and after the program, as also her achievement, in terms of accuracy and speed of calculation were evaluated. The researcher also investigated the effects of parents' and teachers' attitudes towards mathematics and their perceptions about the student's capabilities, and how these reflected on the student's self-esteem and feelings about herself. After the completion of the Vedic Math program, there was a reduction in the student's math anxiety levels and she seemed to be more at ease while doing math. The researcher believes that this could be due to a combination of factors, including the utter simplicity and logic involved in Vedic math, one-on-one interaction with the researcher in a friendly, non-threatening environment, the freedom to ask questions to clear doubts in real-time, small successes that were achieved during each stage of the process and immediate praise given for the same. As this research study had only one participant, results cannot be generalized, but the success enjoyed by the participant was encouraging, and it might be interesting to see the results on a larger sample of students with learning difficulties.

Keywords: *Math anxiety, learning difficulties, Vedic math, attitudes of parents towards math, attitudes of students towards math, attitudes of teachers towards students with learning difficulties*

1. Introduction

"I hate math, and I hate my teacher even more!"

These strong words were uttered by the protagonist in this case study, a nine year old child having learning difficulties in math. Having worked for many years with students with learning disabilities, I have often wondered whether the problems they faced, particularly in mathematics, were intrinsic to them, or due to extrinsic factors, such as a threatening classroom environment, leading to an inability to clear doubts as they arose, teachers' or parents' critical attitudes, pressure to perform, as also a general feeling of low self-worth where mathematics was concerned. Many of those students associated their frustration with mathematics with their being 'just dumb', a notion picked up after hearing teachers or parents repeat it to them several times, over the years. They also reported that they hate mathematics, and/or their mathematics teacher, at times appearing to fail to distinguish between their hatred or fear of the subject, and their hatred or fear of their teacher. Many parents' and teachers' dislike of mathematics also seemed to reflect in the students' attitudes towards that subject. Most disturbing was the students' association of success in life with success in mathematics, and a general 'giving up' on the idea of further study because mathematics was a compulsory subject in college, thereby missing out on a chance of getting themselves well-qualified and leading successful lives. On the other hand, I have also worked with students having learning disabilities, who were happy learners, had no math anxiety and who performed well in mathematics. This sheer disparity in their attitudes towards learning, and life itself, made me undertake this research study in an effort to understand the factors leading to math anxiety, and whether it could be remedied using Vedic Mathematics, which takes a very simple and logical route to teaching basic computational skills.

1.1. Math Anxiety

Math anxiety is defined as an "inconceivable dread of mathematics" or "feelings of tension and anxiety" that can interfere with manipulating numbers and solving mathematical problems within a variety of everyday life and academic situations" (Buckley and Ribordy, 1982: 1; Lewis, 1970; Richardson & Suinn, 1972: 551). According to Oberlin (1982), many common teaching techniques could lead to math anxiety, such as assigning the same work for everyone, rather than differentiating it by ability, using the textbook

to teach problems and insisting on only one correct method and answer. Math anxiety can also be influenced by the school system, gender, socioeconomic status, or parental background. Many people feel that their problems arise out of not having a 'mathematical mind', the belief that boys do better than girls at maths, or due to learning disabilities. McLeod (1991) claims that affective factors play a central role in mathematics learning and instruction. Sarason (1987) contends that math anxiety may be composed of two major components: cognitive concerns regarding performance and emotional concerns that are brought on by stress. Many a times, students seem to understand math concepts when they are in non-stress inducing situations, but when time limits are set, or grades being marked, they tend to become nervous. This often leads to a lack of confidence and failure. Many a times, the purpose of the test or its importance is never understood by students (Hackworth, 1992).

1.2. Effectiveness of Vedic Math in Dealing with Math Anxiety

Recent research has come up with multi-pronged ways in which teachers can prevent or reduce math anxiety amongst their students: ensuring student-friendly teaching methods, (Cornell, 1999; Steele & Arth, 1998), designing non-threatening, safe learning environments (Jackson & Leffingwell, 1999; Steele & Arth, 1998), and providing real-time encouragement to all learners (Godby, 1997; Jackson & Leffingwell, 1999). The Vedic Math program is one such well-researched program, which creates a comfortable learning environment, where students receive a lot of encouragement at every step of the program and also enjoy the whole learning process (Tirthaji, 1965). The Vedas, which means "knowledge," are the ancient holy books of the Hindu religion. They were probably written before 500 B.C. Vedic mathematics has its roots in the Vedas and was rediscovered from the ancient Sanskrit texts by Bharati Krsna Tirthaji between 1911 and 1918. Tirthaji wrote sixteen volumes expounding the Vedic system. His book, Vedic Mathematics, was published in 1981 after his death (Williams 1991)

The beauty of Vedic mathematics is clearly explained by McEnery (2004), who holds a doctorate in modern computation from University College Cork in Ireland:

"Vedic computation... is much more than a set of techniques for developing skills in rapid mental calculation, or for performing algebraic manipulations with dexterity and ease, it is a framework within which any mathematical or computational process can be resolved. The beauty of it, is, that it can be systematically taught to young and old."

The simplicity and logic involved in Vedic math renders it suitable for children having problems in math. The left-to-right method used in formulas in Vedic math makes it easy to be understood by children who have issues in laterality and directionality. Another note-worthy point is that, the techniques of Vedic Mathematics not only enable the students to solve specific mathematical problems; they also develop creativity, logical thinking and intuition (Glover, 1999).

2. Significance of the Present Study

Although the long term objective of the researcher is to attain a complete understanding of the effectiveness of Vedic math program in assisting children with math anxiety, the present paper focuses on explaining the possible causes of the anxiety. Very few published research studies in the area of mathematics education have used a qualitative approach to learn about math anxiety in students with learning difficulties. The majority of studies on math anxiety are quantitative studies that only use attitude scales and statistical tests of significance to determine levels of math anxiety, before and after interventions, but ignore attitudes, perceptions and beliefs of students, parents and teachers, that could be the cause of the same. This research study too, uses a rating scale to study math anxiety, before and after a program in Vedic mathematics was taught to the participant, but it differs from the rest of the studies, in that, it also uses a qualitative approach to study math anxiety, and its causes. Using the case study approach, the researcher did an in-depth study into the possible reasons for the participant's math anxiety, beyond the numbers and the statistics that label, but do not provide reasons and solutions to solve the problem.

In many school systems, special education services are provided almost exclusively on the basis of children's reading disabilities. Even after being identified as learning disabled, few children are provided substantive assessment and remediation of their arithmetic difficulties. As math learning continues, school-age children with language processing disabilities may have difficulty solving basic math problems using addition, subtraction, multiplication and division. The review of literature suggests that Vedic Math could be a logical approach to teaching basic math skills to children with math-related difficulties. Therefore it would be imperative to assess the effectiveness of the same along with the varied possible causes of the anxiety towards math in the first place.

3. Research Questions

The main research question is: Does the Vedic mathematics program decrease math anxiety levels in students with learning difficulties in mathematics? Other research questions which will also be examined in this paper are:

- i. What are the student's attitudes towards mathematics and the Vedic Math Program?
- ii. During and after the program, has the student's math anxiety levels undergone a change, as also her ability to calculate?
- iii. What are the attitudes of the student's parents towards mathematics and how do these attitudes affect the child?

iv. In what ways do the teacher's attitudes and treatment of the child affect her own attitudes towards mathematics and her feelings of self-worth?

4. Methodology

4.1. Participants and Research Site

The researcher chose the theory-based, purposeful sampling strategy (Miles & Huberman, 1994) for this study, as it is important to locate a valid case. The main participant in this research study was a nine year old girl, studying in a public school in Western New York. She was studying in Grade 3 and had been identified as being at-risk for learning disabilities. She had been referred to the Child Study Team by her teacher and was under observation during the period of the study. She was doing very well in her language and social studies classes, but very poorly in mathematics. The main setting for this research study was the participant's residence. The child and her parents were interviewed at their residence. The Vedic math program was taught to the child in twelve one-hour sessions at her residence. The classroom observation and the teacher interview were conducted at the child's elementary school in Western New York.

4.2. Data Collection

The participant was asked to answer a math-anxiety questionnaire (MARS, Richardson & Suinn, 1972). An achievement test, which was a short math-probe, was administered to the participant as a pre-test. Next, a part of the Vedic Math program involving algorithms to teach two-digit by two-digit multiplication was taught to the student. This program parallels the way the mind naturally works and is therefore a great help in directing the student to the appropriate method of problem solving (Tirthaji, 1965). After this, the math-anxiety questionnaire (MARS) was again administered to the student to note changes, if any, in her anxiety-levels towards math. The math probe was also given as a post-test, to determine changes in accuracy of computation. The researcher took notes during the teaching sessions and then wrote them up in her research log, immediately after the sessions.

Along with the sessions, a wide array of data collection methods were employed, in order to build an in-depth picture of the case, such as direct observation (to record the child's behaviour during a few math sessions at school to see if her behaviour in a group was any different from that in a one-on-one situation at home, as well as the teacher's interactions with the child during the lesson and the treatment meted out to the child in the class), participant observation, physical artifacts (like solved worksheets and rough working sheets) and interviews (with the child, her parents, and her math teacher).

The research log was the repository of all the data gathered through the classroom observation and interviews. The writing of the research log was an expansion of the field notes taken by the researcher. Analytic memos were written at different periods in time, about the entries in the log, new, emergent categories, and major trends and themes that were observed.

5. Results and Discussion

The student seemed to revel in the attention she received from the researcher, and the safe environment in which she was taught the Vedic math program. There were six 1-hour sessions in which the researcher taught her how to solve 2-digit by 2-digit multiplication problems, breaking up the procedure into small steps, designed to ensure success. When she realized that the researcher was willing to answer her questions, and clarify all her doubts as many times, as needed, she stopped making excuses for math "not being in my blood, 'coz of my mother" and decided to focus on what was being taught to her. Though her first response always was "But 'I' will not be able to do it, as I'm really dumb", she had many Eureka-like moments during the course of the program and she declared that "It is magic.", whenever she was able to solve problems, using the new methods taught to her. Not only did she seem to need constant positive reinforcement for every small success, she also seemed to be waiting for a verbal blow, whenever she did not succeed in solving a problem. It was almost like her experiences with her teacher had scarred her for life, and she did not think that math could be fun, as could be seen from her question, "Math? Fun? Are you serious?"

The math anxiety rating scale showed a math anxiety score of 39 during the pre-test, which indicated math fear and border-line math anxiety. After the Vedic math program had been taught, the math anxiety questionnaire was again administered, and the score was 34, which, while being lower than the pre-test score, was still in the math-fear category. The average time taken to solve a problem reduced from 20 minutes to 10 minutes after implementation of the Vedic math program

Three major themes developed as a result of the analysis of the data. The first theme pertained to the student's relationship with her teacher, and how the teaching/learning environment contributed to feelings of inadequacy, leading to math anxiety. The second theme pertained to her father exerting a lot of pressure on her to perform well, particularly in mathematics, leading to heightened math anxiety. The third theme was the mixed messages she received from her mother, regarding the mother's own math anxiety, and feelings of inadequacy and victimization, owing to her minority status in the country, thus preventing her from being an effective advocate for her daughter at school. These three themes are elaborated further below.

5.1. Student-Teacher Relationship

Teacher: "I don't understand what goes on inside that head of hers...Maybe she is Special Ed. material...at least for math."

Student: "She's rude to me, and she scolds me all the time. She just doesn't like me. I think she hates me.. She tells me that I'm dumb, and I cannot do math even if I tried."

The teacher's obviously hostile attitude towards the child has made her retreat further into her shell. On asking the teacher questions to clarify her doubts, her response of "I'm tired of trying to make you understand something that you aren't going to get anyway" has made the child stop communicating directly with the teacher, which seems to further enrage the teacher. The importance of the student-teacher relationship cannot be stressed upon more, particularly in a situation where the student already has problems in a subject, and the teacher's total lack of understanding leads to further complications and heightened math anxiety levels.

In spite of the teacher knowing that the child is talented in other areas (such as writing short stories and poems in English classes), the teacher seems determined to retain her poor opinion of the child, refusing to say a few kind words that might increase the child's self-esteem. Teachers can thus make or break a students' positive attitude towards learning, leading to a downward spiral in their self-esteem and increased levels of math anxiety.

Moreover by singling out academically weak students and ridiculing them in front of their peers, some mathematics teachers contribute to the development and nurturing of math phobias and anxiety, and yet seem to be puzzled by their students' lack of motivation and interest in the subject. Students are very self-conscious when they fail to solve problems in front of their classmates. They obviously do not want their peers to think that they are stupid. Thus, any teacher who singles out students and puts them on the spot to do math problems will intimidate them.

Students take the harsh words used by teachers due to their frustration as gospel, and many-a-times, these turn into self-validating prophecies. Thus teachers unknowingly at times, start a vicious circle of failure, ridicule and low self-esteem, which finally leads to the student adopting a don't-care attitude and more hatred for the subject as well as enhanced levels of math anxiety.

5.2. Complications Caused by Father's Pressure to Perform

Father: "Honestly, we are really tired of her attitude towards math. We've tried everything – scoldings, threats...nothing seems to be working. She has turned stubborn. She sits at the back of her class, so that the teacher cannot see her and ask questions."

Student: "Yes, I like to sit behind. I feel safe there. Once I was made to sit in the front row for a whole week, and I was terrified that any moment the teacher would pick on me to answer questions, which she did quite a lot. I sit behind and pray that she forgets about me. My father hates it, I know. He's always telling me that as a child, he always sat in the front row and put his hand up to answer his teachers' questions. But he is smart, and I am dumb."

The child is cognizant of her father's views and wishes, but is too terrified by the teacher to want to change for his sake. Her plea for understanding seems to be falling on deaf ears, leading to higher anxiety levels. Parents, at times add to the woes of their children by not seeing their point of view, thus unknowingly being the cause of more frustration and enhanced math anxiety.

Moreover the father's obvious pride in his own and his extended family's past academic achievements do not seem to be motivating the child to perform better. Instead, it seems to be causing deep anguish to the child, who is made to feel that she is inadequate, and not as good as the rest of the family. Though the father is proud of his daughter's prowess in writing, it does not seem to have mitigated his low opinion of her math skills. He doesn't seem to be even ready to entertain the idea of her having a genuine problem in mathematics. Children always wish to win the approval of their parents, and if that's not forthcoming, it could lead to enhanced levels of math anxiety.

The father appears to have a totally closed mind where his daughter's genuine problems in math are concerned. In fact, he sometimes blames his wife for not 'handling' their daughter properly and being the cause of all her academic problems. Further, after a rough day at school, when the child is looking forward to going out and playing, and forgetting all about math for a couple of hours, the father sits her down to do more of the hated math. Thus, the child doesn't get a break at all and this leads to a deeper hatred for the subject. Enhanced math anxiety levels result due to these circumstances.

5.3. Mixed Messages from the Mother

Mother: "Sometimes she has her friend Suzy over. Suzy's good at math. She always helps out. Sometimes she does my daughter's homework for her. I don't generally allow that, but there's time pressure sometimes and then I don't oppose it too much."

Student: "I call Suzy over and sometimes we have these sleepovers and we work a little and play and have fun! She's really good at math and helps me with my homework. Her handwriting even looks like mine. She helps me at school too, when Miss is not looking."

The student's sense of right and wrong seem to be all awry, with the mother turning a blind eye to Suzy doing her daughter's homework at times. It seems that she is taking the easy way out, by not trying to help her daughter herself, but relying on her

daughter's friend to bail her daughter out of a sticky situation. Students could potentially take advantage of a parent who is easygoing and allows them to do wrong things.

Further, the mother's feelings of inadequacy and victimization owing to her minority status in the country (being of Indian origin in USA) seem to be standing in the way of her becoming an advocate for her child's rights. The child doesn't comprehend these issues and sees it as lack of caring on her parents' part. This is bound to lead to depression and more anxiety for the child, as she has to fight her own battles, though she's not grown-up enough to be able to speak up for herself all the time.

Moreover, the mother herself seems to have a bad case of math anxiety that has lasted through the years. Parents who are afraid of math could pass on math anxiety to the next generation, not genetically, but by modeling behaviors of their own discomfort with the subject (Kutner, 1992). If parents explore their own 'math-history', they might be able to identify experiences which might have contributed to their feelings of frustration about math. Parents need to break this cycle and get over their math anxiety, if they are to contribute positively to their children's progress in math (Duffy, 2002). Parents' differing attitudes towards a subject might also send mixed signals to children and lead to confusion and more anxiety for them.

6. Conclusion and Recommendations

We can see from the results of this study that students' attitudes toward mathematics are to a great deal influenced by the classroom environment that is provided by teachers. It is important that all teachers be consistent in terms of having a knowledge base for teaching mathematics. Teachers not only need to come to terms with their own math anxiety, if any, but also need to be familiar with best practices for teaching mathematics as well as incorporate national and state standards into their instruction. Taking refresher courses/workshops on new research-based best practices for teaching mathematics is critical in a world where technology is quickly changing what and how math is taught. It is also important for students that, as they transition from one teacher to the next, they should receive consistent instruction in mathematics and all teachers prevent the occurrence of math anxiety as each student progresses from one grade to the next (Anton, & Klisch, 1995). It is also important for teachers to get a feel for their students' dispositions toward mathematics since students must have good attitudes and perceptions toward learning before real learning can occur (Marzano, 1992). Teachers can also help by assisting the students to understand how their math anxiety was created (Hackworth, 1992). Tobias (1987) suggests that students can learn to recognize their feelings of panic, and be able to move past them in order to work on the problem. Journal writing may be one way to reduce math anxiety, by allowing students to express their understanding of and feelings about mathematical concepts that could help in self-healing.

Moreover, it could be assessed that parents, by getting involved in their children's math education, can support them and become partners in their progress. They can encourage their children to talk about their feelings towards math and help them overcome, or at least reduce their math anxiety. They can provide a safe, non-threatening atmosphere at home and also provide the needed help. Comparisons never help anyone, hence each child must be allowed to attain his or her own true potential, without any added burdens of having to live up to the achievements of others. If parents realize that their child is being treated unfairly at school, they have to become advocates for their child and get them justice. Thus, it is in the hands of educators and parents to make efforts to reduce or even prevent math anxiety in children and thereby begin to see greater gains in math achievement among children.

Finally, with Vedic math programs math lessons are much livelier and more fun, the children enjoy their work more and they perform to their potential most times. Students develop a great flair and confidence for working with numbers in everyday life. Vedic math mirrors the way our minds work and teaches children how to perform calculations the way they read and write: from left to right. So children with special needs, many of whom have a laterality problem, find it more logical to read, write and also do math from the left to the right.

To paraphrase a Chinese proverb (W. V. Williams, 1988, p.103):

"Tell me mathematics, and I will forget; show me mathematics and I may remember; involve me...and I will understand mathematics. If I understand mathematics, I will be less likely to have math anxiety. And if I become a teacher of mathematics, I can thus begin a cycle that will produce less math-anxious students for generations to come."

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